Spiders (Arachnida: Araneae) from black cotton soil habitats of a highland savanna biome in Laikipia, central Kenya

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ABSTRACT

WARUI, C. M., VILLET, M. H. AND YOUNG, T. P. 2004. Spiders (Araneae) from black cotton soil habitats of a highland savanna in Laikipia, central Kenya. *J. Afrotrop. Zool.* 1: xx-xx.
Spiders were sampled at Mpala Research Centre, Laikipia, Kenya using pitfall trapping and sweep netting. Sampling was conducted from May 2001 to July 2002. A total of 10,487 individuals from 132 species belonging to 30 families were recorded. The family Salticidae had the highest number of species (24), followed by Gnaphosidae (20), Araneidae and Lycosidae (15 each), Theridiidae and Thomisidae (8 each) and Zodariidae (4). Most of the other families had fewer than 4 species. Throughout the study period, species not previously sampled emerged after rainfall peaks. Many species are apparently undescribed, highlighting the inadequate documentation of these taxa in Kenya. We suggest that the spider fauna of black cotton soil habitats is rich and useful for environmental monitoring, that further surveys using other collecting methods are needed, and that support for the conservation of this ecosystem should be continued. The study once more reveals the urgent need for taxonomic studies on Kenyan invertebrates.

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INTRODUCTION

Savanna ecosystems are among the world's largest biomes and cover half of Africa's land surface (Scholes & Walker 1983) and form a large part of Africa's rangelands important to humans, wildlife and cattle. They typically consist of a herb layer and a woody layer dominated by *Acacia* spp. (Menault *et al.* 1985; Cole 1986). In Kenya, they cover an important portion of the country and humans use them in various ways, e.g. for fuel wood harvesting, game hunting, honey collecting, mining, other kinds of farming, pastoralism and tourism. Due to increasing human population density in sub-Saharan Africa, these natural resources are often overexploited, increasing the pressure on native biodiversity, which is still poorly understood. The management of savanna ecosystems is therefore reoriented towards sustainable activities in order to conserve native biodiversity (Young *et al.* 1998) and to improve our ability to monitor biological change in such environments.

Indigenous Kenyan wildlife is well adapted to live in savanna, where it is exploited for game meat and trophies, and used to promote tourism. On the other hand, cattle require higher cash and labour inputs to maintain high productivity. The profitability of livestock production in Kenya is declining, while wildlife values are increasing, and the need to understand the interactions between livestock, large mammalian herbivores and other indigenous biodiversity is growing (Young *et al.* 1998).

Considerable work has already been done on the ecology of both large and small vertebrates and the vegetation of savannas (e.g. Buss 1961; McNaughton 1983; Belsky 1984; Hatton & Smart 1984; Young & Lindsay 1988; Georgiadis & McNaughton 1990; Dublin 1995). However, few studies are available on the invertebrates of African savannas. Scientists have raised their concern over this lack of knowledge (e.g. Russell-Smith *et al.* 1987; Dippenaar-Schoeman *et al.* 1989; Russell-Smith 1999; Villet & Van Noort 1999; Whitmore *et al.* 2001), because the invertebrate species constitute the bulk of the biodiversity.

This study was part of a long-term, multi-species vertebrate herbivore exclusion experiment (KLEE) in a semi-arid savanna ecosystem in Laikipia, Kenya (Young *et al.* 1998). KLEE is aimed at comparing the impacts of cattle and wildlife on various components of the savanna biome. The current study

contributes to the knowledge on a mega-diverse group of invertebrates (spiders) and its role in the ecosystem in order to improve its management, and hence the productivity and the conservation of native biodiversity.

MATERIALS AND METHODS

Study area The ecological study was conducted at Mpala Research Centre (MRC) adjacent to Mpala Ranch in the Laikipia District of central Kenya (Fig. 1) from May 2001 to July 2002. Mpala Research Centre (0°17'N, 37°52'E) is located on 1200 ha of land and scientists have access to the 17000 ha Mpala farm. Sampling was conducted in habitats on black cotton soil, which has impeded drainage (Ahn & Geiger 1987; Taiti 1982). The altitude is 1750-1800 m above sea level and its rainfall averages 500-600 mm per year (Young *et al.* 1995, 1998). However, high precipitation (>1200 mm) was recorded in the 1997/98 seasons, while the average annual rainfall at MRC in 1999 and 2000 was about 400 mm (Paton & Ogada 2001).

The vegetation of the black cotton soil ecosystem consists mainly of *Acacia* bushed grassland (Young *et al.* 1998). The dominant tree, *A. drepanolobium* (Harms) Sjostedt, accounts for over 95% of the woody vegetation and the understorey is dominated by five species of grasses (Young *et al.* 1997, 1998).

Study design The study was conducted at MRC in 18 exclosure plots established in 1995 (Young *et al.* 1998). The main methods of spider collection were pitfall trapping and sweep-netting.

Collecting methods

Pitfall traps Ground-active spiders and other invertebrates were collected by pitfall traps (Greenslade 1964; Uetz & Unzicker 1976; Sutherland 1996). Each trap consisted of two cone-shaped plastic (polyethylene) cups 9 cm wide at the mouth and 14 cm deep, one inside the other, buried to their rim. Three pitfalls per plot for each of the 18 sampling plots were used, making a total of 54 traps. The three pitfall traps were laid on a line transect every 3 m. The inner cup of each trap was filled to a third of its volume with a 2% formaldehyde solution as a preservative. Traps were left open and emptied every second week. Where evaporation was high, refilling was done *ad hoc*. At the end of each fortnight, the contents were collected using an ordinary domestic sieve and emptied into appropriate containers for sorting in the laboratory.

This trapping method has been widely used in spider surveys (e.g. Uetz & Unzicker 1976; Russell-Smith, 1981; Russell-Smith *et al.* 1987; Coddington *et al.* 1991; van der Merwe *et al.* 1996). The merits of this cost-effective method include a continuous sampling effort (including diurnal and nocturnal in all weather conditions) that yields a high percentage of the species present in a community (Uetz & Unzicker 1976). It is not limited to any particular terrestrial habitat (Gist & Crossley 1973). Its drawbacks are that the number of individuals trapped is affected by the preservative used (Pekár, 2002), environmental variation, weather and species-specific factors such as behaviour (Ahearn 1971; Parmenter *et al.* 1989; Krasnov and Shenbrot 1996; Krasnov *et al.* 1996) and by different vegetation types (Southwood 1966). More precisely, male spiders show strong seasonal peaks of activity and numbers in pitfall traps therefore reflect both population densities and levels of activity. The way pitfall traps are positioned in the field can also influence the catch (Greenslade 1964; Russell-Smith 1999; Ward *et al.* 2001). Pitfall traps are prone to damage by large animals, and the number of traps set in this study was increased at the start in anticipation of such an effect.

Sweep-netting This method involved walking through the herb layer swinging a sweep net through the understorey vegetation for a standard number of times (Coddington *et al.* 1996, Scharff & Griswold 1996, Dippenaar-Schoeman *et al.* 1999). The net was 40 cm in diameter and sweep-netting was done on a randomly selected 50 m transect in each of the 18 plots. In this study, one hundred sweeps were made along each transect. After every ten sweeps, samples were emptied on a plain sheet of cloth and all invertebrates collected with a pooter. The process was repeated every fortnight throughout the study period. A similar approach has been found effective for savanna studies (Russell-Smith pers. comm.).

Specimen sorting and identification A total of 29 samples were collected with each collecting technique. Spiders were initially separated from other material and identified to the lowest possible taxonomic level (often family and sub-family initially), using the most recent keys to African spiders (Dippenaar-Schoeman & Jocqué 1997; Dippenaar-Schoeman 2002). The spiders were further sorted into morphospecies, based mainly on a combination of morphological characters as indicated in relevant literature (see Dippenaar-Schoeman & Jocqué 1997), and a reference collection was established. Comparisons were made with voucher collections held at the National Museums of Kenya (NMK) and taxonomic manuals and photographs available there. Reference was also made to recent world spider catalogue (Platnick 2002). Since this was not fully satisfactory, further identification and verification of specimens was done at the Royal Museum
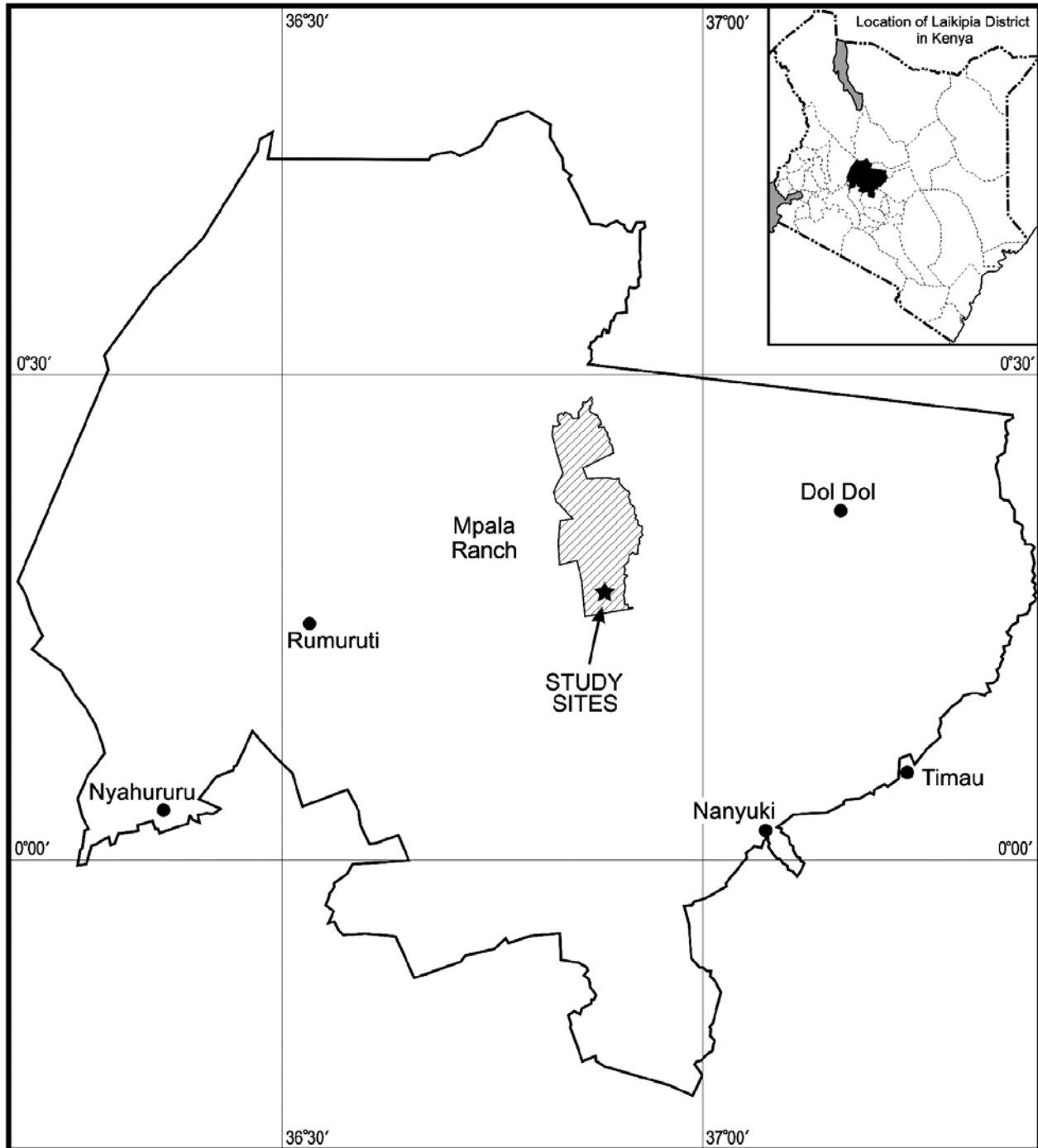
Figure 1. Location of Mpala Research Centre (study sites), at Mpala Ranch of Laikipia district, Central Kenya.

for Central Africa, (MRAC) Tervuren, Belgium, in September and October 2002.

Analysis *Diversity and evenness indices* There is little consensus on the best diversity measure and no index has received backing of the majority of workers in the field (Magurran 1988, Feinsinger 2001). However, diversity indices incorporate both species richness and evenness in a single value (Magurran 1988), and allow comparisons between two habi-

tats. Our study adopted the Shannon-Wiener diversity index (H´):

$$H´ = -\sum_{i=1}^{n} p_i (\log_2 p_i)$$

where n is the number of species and p_i is the proportion of the total count arising from the *i*th species (Clarke & Warwick 1994). The Shannon-Wiener index has moderate discriminant ability, an

intermediate ease of calculation and is widely used (Magurran 1988). It is chosen for this study because it would allow wider comparison of other spider studies that have used it (e.g. van der Merwe *et al.* 1996; Jocqué 1973; Uetz & Unzicker 1976). However since diversity indices are always difficult to interpret, species richness and species evenness were also calculated. Single-number species richness measures computed were the total number of species (S) and Margalef's diversity index (d) (Clifford & Stephenson 1975): d = (S-1) / log N where S is the total number of species and N is the total number of individuals. The Margalef's index of species richness minimizes the effect of sample size bias (Odum 1971). S and d are simple and easy to calculate, but sensitive to sample size (Magurran 1988).

The equitability (evenness) index used was Pielou's evenness index (J′), which expresses how evenly the individuals present are distributed among the different species. The index is computed as follows: J′ = H′ (observed) / H′$_{max}$ where H′$_{max}$ is the maximum possible diversity, which would be achieved if all species were equally abundant. It reduces the influence of sample size and is simple to compute (Pielou 1975).

Checklist evaluation The completeness of the checklist was assessed using species accumulation curves calculated using PRIMER statistical software (Clarke & Warwick 1994, Clarke & Gorley 2001). First the accumulation curve was calculated using the raw data in the chronological sequence in which the samples were collected. The average species accumulation curve was calculated using the same software by iteratively resampling the raw data 999 times and averaging the results (Clarke & Gorley 2001).

RESULTS

Overall checklist A total of 132 species (Annex 1) belonging to 30 families were recorded. Of all the species, collected 16.67% were identified to species, 43.94% were identified to genus and the remainder could not be identified beyond the family. Salticidae, Gnaphosidae and Lycosidae were among the taxonomically problematic families. There were several immature specimens that were difficult to identify to species level.

The average species accumulation curve for the entire sample (Fig. 2) shows a typical initial rapid increase in species with increasing number of samples, which gradually sloped down with more samples until there were few new species recorded with further sampling. This shows that the number of
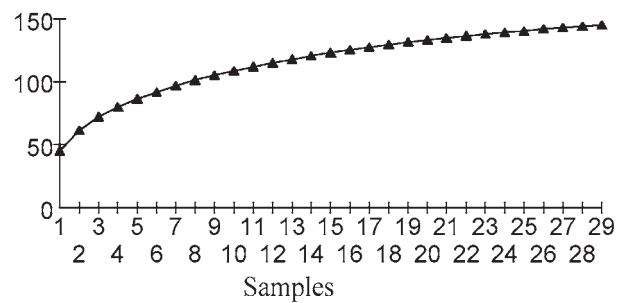

Figure 2. Mean species accumulation curve for spiders sampled with sweep-netting and pitfall methods combined, calculated from 999 iterations of random samples of the raw data from black cotton soil in Laikipia, Kenya.

species continued to increase slowly right until the last sample and implies that further sampling would have continued to add species to the total for either collecting method. The overall Shannon-Wiener diversity index for the combined samples is 3.34. This implies that the diversity of the spider fauna is fairly high, especially given that only two methods were used to collect data. It is important to note that the canopy and burrowing spiders were not sampled by the current methods and therefore not well represented in this checklist. Pielou's evenness index was 0.671.

Of the 10,487 specimens collected in total, Araneidae was the numerically predominant family, forming 29.20% of the sample. It was followed by Salticidae (21.08%), Lycosidae (13.22%), Oxyopidae (10.85%), Thomisidae (9.82%) and Gnaphosidae (5.38%). All of the other families contributed less than 5% to the overall abundance. The most abundant species was *Cyclosa insulana* Costa, which represented 23.64% of all the specimens collected, and 80.96% of all the Araneidae collected. Other very abundant species were Salticidae sp. 19 (Salticidae) (8.21%), *Aelurillus* sp. (Salticidae) (5.01%), *Runcinia flavida* Simon (Thomisidae) (4.65%) and *Oxyopes* sp. 1 (Oxyopidae) (4.64 %).

Composition The total number of species per family is shown in Fig. 3. The families with the highest number of total species are the jumping spiders (Salticidae) with 24 species (19% of all species), followed by ground spiders (Gnaphosidae) (20 species; 16%). The wolf spiders (Lycosidae) and orb-web spiders (Araneidae) come third (15 species; 11% each), while crab spiders (Thomisidae) and comb-footed spiders (Theridiidae) are next (8 species; 6%). Lynx spiders (Oxyopidae), small huntsman spiders (Philodromidae) and burrowing and ant eating spiders (Zodariidae) have 4 species each (3%) while all other families have less than 4 species.

Effect of sampling methods Pitfall trapping yielded more species than sweep-netting, but the
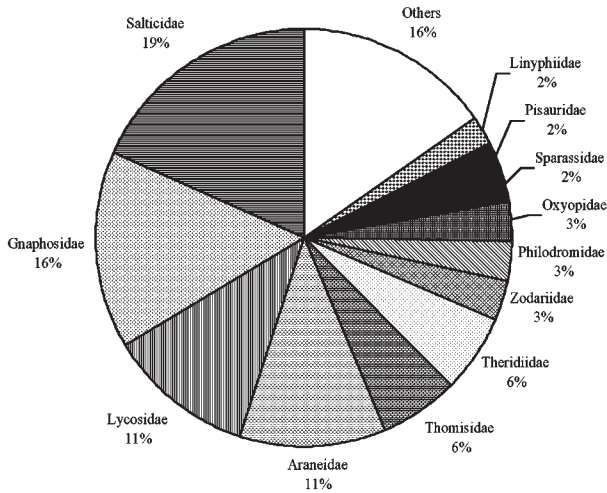
Figure 3. The percentage composition of family in terms of the total number of species per family for all spider species recorded from start of May 2001 to end of July 2002 for the black cotton soil habitat Mpala, Laikipia, 2001-2002.

species accumulation curves of both sampling methods (Figs 4, 5) suggest that neither method was exhaustive of the species present. This study also looked at the frequency of occurrence of spiders for both sweep-netting and pitfall trapping samples, which is an expression of the individual spider presence in every sampling occasion as a fraction of the
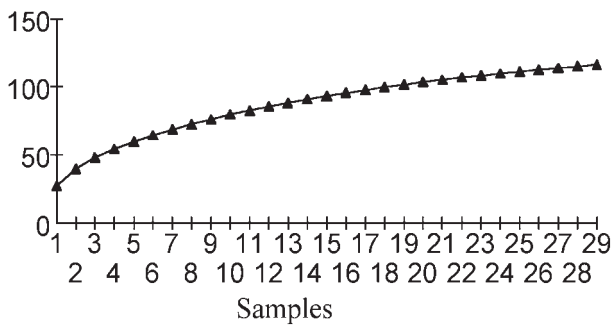

Figure 4. Mean species accumulation curve for spider collection by pitfall trapping alone, calculated from 999 iterations of random samples of the raw data from black cotton soil in Laikipia, Kenya.

total sampling occasions during the study period, expressed as a percentage. The ten most frequent species for sweep-netting samples are shown in Fig. 6, while those from pitfall trapping are shown in Fig. 7. The overlap between species obtained by the two methods was low and only one species appeared for both methods among the first ten most frequent species.

A further comparison of the diversity indices for the two methods (Table 1) shows that the species composition differs according to the method used. In total, only 43 species were obtained with both
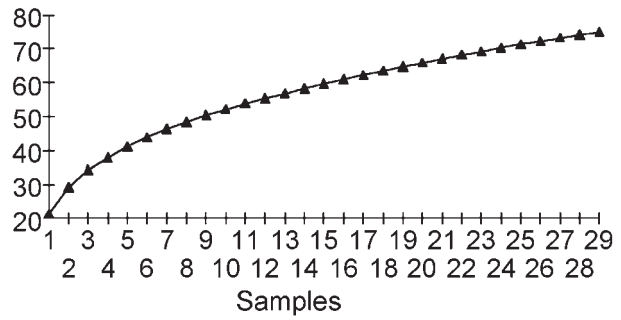

Figure 5. Mean species accumulation curve for spider collection by sweep-netting alone, calculated from 999 iterations of random samples of the raw data from black cotton soil in Laikipia, Kenya.

methods. Only seven of these species were fairly equally abundant in both samples. These were *Thanatus* sp*., Oxyopes* sp. 1, *Oxyopes pallidecoloratus, Oxyopes* sp. 3., *Evarcha* sp. 1*, Opopaea* sp. and *Philodromus* sp. This shows that pitfall trapping and sweep-netting are complementary methods and target different spider species.

Table 1. Overall diversity results for both pitfall trapping and sweep-netting methods

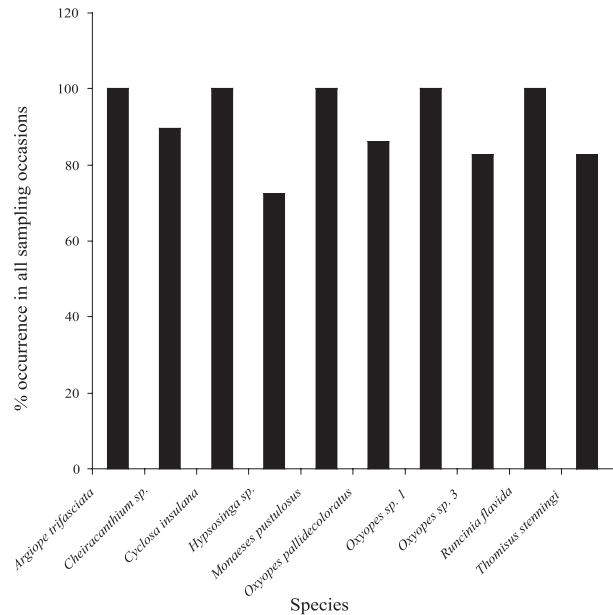|	S	N	d	J′	H′
Pitfall	116	5201	8.648	0.539	2.331
Sweep-netting	75	5193	13.44	0.6641	3.157

Figure 6. The frequency of occurrence of the ten most common spiders in the sweep-netting samples, as a percentage of the total sampling occasions during the study period.
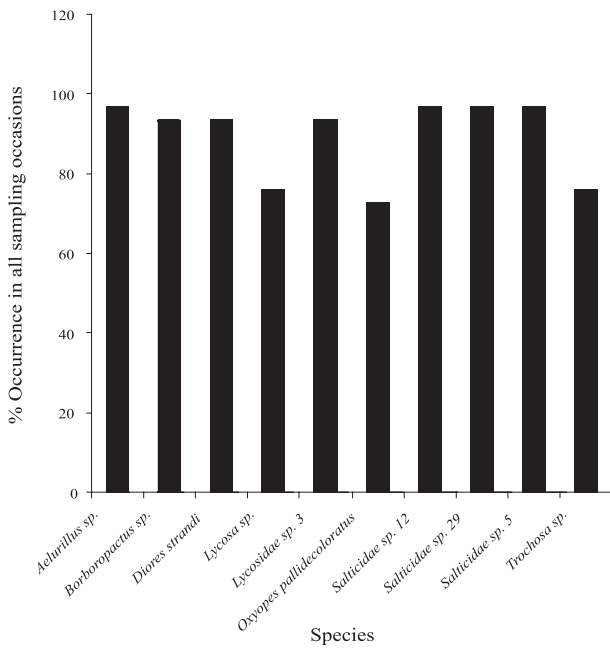
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Figure 7. The frequency of occurrence of the ten most common spiders in the pitfall trapping samples, as a percentage of the total sampling occasions during the study period.

Effect of season The species accumulation curve calculated from the sweeping samples (Fig. 8) showed that novel species appeared in the sample after the rainfall peaks in June and November 2001, and March to May 2002. In addition, the abundance of some species increased after rainfall set in. Species from the pitfall-trapping sample that showed remarkable increases in abundance included *Borboropactus* sp. (Thomisidae), *Diores strandi*

(Zodariidae), *Camillina* sp. (Gnaphosidae) *Lycosa* sp., *Trochosa* sp., Lycosidae sp. 3 (Lycosidae), and Salticidae sp. 29 (Salticidae). The spiders from the sweep-netting sample that showed fairly high increase in abundance after rains included *Argiope trifasciata* (Araneidae), *Runcinia flavida* (Thomisidae) and *Oxyopes* sp. 1 (Oxyopidae).

DISCUSSION

Bearing in mind that the study area is not exhaustively surveyed, the overall number of species reported is fairly high. Species that had not been previously recorded emerged after rainfall peaks (Fig. 8). Similarly, the abundance of the already recorded species continued to increase, showing that the spider community responded positively to an increase in rainfall. Although it is a well-known phenomenon that in areas with a pronounced dry season, the activity period of adult spiders starts with the onset of rainfalls, the findings from this study suggest that there are a handful of species that are largely active throughout the season, e.g. *Aelurillus* sp., *Cyclosa insulana* and *Oxyopes* sp. 1.

The pitfall trapping survey sample has a higher species diversity than the sweep-netting sample. This might be due to the fact that the pitfall traps were constantly in operation whereas sweep-netting was only carried out for a few hours fortnightly. It was also probable there were more species inhabiting the ground layer than the herb layer. In general however, it might not be very meaningful to compare these methods in detail, as the overall sampling
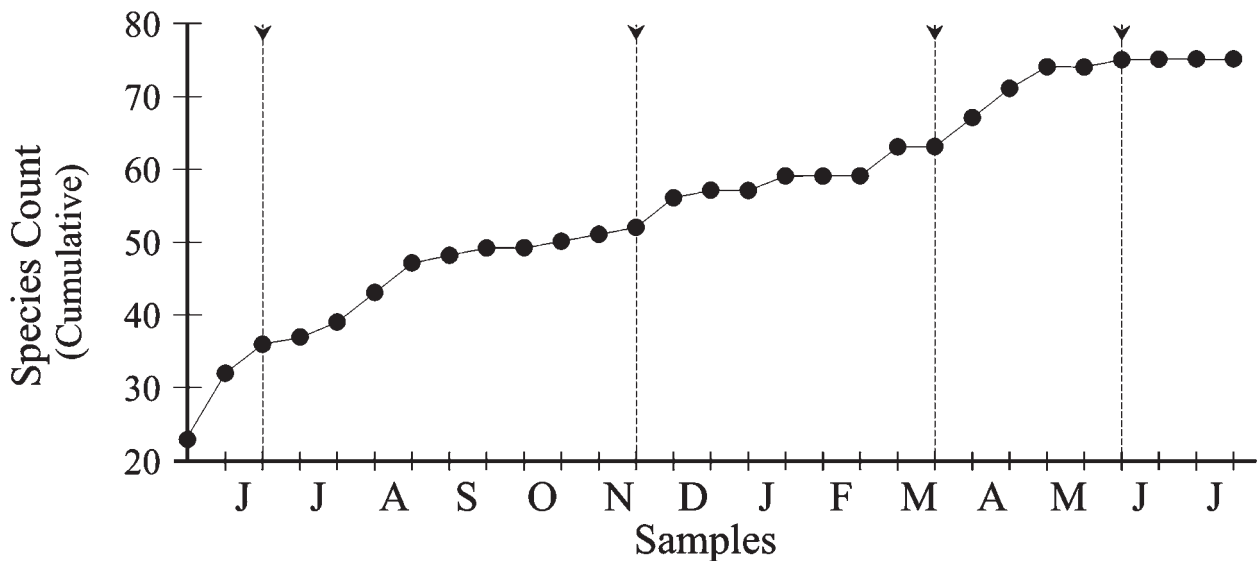

Figure 8. Species accumulation curve for spider collection by sweep-netting alone, showing the appearance of novel species in the samples with time of the year. The arrows indicate the timing of peaks of rainfall during the sampling period.

effort differed and that they targeted different habitats. Similar caution was shown by Russell-Smith *et al.* (1987) in his work on Kenyan savanna spiders. Furthermore, in pitfall trapping, male spiders show strong seasonal peaks of activity (Warui, personal observations) and therefore the numbers caught do not accurately reflect population densities. Pitfall traps have been found to be selective in the species they trap. Green (1999) and Russell-Smith (1999) have also reported that several factors, such as habitat structure (Melbourne 1999) and the positioning of traps (Russell-Smith 1999), influence pitfall trap data and this may therefore have contributed to the differences observed in this study.

Since this study was mainly based on two collecting methods, other sampling methods such as beating, fogging, visual searches and sieving, and a longer period of pitfall trapping and sweep-netting, would certainly increase the species list. Past studies have shown that different methods tend to compliment one another (e.g. Coddington *et al.* 1991; Churchill & Arthur 1999; Russell-Smith 1999). However, the presence of fierce *Crematogaster* spp. ants in *Acacia drepanolobium* (Young *et al.* 1997) and the nature of the canopy of *Balanites* sp. might make beating difficult. The study did not address the burrowing spiders, which would also require a specialized collecting technique (Dippenaar-Schoeman 2002) but should doubtlessly increase the species list.

Some studies done in the past have reported results that are worth noting (Table 2). For example, pitfall traps set for 3 weeks in a lowland savanna in Kora Reserve, Kenya (200 km from the current study site) collected 68 species belonging to 20 families (Russell-Smith *et al.* 1987). This is a fairly low number of species compared to that of the current study, but the difference could be attributed to the total sampling effort, and the types and number of collecting methods employed.

On the other hand, the study conducted in savanna at Mkomazi Game Reserve, Tanzania (Russell-Smith 1999) reported a much higher number of taxa: 508 species from 241 genera belonging to 52 families. Approximately 155 (30%) of these spiders were identified to species level. However, the difference in diversity can mainly be attributed to the number of habitats sampled (12) and the variation in methods used (pitfall trapping, tree fogging, hand collection, litter sorting and malaise trapping). In terms of composition, there is some similarity in the dominant families and their relative proportions. In both studies, Salticidae was the family with the highest number of species followed by Gnaphosidae. In Russell-Smith's (1999) study, Thomisidae, Theridiidae and Araneidae followed jointly, whereas in the current study, Lycosidae and Araneidae were next most species-rich. This could probably be attributed to the higher intensity of sweep-netting in the current study which produced more Araneidae compared to his (30 samples of 10 x 20 sweeps per habitat). The high number of Lycosidae in the current study is attributed to the higher intensity of pitfall trapping.

In terms of the overall abundance per family, the current study found that it was not necessarily true that the most speciose family was the most abundant. Thus Araneidae, mainly *Cyclosa insulana*, which comprised 23% of all specimens, were more abundant than Salticidae despite the later having more species. If this *Cyclosa* was removed from the list, the Salticidae would retain the top position as the richest family in terms of numbers of both species and specimens.

Most spider studies in Africa have been conducted in South Africa, where scientists have produced savanna checklists with similar results (e.g. Dippenaar-Schoeman *et al.* 1999; Whitmore *et al.* 2001; Ford *et al.* 2002; Dippenaar-Schoeman & Leroy 2003). However, they are hard to compare because of disparities in the types and number of methods employed, the duration of sampling and the number of habitats sampled (Table 2). Table 2 also shows that combining several methods and sampling for a longer period gives better results. That the current

Table 2. Selected checklists of African savanna spiders, showing sampling effort, number of collecting methods employed, and the corresponding number of species and families recorded in the studies.

Locality	Species	Families	Methods	Duration (years)	Source
Roodeplaat Dam (SA)	98	27	2	4	Dippenaar-Schoeman *et al.* (1989)
Kruger National Park (SA)	152	40	3	Over 16	Dippenaar-Schoeman *et al.* (2003)
Soutpansberg (SA)	127	46	4	5	Ford *et al.* (2002)
Bloemfontein (+SA)	-	31	1	1	Lotz *et al.* (1991)
Mkomazi GR (Tanzania)	508	52	5	4	Russell-Smith (1999)
Kora GR (Kenya)	68	20	1	3 weeks	Russell-Smith *et al.* (1987)
Middelburg (SA)	55	21	1	3	Van den Berge & Dippenaar-Schoeman (1991)
Northern Province (SA)	268	37	6	1	Whitmore *et al.* (2001)

study came up with 132 species in just 14 months may also show that sampling intensity is important for inventory studies too.

Spider checklists from other parts of Africa include that of Russell-Smith (1981), who reported 135 species belonging to 21 families in Botswana. Blandin & Célérier (1981) and Lotz (1991) also added to the existing knowledge on African savanna spiders. Other work is mainly a compilation of all the literature on spiders in a particular country and not an actual survey, e.g. Griffin & Dippenaar-Schoeman (1991) reported an overall checklist of Namibian spiders with 578 species belonging to 238 genera and 50 families. The taxonomic impediments to identifying the majority of these spiders to species limits the scope for biogeographical comparisons of these studies. However, an improvement in identification would facilitate such comparisons and can reveal interesting faunal patterns as already shown in work on other taxa (e.g. Warui 1998; Warui *et al.* 2001).

CONCLUSIONS

This study shows that the black cotton soil ecosystem has a high spider richness and abundance. We suggest that this arachnofauna is sufficiently rich to be useful for biological monitoring work. Being among the few savanna surveys in the region, it provides baseline information for comparison with future surveys. With the increase of human activity in this biome, there is a danger of losing part of the fauna. Future survey work should be done using other methods such as litter sieving, visual searches, thorough beating and canopy fogging. Seasonal effects evidently affect inventories, so studies should be made over longer periods of time. There is a tremendous need for taxonomists to study and name the many undescribed species in Africa, especially since comparisons are needed between the faunas of different sites and study areas. There is also a need to extend survey work to the neighbouring red soil ecosystem as nothing is known of its arachnofauna at the moment.

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Annexes, Tables and figures

Annex 1. Provisional checklist of spiders from black cotton soil habitats of a highland savanna ecosystem in Laikipia, Kenya. The symbol (+) shows present and (–) absent. The last column of the table represents the total number of specimens collected.

FAMILY	GENUS	SPECIES	METHOD OF COLLECTION		TOTAL
			SWEEPS	PITFALLS	
Agelenidae	*Olorunia*	*Olorunia* sp.	-	+	2
Araneidae	Araneidae indet.	Araneidae sp. 2	+	-	2
"	"	Araneidae sp. 5	+	-	1
"	"	Araneidae sp. 6	+	-	64
"	"	Araneidae sp. 9	+	-	12
"	*Araneus*	Araneus sp. 1	+	+	5
"	*Argiope*	*Argiope trifasciata* Forskal, 1775	+	+	289
"	*Caerostris*	*Caerostris* sp.	+	-	10
"	*Cyclosa*	*Cyclosa insulana* (Costa, 1834)	+	+	2480
"	*Cyrtophora*	*Cyrtophora* sp.	+	-	1
"	*Gea*	*Gea* sp.	+	-	7
"	*Hypsosinga*	*Hypsosinga* sp.	+	+	125
"	*Neoscona*	*Neoscona moreli* (Vinson, 1863)	+	+	37
"	"	*Neoscona* sp. 1	+	-	4
"	*Poltys*	*Poltys* sp.	+	-	25
"	*Pycnacantha*	*Pycnacantha* sp.	+	-	1
Clubionidae	*Clubiona*	*Clubiona africana* Lessert, 1921	-	+	1
Corinnidae	*Castianeira*	*Castianeira mestrali* Lessert, 1921	-	+	4
"	*Merenius*	*Merenius* sp. 1	-	+	2
Cyrtaucheniidae	*Ancylotrypa*	*Ancylotrypa* sp.	-	+	86
Eresidae	Eresidae indet.	Eresidae sp. 1	-	+	1
Gallieniellidae	Gallieniellidae indet.	Gallieniellidae sp.1	-	+	1
Gnaphosidae	*Asemesthes*	*Asemesthes* sp. 2	-	+	5
"	*Camillina*	*Camillina* sp.	-	+	52
"	*Xerophaeus*	*Xerophaeus* sp.1	-	+	19
"	"	*Xerophaeus* sp. 2	-	+	11

FAMILY	GENUS	SPECIES	METHOD OF COLLECTION		TOTAL
			SWEEPS	PITFALLS	
"	"	*Xerophaeus* sp. 3	-	+	21
"	"	*Xerophaeus* sp. 4	-	+	16
"	Gnaphosidae indet.	Gnaphosidae sp. 3	-	+	15
"	"	Gnaphosidae sp. 4	-	+	3
"	"	Gnaphosidae sp. 5	+	+	22
"	"	Gnaphosidae sp. 7	-	+	2
"	"	Gnaphosidae sp. 8	-	+	12
"	"	Gnaphosidae sp. 9	-	+	26
"	"	Gnaphosidae sp. 10	-	+	2
"	"	Gnaphosidae sp. 11	-	+	2
"	"	Gnaphosidae sp. 12	-	+	11
"	"	Gnaphosidae sp. 14	-	+	21
"	"	Gnaphosidae sp. 15	-	+	23
"	"	Gnaphosidae sp. 16	-	+	297
"	Zelotinae indet.	Zelotinae sp. 1	+	+	4
"	"	Zelotinae sp. 2	-	+	1
Hahniidae	*Hahnia*	*Hahnia* sp.	-	+	3
Linyphiidae	*Microlinyphia*	*Microlinyphia sterilis* (Pavesi, 1883)	+	-	3
"	*Tybaertiella*	*Tybaertiella convexa* (Holm, 1962)	-	+	2
"	Linyphiidae Indet.	Linyphiidae sp. 2	+	+	2
Liocraniidae	Liocraniidae indet.	Liocraniidae sp. 1	-	+	6
Lycosidae	*Evippa*	*Evippa* sp.	-	+	6
"	Geolycosa	Geolycosa sp. 1	-	+	226
"	"	Geolycosa sp. 2	-	+	106
"	"	Geolycosa sp. 3	-	+	7
"	"	Geolycosa sp. 4	-	+	38
"	"	Geolycosa sp. 5	-	+	32
"	"	Geolycosa sp. 6	-	+	3
"	Lycosa	*Lycosa* sp.	+	+	259
"	Lycosidae indet.	Lycosidae sp. 1	-	+	9
"	"	Lycosidae sp. 2	-	+	105
"	"	Lycosidae sp. 3	-	+	478
"	"	Lycosidae sp. 4	-	+	3
"	*Pardosa*	*Pardosa* sp.	-	+	2
"	*Trabea*	*Trabea heteroculata* Strand, 1913	-	+	35
"	*Trochosa*	*Trochosa* sp.	-	+	84
Miturgidae	*Cheiracanthium*	*Cheiracanthium* sp.	+	+	142
"	Miturgidae indet.	Miturgidae sp. 2	-	+	1
Idiopidae	Idiopidae indet.	Idiopidae sp. 2	-	+	4
Oonopidae	*Opopaea*	*Opopaea* sp. 1	+	+	30
"	"	*Opopaea* sp. 2	+	+	12
Oxyopidae	*Oxyopes*	*Oxyopes* sp. 1	+	+	587
"	"	*Oxyopes pallidecoloratus* Strand, 1906	+	+	432
"	"	*Oxyopes sp. 3*	+	+	115
"	"	*Oxyopes sp. 4*	-	+	4
Palpimanidae	*Boagrius*	*Boagrius incisus* Tullgren, 1910	-	+	27
Philodromidae	*Philodromus*	*Philodromus montanus* Bryant, 1933	-	+	2
"	"	*Philodromus* sp.	+	+	47
"	*Thanatus*	*Thanatus* sp.	+	+	33
"	*Tibellus*	*Tibellus minor* Lessert, 1919	+	-	42
Pholcidae	Pholcidae indet.	Pholcidae sp.	+	-	2
Pisauridae	*Euprosthenopsis*	*Euprosthenopsis* sp.	-	+	66
"	Pisauridae indet.	Pisauridae sp. 1	+	+	10
"	"	Pisauridae sp. 3	-	+	1

FAMILY	GENUS	SPECIES	METHOD OF COLLECTION		TOTAL
			SWEEPS	PITFALLS	
Prodidomidae	*Prodidomus*	*Prodidomus* sp.	-	+	8
Salticidae	*Aelurillus*	*Aelurillus* sp.	-	+	526
"	*Evarcha*	*Evarcha* sp. 1	+	+	65
"	"	*Evarcha* sp. 2	+	+	5
"	*Harmochirus*	*Harmochirus bianoriformis* (Strand, 1907)	-	+	2
"	*Heliophanus*	*Heliophanus* sp. 1	+	-	13
"	*Hyllus*	*Hyllus* sp.	+	-	19
"	*Myrmarachne*	*Myrmarachne naro* Wanless, 1978	-	+	2
"	*Rhene*	*Rhene* sp.	+	+	71
"	Salticidae indet.	Salticidae sp. 5	-	+	160
"	"	Salticidae sp. 6	+	+	20
"	"	Salticidae sp. 8	+	+	8
"	"	Salticidae sp. 12	+	+	320
"	"	Salticidae sp. 14	+	-	1
"	"	Salticidae sp. 16	-	+	1
"	"	Salticidae sp. 17	+	-	17
"	"	Salticidae sp. 18	+	-	18
"	"	Salticidae sp. 29	+	-	861
"	"	Salticidae sp. 20	+	+	6
"	"	Salticidae sp. 22	-	+	10
"	"	Salticidae sp. 23	+	+	26
"	"	Salticidae sp. 24	+	+	5
"	"	Salticidae sp. 25	+	-	9
"	*Thyene*	*Thyene* sp. 1	+	-	41
"	"	*Thyene* sp. 2	+	+	5
Scytodidae	*Scytodes*	*Scytodes* sp.	+	-	1
Sparassidae	Sparassidae indet.	Sparassidae 1	+	+	3
"	"	Sparassidae 2	+	+	5
"	"	Sparassidae 3	+	+	5
Tetragnathidae	*Leucauge*	*Leucauge* sp.	+	-	7
Theridiidae	*Anelosimus*	*Anelosimus* sp.	+	+	1
"	*Argyrodes*	*Argyrodes* sp.	+	-	22
"	*Coscinida*	*Coscinida* sp.	-	+	3
"	*Episinus*	*Episinus* sp. 1	-	+	15
"	*Latrodectus*	*Latrodectus* sp.	+	+	30
"	*Steatoda*	*Steatoda tristis* (Tullgren, 1910)	-	+	5
"	Theridiidae indet.	Theridiidae sp.1	+	+	3
"	"	Theridiidae sp. 2	+	+	3
Theridiostomatidae	Theridiostomatidae indet.	Theridiostomatidae sp.	+	+	1
Thomisidae	*Borboropactus sp.*	*Borboropactus* sp.	-	+	234
"	*Monaeses*	*Monaeses gibbus* Dippenaar-Schoeman, 1984	+	-	3
"	"	*Monaeses pustulosus* Pavesi, 1895	+	+	152
"	*Runcinia*	*Runcinia flavida* Simon 1881	+	+	488
"	*Stiphropus*	*Stiphropus* sp.	-	+	1
"	*Synema*	*Synema* sp.	+	-	33
"	*Thomisus*	*Thomisus stenningi* Pocock, 1900	+	-	52
"	*Xysticus*	*Xysticus* sp.	-	+	67
Uloboridae	Uloboridae indet.	Uloboridae sp. 1	+	-	5
Zodariidae	*Akyttara*	*Akyttara ritchiei* Jocqué, 1987	-	+	26
"	*Diores*	*Diores strandi* Caporiacco, 1949	-	+	325
"	*Dusmadiores*	*Dusmadiores* sp.	-	+	86
"	*Mallinella*	*Mallinella kibonotensis* (Bosmans & van Hove, 1986)	-	+	1