PROJECT OUTLINE: HABITS AND HABITAT OF SAND-DWELLING SPIDERS

J.R.Henschel
State Museum of Namibia
P.O.Box 1203
Windhoek
Namibia

Introduction

Sand is an important substratum in the arid and semi-arid areas of south-western Africa, especially Namibia, and south-western Australia. Sand is a good substratum to conduct arachnological studies in because of the morphological and behavioral specializations of its inhabitants and the relative ease with which spiders can be accessed by following tracks on the surface and by excavating spiders from such unconsolidated substratum.

During previous studies, I have gained considerable experience in locating sand-dwelling spiders, in capturing them and in describing their micro-habitat (Henschel 1990a, 1991, Henschel & Lubin, 1992). Besides papers on the ecology, behaviour and physiology, I am currently processing notes, data and specimens towards publications on the natural history of desert dune spiders from the Namib and Negev deserts. Experience gained in the Namib desert was extended last year into comparable habitats in the northern hemisphere (Israel); this threw more light on the postulated cross-African similarities between the Namib-Kalahari sand fields and the Sahara sand fields (of which the Negev dunes are an extension).

Previous collections of Namibian psammophilous spiders have largely been incidental, or very local. Although Griffin (pers.comm.) appears to have sampled from a variety of sand fields, areas were usually not covered extensively or intensively, nor have isolated sand micro-habitats been specifically explored as islands, containing their complements of spiders that should be compared with the fauna from other sand islands or near-by non-sandy areas.

Some psammophilous spiders such as mygalomorphs have and are being examined in the Australian dunes (Main 1981, 1982). However, the studies concentrated on the fauna, taxonomy and adaptations to sheet flooding and not so much on the adaptations to the sandy habitat, which is the central focus of the present study. Furthermore, some specialized morphological characters of psammophilous spiders are only beginning to be understood (e.g. Peters, 1991). I intend addressing these subjects.

Project Descriptions

A. Spider Diversity Lists, Distribution and Natural History

Spiders will be captured in different sandy areas. This will be done with the aid of pit-traps, visual cues, opportunistic capture, excavation, pursuit, or spider trap-door traps (Henschel, 1991) to capture large wandering spiders from their burrows.

Captured specimens will be examined, identified as far as possible in the field, and unless they are familiar and have already been collected from the area, will be preserved, or raised to adulthood in the laboratory before preserving. Preserved specimens will be used in the following ways:

1. to make accurate identifications where possible
2. as specimens for systematic/biogeographic study
3. generate biodiversity lists
4. voucher specimens linked to natural history notes
5. to study morphological adaptations to sand
6. as museum specimens serving as sources of information.

B. Comparative Functional Morphology and Phylogeny of Psammophilous Spiders

Many spiders that occur in or on sand have morphological structures and build silken structures that facilitate their existence in arenaceous habitats. Unrelated spiders may have convergent characters that are absent in non-dune spiders. Amongst others these include: Well-developed distal tarsal scopulae (dense brush of hairs on the feet) but reduced proximal scopulae; Exceptionally long and retractable spigots (openings of silk glands) on telescoping spinnerets (Peters, 1991); Dense rows of interlocking hairs; Production of cribellar tangles that entangle insects, but not sand nor other spiders. Other characters may be uniquely associated with psammophilous spiders: e.g. The ability to sand-swim voluntarily or when inundated with sand; or wheeling down smooth dune slopes (Henschel, 1990b). How the various structures function has in many cases not been demonstrated for psammophilous spiders.

I propose to carry out morphological examinations of psammophilous spiders. Ideally this would include scanning electron microscopic examinations of silk production and adhesion in sand (following the example of Peters, 1991) as well as SEM characterizations of tarsal scopulae structures. Similarly, other morphological and behavioral features should be examined and related to the spiders' modes of life in sand. Different species will be compared from other areas. Sister groups will be sought in adjacent non-sandy areas.

This project includes both cross-species comparisons of convergent features and intra-specific characterization, especially the heteropodids and eresids in which this can be related to previous studies of ecology and behaviour of psammophilous species (Henschel, 1990a,b; Lubin & Henschel, 1990, in prep.; Peters, 1991; Henschel & Lubin, 1992, in prep.; Turner, Henschel & Lubin, submitted).

C. Comparative Functional Morphology and Phylogeny of Silken Structures made by Psammophilous Spiders

Silk is an important feature in understanding spiders (Vollrath, 1988). Psammophilous spiders often modify their environment by using silken structures. These can be used either as retreats or to trap prey. Other sand-dwelling spiders appear to use no silk at all, except to harbour their eggs and young.

Silk could be important in understanding the evolution and phylogeny of psammophilous spiders (Shear, 1986; Eberhard, 1990). Spiders provide a good opportunity to study a multiple-character feature (potentially useful in systematic and phylogenetic studies) that is not part of the animal as such. To date, the thrust of work in this field has been on aerial webs (Eberhard, 1990). Burrowing spiders are less known in this respect (Main, 1986; Coyle, 1986; Peters, 1991).

The nests and webs of Namibian psammophilous spiders are in many cases unknown or poorly known and understood. Where they have been examined in some detail (Henschel, 1990a; Henschel & Lubin, 1991; Peters, 1991), it is apparent that there are some similarities between different taxa. In contrast, there also appear to be some distinctive characters that may assist identification of even closely related taxa without seeing the actual spider. Such distinctions or similarities need to be documented and compared among spiders living in an area and between spiders living in different sandy regions or in adjacent non-sandy areas.

Comparisons of silk among psammophilous spiders and between them and sister groups from non-sandy areas may be valuable to understand:

1. some essential adaptations of spiders to living in sand
2. the consequences of living in a sandy environment
3. phylogenetic relationships, origins and constraints.

This will be achieved by documentation in the field or in the laboratory using measurements and descriptions of the whole structure or of parts of it under ocular or electron microscope.

This should include the following features:

a) architecture
b) manner of constructing
c) utility
d) silk content
e) types of silk applied
f) chemical & physical properties.

Silken structures will be described in the field and collected for analysis. Some of the analytical work involves techniques not available in Namibia or Australia, but may in future be conducted in collaboration with the Universities of Würzburg, München and Hamburg, Germany. Some of the techniques and approaches used and suggestions made by other workers on aerial webs will be applied, modified or developed further for this study of psammophilous spiders.

Field Study Areas

Namibia and Australia are ideal areas to conduct such research, because both countries have sand dunes, and the existing infrastructure to support such research immediately.

Natural scientists of the University of Sydney have access to sand dunes in southern Australia where they are presently conducting research. The present study would be an extension of their activities there. Henschel has ready access to the Namibian dunes for approved projects, of which the current proposal is one.

References Cited

Coyle, FA (1986) The role of silk in prey capture by nonaraneomorph spiders. In: Spiders: webs, behavior and evolution. Shear, WA (Ed). Stanford University Press, Stanford, California, pp 269-269

Eberhard, WG (1988) Combing and sticky silk attachment behavior by cribellate spiders and its taxonomic implications. Bull.Br.Arachnol.Soc. 7: 247-251

Eberhard, WG (1990) Function and phylogeny of spider webs. Annu.Rev.Ecol.Syst. 21: 341-372

Henschel, JR (1990a) The biology of Leucorchestris arenicola (Araneae: Heteropodidae), a burrowing spider of the Namib Dunes. In: Current Research in Namib Ecology - 25 years of the Desert Ecological Research Unit. Seely, MK (Ed). Transvaal Museum Monograph 7, Transvaal Museum, Pretoria, pp 115-127

Henschel, JR (1990b) Spiders wheel to escape. S.Afr.J.Sci. 86: 151-152

Henschel, JR (1991) A trap to capture burrowing arachnids. J.Arachnology 19: 150-152

Henschel, JR & Lubin, YD (1992) Environmental factors affecting the web and activity of a psammophilous spider in the Namib Desert. J.Arid Environments (in press)

Lubin, YD & Henschel, JR (1990) Foraging at the thermal limit: burrowing spiders (Eresidae) in the Namib Desert Dunes. Oecologia 84: 461-467

Main,BY, (1981) Australian spiders: diversity, distribution and ecology. In: Ecological Biogeography of Australia. Keast,A (Ed) Dr.W.Junk, The Hague, Netherland, pp 809-852

Main,BY, (1982) Adaptation to arid habitats by mygalomorph spiders. In: Evolution of the Flora & Fauna of arid Australia. Barker,WR,Greenslade,PJM (Ed) Peacock Publications, Frewville, South Australia, pp 273-283

Main,BY (1986) Trapdoors of Australian mygalomorph spiders: protection or predation?. Actas X Congr.Int.Aracnol.Jaca/Espana 1: 95-102

Peters, HM (1991) On the burrowing behaviour and the production and use of silk in Seothyra, a sand-inhabiting spider from the Namib Desert, with some comparative aspects. Verh.naturw.Ver.Hamburg (in press)

Shear, WA (1986) Spiders: webs, behavior, and evolution. book: Ed, Stanford University Press, Stanford, California.

Vollrath, F (1988) Untangling the spider's web. Tree 3: 331-335