Notes on the behavior of *Pachistopelma rufonigrum* Pocock (Araneae, Theraphosidae, Avicullariinae)

Sidclay Calaça Dias [1] & Antonio Domingos Brescovit [2]

[1] *Departamento de Sistemática e Ecologia, Programa de Pós-Graduação em Ciências Biológicas (Zoologia), Universidade Federal da Paraíba. Campus I, 58059-900 João Pessoa, Paraíba, Brasil. E-mail: pachistopelma@hotmail.com*

[2] *Laboratório de Artrópodes, Instituto Butantan. Avenida Vital Brazil 1500, 05530-900 São Paulo, São Paulo, Brasil. E-mail: adbresc@terra.com.br*

ABSTRACT. Aspects of the behavior of the theraphosid spider *Pachistopelma rufonigrum*, in two species of tank bromeliads in an area with white sands in the Serra de Itabaiana, Sergipe, Brazil, are described. Observations on habitat, microhabitat, foraging, ecdysis and reproduction, were made. Our data suggested that *P. rufonigrum* inhabits only these species of bromeliads, since all stages of the life cycle were observed in the plant. The relationships degrees between *P. rufonigrum* and the species of studied tank bromeliads are discussed.

KEY WORDS. Behavior, Brazil, bromeliads tank, *Pachistopelma rufonigrum*, Theraphosidae.

The biology and ecology of Theraphosidae spiders are poorly known. The few existing ecological studies deal with ecotype description, microhabitat utilization and home range determination (Costa & Peréz-Miles 1992; Stradling 1994). Pérez-Miles *et al*. (1993), while studying the cryptozoic Mygalomorphae from Sierra de Los Animas, Uruguay, observed that these spiders can be found on the ground, under cattle excrement, stones, in litter and in the concavity under the stones. In a similar study in Trinidad, Stradling (1994), described a large variety of plant ecotypes occupied by *Avicularia avicularia* L., establishing relationships between these microhabitats and the reproductive instars of this spider.

The subfamily Avicullariinae includes five genera: *Ephebopus* Simon, *Avicularia* Lamarck, *Pachistopelma* Pocock, *Iridopelma* Pocock and *Tapinauchenius* Ausserer (Raven 1985). With the exception of species of the genus *Ephebopus,* these spiders are essentially arboreal (Bertani & Marques 1996).

To date, the genus *Pachistopelma* includes only two species: *P. rufonigrum* Pocock, from Brazil and *P. concolor* Caporiacco, restricted to the Guyana (Platnick 2002). Voucher specimens, deposited in Brazilian collections, indicate that *P. rufronigrum* occurs mainly in "restinga" and "caatinga" areas from northern Bahia to Rio Grande do Norte. This species represents an exception within Avicullariinae, being the only species that inhabits bromeliads throughout it´s entire reproductive cycle. Stradling (1994) studied the behavioral ecology of *A. avicularia* L. and observed that this species is strictly arboreal, and that adults inhabit the bark on tree trunks and juveniles, the leaves of low growing plants (e.g., bromeliads). Dias *et al*. (2000) collected 70 specimens of *P. rufronigrum* on three species of terrestrial bromeliads. During preliminary observations, several females were found with egg-sacs. This fact suggests that this species might have adapted to inhabit this kind of vegetation. This study aims to contribute towards the description of habitat, microhabitat and behavioral apects of *P. rufronigrum* in bromeliads.

MATERIAL AND METHODS

This study was carried out in the "Estação Ecológica Serra de Itabaiana", Areia Branca, State of Sergipe, Brazil (10°40'S; 37°25'W) (Fig. 1).

The Serra de Itabaiana is situated in a transition area, between the coast of Sergipe and the Bahia "caatinga", in the Atlantic Forest morphoclimatic domain and phytogeographic province (Ab'Saber 1967). This study was conducted in a white sand area, where the vegetation is composed mainly by creeping plants such as Cactaceae, Velloziaceae and Bromeliaceae (Vicente *et al*. 1997). The study site is located on the right margin of the "Água Fria" stream, at approximately 500 meters from the Estação Ecologica´s headquarters.

Recapture method was used to determine the habitat and microhabitat of *P. rufronigrum*. Twenty seven spiders were marked (Fig. 2), between 20.VI.2000 and 03.IX.2000, disregarding the bromeliad species they were found on. The marks were make with white paint and an ink number. Two bromeliads were observed, during a 7 h period each (between 17:30h and 00:30h), three times a month, during 12 months (I.2000 to XII.2000), in order to describe the behavioral ecology of *P. rufronigrum*. In addition, a female with egg-sac and a juvenile were captured and maintained in the laboratory. The spiders were kept in glass boxes and fed with *Tenebrio* sp. larvae.

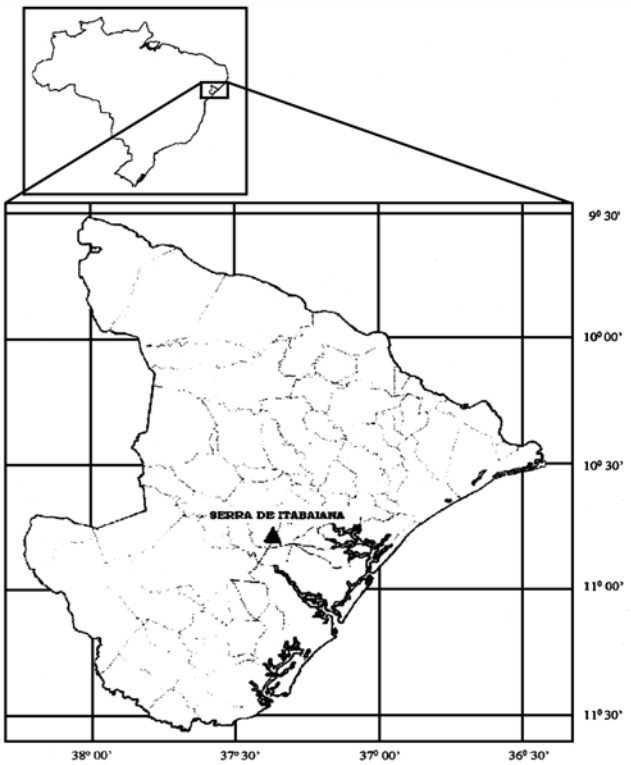


Figura 1. Serra de Itabaiana, State of Sergipe, Brazil.

RESULTS

Habitat and foraging

Pachistopelma rufonigrum specimens (Fig. 2, adult female) was observed in white sand areas, associated to *Aechmea* sp. and *Hohenbergia* sp. bromeliads. We did not find this spider in any other plant neither did we observe the spider foraging outside the bromeliad groups. Extra samplings were carried out by the authors, in the white sand region, during one week using four sampling methods: pitfall traps, Winkler extractors, nocturnal manual collection and diurnal collections with beating trays. *Pachystopelma rufonigrum* specimens were collected only during the nocturnal manual collections, on *Aechmea* sp. and *Hohenbergia* sp. bromeliads, were they were observed occupying all the plant area, central tank, axils, leaf surface and the external base of the plant with dry leaves (Figs 4-6).

Only one specimen was found per bromeliad, however, the presence of two individuals in one plant was observed in two occasions. In both cases, the plant was occupied by an adult and an immature spider. A ctenid spider, *Nothroctenus* sp., was observed occupying the same plant as *P. rufonigrum*, however, there was no record of interaction between them.

The data regarding the recapture methodology indicated that the habitat for *P. rufonigrum* was restricted to bromeliaceous plants. Of a total of 27 marked specimens, 11 were recaptured. Marked specimens were recaptured as described bellow: i) in the same plant were the spider was initially observed (N = 8); or ii) in a different bromeliad, close to the one where the spider was initially observed (N = 3). The spiders that were not recaptured might have lost the marking due to molting or have been hidden deep inside the bromeliads.

As most theraphosid spiders, *P. rufonigrum* is not an active hunter. The spider remains inside the plants' leaves and does not move for periods of almost four consecutive hours. During the periods of nocturnal observation, the locomotion of *P. rufonigrum* (30 cm maximum) was observed in cases where the spider left the retreat and positioned itself on the external base of the plant on the dry leaves (Fig. 4). Only one spider was found feeding on a grasshopper (Orthoptera), which is common on bromeliads in the Serra de Itabaiana.

Courtship behavior

Only one courtship event was observed, on the surface of an *Aechmea* sp. leaf. The event took place during the night at approximately 20:40h. The courtship behavior is similar to that of other theraphosids with some additional events (see Costa & Pérez-Miles 1992; Foelix 1996; Costa 1998). Following clasper, the male begins palpal drumming the bromeliad leaf. Forty seconds later, it upraises the female, palpal drums her genital zone and begins palpal insertion.

Silk retreat

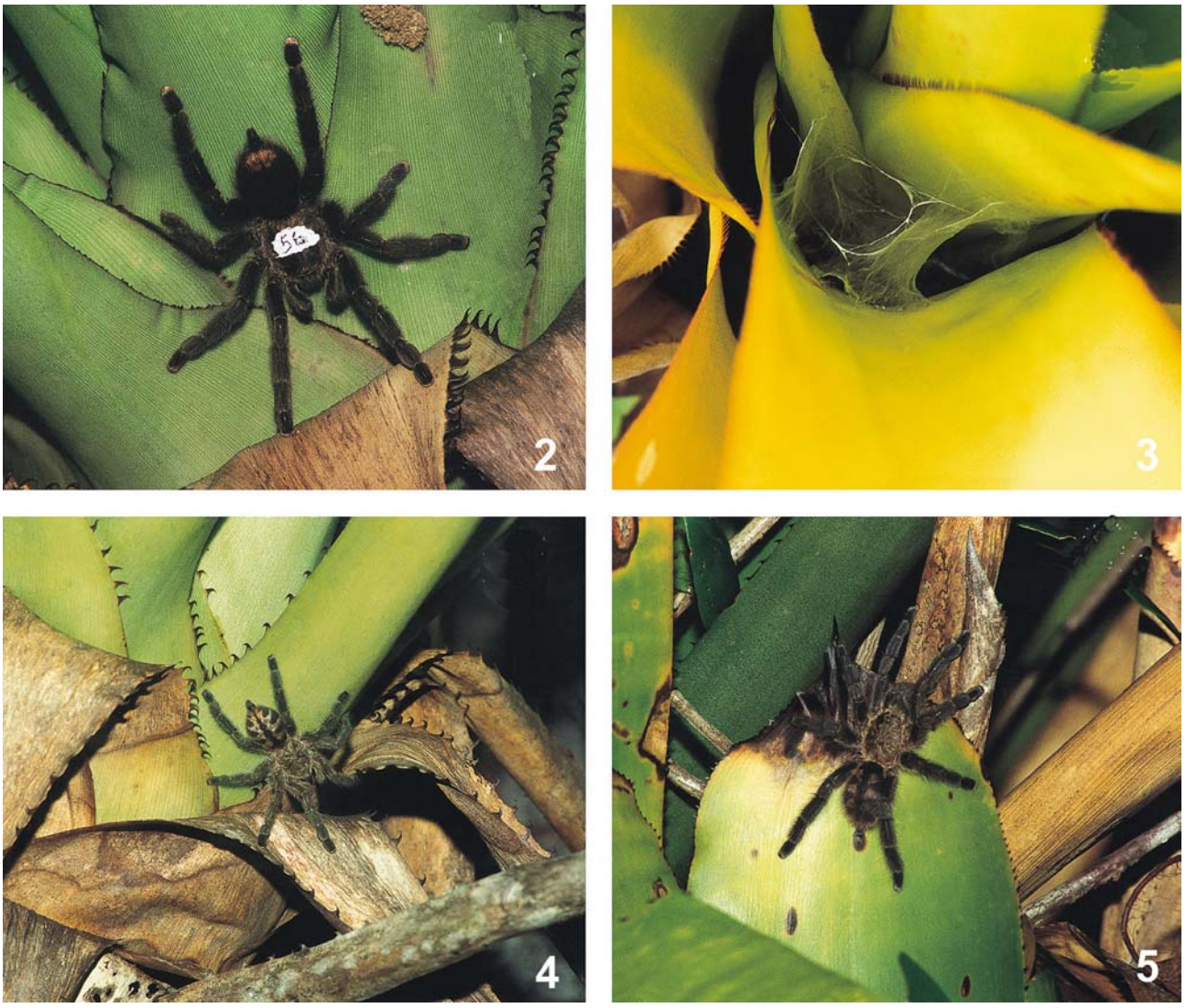
Ecdysis and exuviae. Three exuviae were collected in the field, in both bromeliad species. The building of the silk retreat in the plant was observed. Before the beginning of the molting process, the spider uses it's silk to close up empty spaces between two or three neighboring leaves (Fig. 3). These retreats are not completely closed up, probably due to some of the strongest leaves that eventually leave open spaces in the retreats. In the laboratory we observed that the molting process usually lasts seven days, from the building of the retreat to the exuvia itself.

Egg sac and maternal care. Females of *P. rufonigrum* were observed, with egg sacs, in both bromeliad species. All females were protected by a silk retreat similar to the ones built for molting. Another female, also with an egg sac, was in a silk retreat built in the central tank of *Aechmea* sp. Thirty six days later the female was accompanied by it´s offspring in this same bromeliad. The retreat was intentionally destroyed with tweezers twice during the observations: once while the female had the egg sac and once while the female had the spiderlings. In both cases, the retreat was rebuilt after a few hours.

From the egg sac observed in laboratory, 30 individuals emerged and 30 eggs did not hatch. After 40 days the spiderlings had grown considerably although no exuviae were observed.

DISCUSSION

Pachistopelma rufonigrum presents morphological adaptations that enable the spider to inhabit tank-bromelids. The low eye tubercle and flattened body are probably adaptations to live in between the bromeliad leaves. There are not many references on morphological modifications as an adaptive process for living in a specific microhabitat. However Vitt (1981, 1983) suggested that a lizard species (*Tropidurus semitaeniatus* Spix), by means of a flattening of the body, became adapted to live in rock crevices in order to escape predators and enhace it´s reproductive success.



Figuras 2-5. (2) *Pachistopelma rufonigrum*, adult female, marked; (3) silk retreat between two leaves of the *Aechmea* sp. bromeliad; (4) *P. rufonigrum* on external base of *Hohenbergia* sp. bromeliad, juvenile specimen; (5) *P. rufonigrum* on leaves of *Aechmea* sp. bromeliad, adult female.

The apparent anatomical modifications as well as the behavior pattern observed during this study, indicate that the spider adapted to this microhabitat. Barth *et al.* (1988) discuss that tank bromeliads offer protection against desiccation due to their characteristic foliar arrangement. In addition they also offer mechanical protection against predators. This same author states that the bromeliads offer a microclimate (temperature and humidity) that enables the maintenance of some endemic species. We believe *P. rufonigrum* to be one of these species adapted to the bromeliad microclimate, which is essentially different from the dry hot climate predominant in the Serra de Itabaiana region.

Dias *et al.* (2000), while working in restinga areas, associated the humidity retained in the tank bromeliads with a probable habitat selection by their inhabiting spiders, including *P. rufonigrum*. Vicente *et al.* (1997), refer to similarities between the vegetation and soil profile of the coastal restingas and the white sands of the Serra de Itabaiana. Nevertheless, due to the great distance between the areas as well as the altitude difference (670 m) no relationship can be established between these environments.

The fact that only one specimen of *P. rufonigrum* was observed per plant can be explained by Gunnarson (1992). This author states that the fractal dimention of the plant habitats

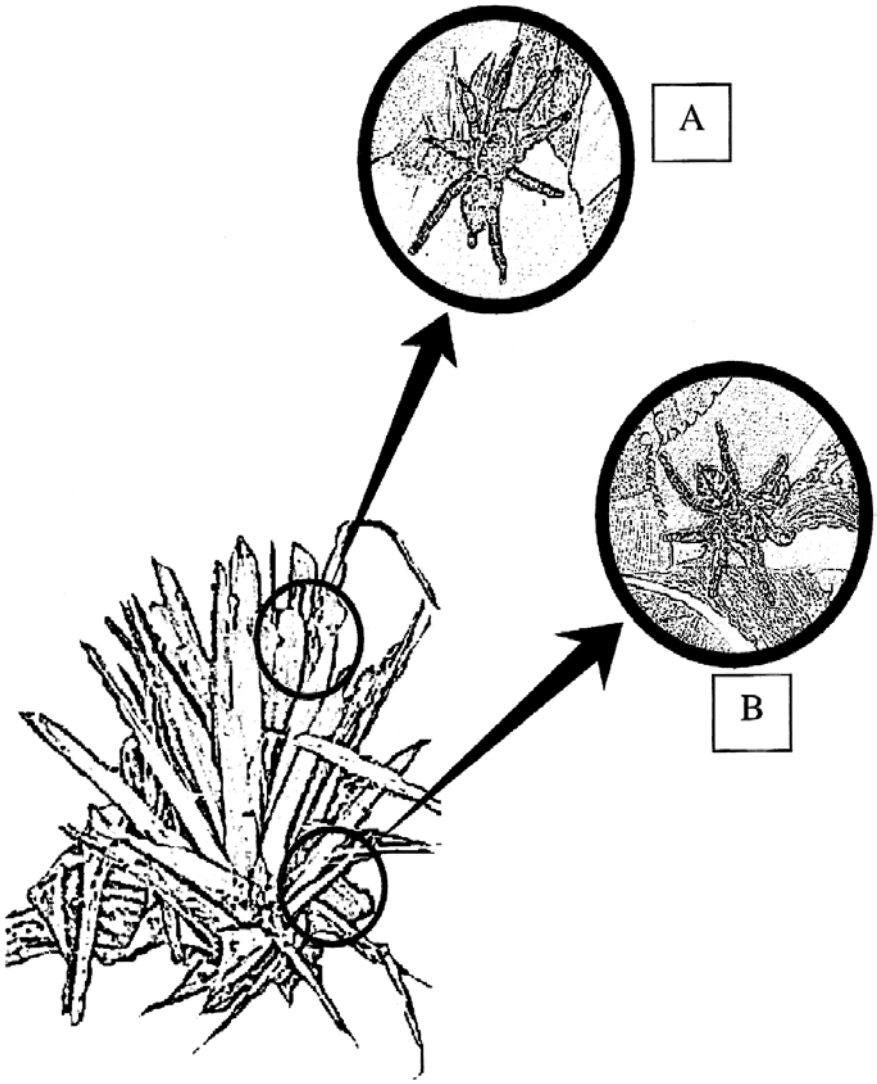


Figura 6. Schematic drawing with the location of *P. rufonigrum* in all the bromeliad plant area: (a) leaf surface, (b) external base of the plant with dry leaves.

influences the body size of arthropods that inhabit them. There are probably two relations between spiders and the host plants: depending on the high or low fractal dimension the fauna can be composed by several small animals or few larger animals. Measurements of the plants surface area were not made during this study. However, *P. rufonigrum* is considered a large spider, with 40mm average carapace length in adults. This fact could indicate that, most likely, the bromeliad´s architecture supports, in terms of water supply and nourishment, only one spider. Considering our observations, *P. rufonigrum* moves very little and presents a "sit and wait" foraging strategy according to Pianka (1994).

Several examples of spider adaptation to certain kinds of microhabitats, such as the construction of silken retreats and relationships between plants and spiders, are known. Barth *et al*. (1988) observed that *Cupiennius* Simon (Ctenidae) uses silk to close open spaces between two or three monocot leaves and that in general, these retreats were occupied by pregnant females of females that were carrying egg sacs.

Stradling (1994) found silk retreats of *A. avicularia* L. in three kinds of plants (including bromeliads) and associated the migration of juveniles from bushes to tree trunks, where adults are found, with the need of larger retreats due to the increase in body size. Rossa-Feres *et al*. (2000) observed that the

females of *Psecas viridipurpureus* Simon (Salticidae) build their egg-sacs by covering a small portion of the bromeliad leaf with silk. During the molting process and egg maturation, the search for protection between the plants leaves, associated to the silken retreat, suggests another adaptation of *P. rufonigrum* to this microhabitat.

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