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A checklist of the ground-dwelling spiders of coastal dune forests at Richards Bay, South Africa (Arachnida: Araneae)

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Summary

The South African National Survey of Arachnida (SANSA) was initiated to make an inventory of the arachnid fauna of South Africa. Various projects are in progress to prepare inventories of the spider fauna of the different biomes and provinces of South Africa. Between 1996 and 1997 ground-dwelling spiders were sampled with pitfall traps from different stands of coastal dune forest at Richards Bay, KwaZulu-Natal. The forest biome, of which the coastal dune forest forms part, is the smallest floral biome in Southern Africa, covering less than 0.25% of the surface area. This was the first quantitative survey of spiders of coastal dune forest at Richards Bay. Twenty-five families represented by 39 genera and 48 species were recorded. The Lycosidae was the most abundant family (589 individuals), representing 71% of all the spiders sampled, followed by the Ctenidae (102) with 12% and the Thomisidae (23) with 3%. The most abundant spider species was an undescribed lycosid species, followed by *Ctenus gulosus* Arts, 1912 (Ctenidae). The Lycosidae was the most species rich family (7) followed by the Corinnidae (6), while 13 families were represented by single species. Forty-eight species were new distribution records for the Richards Bay area.

Introduction

Conservation biologists have started to recognise the importance of the invertebrate component in the functioning of healthy ecosystems. However, meaningful conservation cannot take place if the species involved are not known. Although the Araneae constitute an abundant and highly successful group of invertebrate animals, little is still known about their diversity within most ecosystems in South Africa. Compared with areas in the Northern Hemisphere our knowledge of African spiders is particularly sparse and largely restricted to taxonomy, but even here only 16% of the genera have been revised (Dippenaar-Schoeman & Jocqué, 1997). In 1997 the South African National Survey of Arachnida (SANSA) was initiated to make an inventory of the arachnid fauna of South Africa (Dippenaar-Schoeman & Craemer, 2000). As part of SANSA various projects are in progress to prepare inventories of the spider fauna of the different floral biomes and provinces of South Africa.

This pilot study was undertaken to gather information on the species present in different stands of rehabilitated coastal dune forest at Richards Bay in KwaZulu-Natal, South Africa after mining by a local mining company, Richards Bay Minerals (RBM). RBM began the extraction of minerals from coastal sand dunes in 1976. The mining operation required the clearing of 14 km^2 of natural dune forest vegetation, with an obviously devastating effect on the indigenous flora and fauna. Rehabilitation of parts of the mined area began in 1977 and continues to the present day. The rehabilitation process, described in detail by Van Aarde *et al.* (1996a,b), resulted in the formation of a series of stands of regenerating coastal dune forest of known age. Rehabilitation entails the re-shaping of dunes after mining, spreading of topsoil harvested from cleared forest, and the establishment of a fast-growing set of annual and perennial plant species to stabilise the soil. From this point on rehabilitation occurs through a process of natural succession (Mentis & Ellery, 1994), with minimal management input except for removal of exotic invasive plant species.

In this study we record information on spider species present in rehabilitating and unmined coastal dune forest at Richards Bay. Spiders were collected during four trapping periods between 1996 and 1997. Further studies to analyse the effect of season and successional age on the spider communities of both the herbaceous and ground-dwelling spider fauna will be reported on by Wassenaar & Dippenaar-Schoeman (in prep.).

Methods and study area

Spiders were sampled from three mined, rehabilitating stands with median ages of 2, 8 and 16 years. One

unmined stand, which had been disturbed before 1937 (most likely by agriculturalists) but revegetated by 1960 and hence about 40 years old by the time of the study, and an unmined, relatively undisturbed stand of mature coastal dune forest (at least 100 years old) were also sampled. The rehabilitating areas were established after mining in the Tisand lease area of Richards Bay Minerals, north-east of Richards Bay (28°43′S, 32°12′E).

Topographically the area is characterised by longitudinal sand dunes rising to an elevation of between 40–90 m above sea level. The slope angles of the sea-facing dunes are steep (10–30°), while the landward facing slopes are gentler (10–15°). Most rain falls from January to March, with February usually being the wettest month. The area seldom experiences extended droughts, with rainfall being recorded for about seven months of the year (approximately 30% of annual precipitation occurs in the winter). Mean annual rainfall is 1292 mm. Mean daily maximum temperatures range from 22.6°C in June to 30.0°C in January (maximum recorded was 40.8°C). Mean daily minimum temperatures range from 10°C in June to 20.6°C in January. Frost is not known to occur. Most of the winds blow either north-easterly or south-westerly, parallel to the coast. Wind occurs throughout the year, with the autumn months being the calmest. Mean relative humidity, as measured at Richards Bay, ranges from 59% in August to 72% in April and November.

The vegetation structure of the rehabilitating forest was as follows: (a) 2-year old stand with dense *Acacia karroo* (height 0.7 m) scrub with open grass-herb patches, with percentage ground vegetation cover below 30 cm relatively high in open areas (70–90%) and low in shrubby areas (<50%); (b) 8-year old stand with *A. karroo* shrubland (height 1.5–3 m), with sparse undergrowth and low percentage ground cover (<60%); (c) 16-year old stand with *A. karroo* woodland (height 9–12 m), with relatively thick undergrowth and high percentage ground cover (70–90%). The unmined secondary coastal dune forest was a 40-year old stand dominated by *A. karroo* (height 12–>15 m), with a true sub-canopy layer forming and percentage ground cover relatively low (<20%). The 100-year old stand had a relatively high tree diversity (height 12–>15 m), with a true sub-canopy layer present and percentage ground cover relatively low (<20%); dominant tree species were *Englerophytum natalense* (Sapotaceae), *Kraussia floribunda* (Rubiaceae) and *Erythroxylum emarginatum* (Erythroxylaceae).

Spiders were sampled in 70% alcohol pitfall traps, constructed of 10 × 20 cm plastic containers, with a depth of 15 cm. Five grids consisting of nine traps in a 3 × 3 pattern with traps 5 m apart were randomly located in each stand. Random sample sites were located using a random number generator in a spreadsheet and translating these numbers into grid references. Sampling took place over four trapping periods: August 1996, December 1996, February 1997 and May 1997. The traps were open for five days during each period, resulting in a total of 1,125 trap-days per period and 4,500 for the year. At the end of each trapping period the contents were collected and the traps closed. The inherent drawbacks and advantages for invertebrate sampling of using pitfall traps have been discussed by Curtis (1978) and Southwood (1978). Notwithstanding the drawbacks of the method, it has the obvious advantage in community work of being relatively easy (Curtis, 1978) and is therefore probably the most cost-effective way of sampling ground-living spiders from different habitats, as long as trapping occurs over a sufficiently long period (Riecken, 1999).

Some specimens could not be identified to species owing to the unresolved taxonomy of certain families in Africa (e.g. the Lycosidae) and the immature stage of some specimens collected. Voucher specimens were deposited in the National Collection of Arachnology (NCA) at the ARC-Plant Protection Research Institute in Pretoria, South Africa.

Results

During the four trapping periods a total of 834 adult or identifiable immature ground-living spiders belonging to 25 families, 39 genera and 48 species were caught (Table 1). The Lycosidae was the most abundant family with 589 specimens, representing 71% of all the spiders sampled, followed by the Ctenidae with 102 (12%) and the Thomisidae with 23 (3%). The rest of the families were low in abundance and none exceeded 2% of the total. The three most abundant species overall were an undescribed lycosid sp. (sp. 8) cf. *Trochosa*, representing 62% of the total number of specimens, followed by a ctenid, *Ctenus gulosus* Arts, 1912 (12%), with another undescribed lycosid (sp. 5) at 3% (Table 1). The Lycosidae had the highest number of species (7, or 15% of total) followed by the Corinnidae (6, or 13%), while thirteen families were represented by single species.

Four per cent of the spiders collected were web builders. However, some of these species were probably caught accidentally in the pitfall traps, e.g. the orb-web species *Araneus nigroquadratus* Lawrence, 1937, *Neoscona subfusca* (C. L. Koch, 1937) and *Leucauge festiva* (Blackwall, 1866).

The 8-year old stand had the highest proportion (40%) of the total number of specimens, followed by the 16-year old stand with 20% and the 2-year old stand with 17% (Table 1). The 100-year old, mature stand had the lowest proportion with 7%. The 2-year old stand had the highest number of species (56% of the total species richness), followed by the 40-year old stand (35%) and the 8-year old stand (31%). Only two species, the undescribed lycosid (sp. 8) and *Ctenus gulosus*, were recorded from all the stands. In the 8- and 16-year old stands the lycosid (sp. 8) represented 82–83% of all the spiders collected. Its numbers declined to 63% in the 2-year old stand, 12% in the 100-year old stand and 5% in the 40-year old stand. In comparison *Ctenus gulosus*, which occurred in low numbers (<1%) in the three younger stands, increased to 44% in the 40-year old stand and 63% in the 100-year old forest.

Discussion

Except for taxonomic descriptions, the spider fauna of South Africa is poorly known. Our knowledge of the spiders of KwaZulu-Natal is based on short collecting expeditions to the coastal dune forests at Kosi Bay (Lawrence, 1937, 1942) and Lake Sibaya (Lawrence, 1968). Data from these trips were used to compile a checklist of spiders of Maputaland, a part of KwaZulu-Natal (Lawrence *et al*., 1980). The only other survey was by Van der Merwe (1994) who sampled ground-active spiders from afromontane forest at Ngome State Forest over a period of a year. Since trapping during the present study occurred over a relatively sort period totalling only 20 days, our results may not reflect the true diversity and species richness of the area, but nevertheless they give an indication of the species present (a ''minimum community'').

Family	Species	Guild	Median stand age (years)					Total
			2	8	16	40	100	
Araneidae	*Araneus nigroquadratus* Lawrence, 1937	WB	0	0	0	0	1	1
	Neoscona subfusca (C. L. Koch, 1837)	WB	0	1	0	0	0	1
Corinnidae	*Apochinomma formicaeforme* Pavesi, 1881	W	2	0	0	0	0	2
	Austrachelas incertus Lawrence, 1938	W	0	0	0	1	0	1
	Castianeira fulvipes Simon, 1896	W	1	0	0	0	0	1
	Copa benina Strand, 1916	W	1	0	0	0	0	1
	Copa sp. 2*	W	1	0	0	0	0	1
	Medmassa nitida Lawrence, 1937	W	0	0	0	2	0	2
Ctenidae	*Ctenus gulosus* Arts, 1912	W	1	2	1	59	37	100
	Ctenus sp. 2	W	1	1	0	0	0	2
Cyrtaucheniidae	*Ancylotrypa nuda* (Hewitt, 1916)	W	0	0	0	0	1	1
	Ancylotrypa zuluensis (Lawrence, 1937)	W	0	0	0	4	0	4
	Homostola vulpecula Simon, 1892	W	0	0	0	5	1	6
Eresidae	*Dresserus obscurus* Pocock, 1898	WB	0	0	0	1	2	3
Gnaphosidae	*Camillina cordifera* (Tullgren, 1910)	W	1	0	0	0	0	1
	Echemus erutus Tucker, 1923	W	1	0	0	0	0	1
	Trephopoda hanoveria Tucker, 1923	W	2	0	0	0	0	2
Hahniidae	*Hahnia tabulicola* Simon, 1898	WB	1	0	0	0	0	1
Idiopidae	*Ctenolophus pectinipalpis* (Purcell, 1903)	W	0	0	0	1	0	1
	Segregara paucispinulosa (Hewitt, 1915)	W	0	1	0	0	0	1
Linyphiidae	Linyphiidae sp. 1	WB	1	0	0	5	1	7
Lycosidae	*Lycosa* sp. 2	W	6	7	0	4	1	18
	Hippasa australis Lawrence, 1927	WB	2	0	0	0	0	2
	Pardosa crassipalpis Purcell, 1903	W	7	0	0	0	0	7
	Lycosidae sp. 5	W	0	2	0	23	0	25
	Pardosa sp. 7	W	0	0	0	17	0	17
	Lycosidae sp. 8 * cf. *Trochosa*	W	87	275	141	6	7	516
	Lycosidae sp. 4 *	W	4	0	0	0	0	4
Microstigmatidae	*Microstigmata zuluense* (Lawrence 1938)	W	0	0	0	0	3	3
Oxyopidae	*Oxyopes longispinosus* Lawrence, 1938	W	2	0	0	0	0	2
	Oxyopes bothai Lessert, 1915	W	0	0	1	0	0	1
Philodromidae	*Suemus punctatus* Lawrence, 1938	W	2	0	0	0	0	2
Pholcidae	*Smeringopus pallidus* (Blackwall, 1858)	WB	2	0	0	0	0	2
Phyxelididae	*Xevioso amica* Griswold, 1990	WB	1	6	3	0	1	11
Pisauridae	*Charminus ambiguus* (Lessert, 1925)	W	0	2	4	0	0	6
Salticidae	*Thyenula juvenca* Simon, 1902	W	0	9	5	1	2	17
Scytodidae	*Scytodes maritima* Lawrence, 1938	W	3	0	0	0	0	3
Segestriidae	*Ariadna natalis* Pocock, 1900	WB	1	0	0	0	0	1
Selenopidae	*Anyphops alticola* (Lawrence, 1940)	W	0	1	0	1	0	2
	Anyphops stauntoni (Pocock, 1902)	W	0	3	2	0	0	5
Sparassidae	*Olios biarmatus* Lessert, 1925	W	0	0	2	1	2	5
	Palystes superciliosus L. Koch, 1875	W	1	0	0	0	0	1
Tetragnathidae	*Leucauge festiva* (Blackwall, 1866)	WB	1	0	1	0	0	2
Theraphosidae	*Brachionopus robustus* Pocock, 1897	W	1	1	1	1	0	4
Thomisidae	*Heriaeus crassispinus* Lawrence, 1942	W	2	17	1	0	0	20
	Xysticus natalensis Lawrence, 1938	W	3	0	0	0	0	3
Zodariidae	*Cydrela unguiculata* (O. P.-Cambridge, 1870)	W	0	6	8	0	0	14
	Cydrela spinimana Pocock, 1898	W	0	0	0	1	0	1
Total number of specimens			138	334	170	133	59	834
Total number of species			27	15	12	17	12	

Table 1: Annotated checklist of spider species recorded during four trapping periods in three mined stands of rehabilitating coastal dune forest (2-, 8- and 16-year old stands), one unmined, disturbed stand (40 years old) and one unmined, undisturbed stand (100 years old) at Richards Bay, South Africa. Totals per species are given in the last column and totals per stand and number of species in the last two rows. Guilds: WB = web-dwellers; W = wanderers. *Probably new species.

Although various surveys of African ground-dwelling spiders have been undertaken, comparison between habitats is complicated owing to the differences in sample size and trapping seasons. However, most of these studies at least indicate that the relative abundance of species differs between plant biomes (Russell-Smith *et al*., 1987; Russell-Smith, 1999). Unfortunately many biomes in Africa have not yet been sampled. Surveys of spiders from coastal dunes outside Africa are mainly restricted to sand dunes (Almquist, 1973; Bell & Haughton, 1995). Bell *et al*. (1998) found that despite the harsh environment sand dunes are rich in invertebrates and 53 spider species were sampled from a coastal sand-dune system in north-west England, while Duffey (1968) sampled 188 species.

The skewed abundance distribution pattern, with only two species representing about 74% of the total number of specimens, follows a pattern typically observed in spiders. Similar patterns in ground-dwelling spiders have been observed in other surveys in South Africa, e.g. from Ngome State Forest, KwaZulu-Natal, where three spider species represented 57% of all those collected (Van der Merwe, 1994; Van der Merwe *et al*., 1996). Three species represented 61% of the spider ground fauna at Rietondale Research Station, Pretoria (Van den Berg & Dippenaar-Schoeman, 1991) and three species represented 62% of the total spider fauna collected at Sabie State Forest in Mpumalanga (Van den Berg & Dippenaar-Schoeman, 1988).

The high number of lycosids recorded is interesting, as other surveys in Africa have shown that lycosid species are usually more abundant in savanna habitats and less frequently encountered in forested or woodland areas. For example, only 0.4% of the spiders collected at Ngome State Forest by Van der Merwe (1994) were lycosids. Similar low lycosid numbers were recorded from pine plantations in Sabie Forest (Van den Berg & Dippenaar-Schoeman, 1988). In comparison Russell-Smith (1981) recorded high numbers of lycosids (20%) from floodplain grassland in Botswana, while their numbers were much lower (10%) in Mopane woodland. In the present study five of the seven lycosid species were found mostly in the younger, more open stands, while only eight individuals were sampled from the mature 100-year old stand. Similar results were found in studies of Finnish primeval forest (Väisänen & Biström, 1990), where the spider species assemblage was much richer in the more open and relatively sunny parts of the forest. The ground-living lycosids were very scarce in the dense primeval forests. It therefore appears that physical characters such as the amount of sunshine on the forest floor can be more important than the dominant plant species present. Jennings *et al*. (1988) found that ground-inhabiting spiders preferred the more open, cleared habitats of clear cut strips to those of closed, shaded uncut strips in dense coniferous stands in North America. They found that this unequal distribution could be attributed to the greater abundance of lycosid spiders. Helle & Muona (1985) made similar observations in Finland and found that the spider fauna near the forest edges may be more diverse than in virgin forests. Studies in agroecosystems, especially, have indicated that lycosids are apparently able to colonise disturbed habitats very quickly (Dippenaar-Schoeman, 1979; Van den Berg *et al*., 1991). Usually these habitat types are more open, with less dense vegetation cover.

The presence of ctenids, with *Ctenus gulosus* as the dominant species, mainly in the older forest, corresponds with the findings of Van der Merwe (1994) who found *Ctenus pulchriventris* Simon, 1896 to be dominant in the forest areas of Ngome Forest, with relatively low numbers in the grassland and pine plantations. According to Lawrence (1937) ctenids are commonly found in forests in KwaZulu-Natal, where they are free-living hunters in the humus layer of the forest. Jocqué & Steyn (1997), working in the Ivory Coast, also found ctenids to be dominant in forests.

The Thomisidae was the third most abundant family. *Heriaeus crassispinus* Lawrence, 1942, a grass-dwelling species, was the most abundant thomisid and recorded mainly from the younger stands. This is the first time that a *Heriaeus* sp. has been recorded in relatively high numbers during surveys in South Africa.

The Corinnidae had a high number of species (6) but their total abundance was low, with only 8 individuals collected. More intensive collecting could, however, show a different picture. Van der Merwe (1994) recorded 13 species from the forested areas at Ngome State Forest, while several corinnids were also recorded in high numbers from Sabie Forest (Van den Berg & Dippenaar-Schoeman, 1988). Little is known about the Corinnidae and their habitat requirements.

Although only a single salticid species, *Thyenula juvenca* Simon, 1902 was collected (2% of all spiders collected), the family was better represented in the herbaceous layer in the same study area (Dippenaar-Schoeman & Wassenaar, in prep.). In the herbaceous layer 8 salticid species, with *T. juvenca* the most dominant, collectively made up 14% of all spiders collected.

A total of 97 species were recorded from the herbaceous layer over a period of only two months using a sweepnet (Dippenaar-Schoeman & Wassenaar, in prep.). This increases the total number of species recorded for this area to 141. Fifteen species were collected from both the ground and herbaceous layer, which confirms the observation of Russell-Smith (1999) that more than one habitat type of a region needs to be sampled for arachnids in order to obtain a clearer picture of the species richness and diversity.

Conclusion

With the ecology and diversity of the spider fauna of KwaZulu-Natal so poorly known, this study is a contribution to our knowledge of the geographical distribution of spider species in KwaZulu-Natal. As such it represents new distribution records for all the species recorded and specimens of some possibly undescribed species.

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