Research Note

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Anatomical location of *Periglischrus iheringi* (Acari: Spinturnicidae) associated with the great fruit-eating bat (Chiroptera: Phyllostomidae)

Localização anatômica de *Periglischrus iheringi* (Acari: Spinturnicidae) associado com o morcego-das-frutas (Chiroptera: Phyllostomidae)

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Abstract

Spinturnicid mites are ectoparasites that infest the wings of bats, and species of the genus *Periglischrus* Kolenati, 1857 are associated exclusively with bats of the family Phyllostomidae. We tested the hypothesis that a long-term evolutionary association led *P. iheringi* to choose very specific wing locations to infest the great fruit-eating bats, *Artibeus lituratus.* Seven anatomical wing regions and the uropatagium from 140 bats were analyzed and a total of 78 parasites were collected. *Periglischrus iheringi* had a significant preference for the plagiopatagium and dactylopatgium major wing regions (i.e., large, proximal regions) and infestation was directly correlated to area (r=0.9744). However, other factors may also influence mite choice, such as higher and more stable temperature and humidity, vascularization and lower risk of displacement.

Keywords: Anatomical preference, *Artibeus lituratus*, bat, *Periglischrus iheringi*, southeastern Brazil.

Resumo

Spintunicídeos são ácaros ectoparasitos encontrados nas asas dos morcegos, e espécies do gênero *Periglischrus* são associadas exclusivamente com morcegos filostomídeos. Foi testada a hipótese de que a longa associação evolutiva entre ácaro e hospedeiro, permitiu *P. iheringi* escolher uma localização específica na asa do morcego-das-frutas, *Artibeus lituratus.* Sete regiões anatômicas da asa e o uropatágio de 140 morcegos foram analisados, e um total de 78 ácaros foram coletados. *Periglischrus iheringi* apresentou preferência significativa para as regiões denominadas plagiopatágio e dactilopatágio largo (ou seja, regiões grandes e proximais), e sua infestação está correlacionada com o tamanho apresentado por essas áreas (r=0.9744). No entanto, outros fatores também podem influenciar a escolha parasitária, tal como a estabilidade da temperatura e umidade, maior vascularização e menor risco de deslocamento.

Palavras-chave: Preferência anatômica, *Artibeus lituratus*, morcego, *Periglischrus iheringi*, sudeste do Brasil.

Introduction

Spinturnicid mites are permanent bloodfeeding ectoparasites that infest the wings of bats, and members of the genus *Periglischrus* Kolenati, 1857 are associated exclusively with bats of the family Phyllostomidae (HERRIN & TIPTON, 1975). Because there is a general belief that many mite species are yet unknown, bat ectoparasite studies are often limited to taxonomic research, host-parasite associations and abundance patterns. Additionally, many studies document host location of spinturnicid and macronyssid parasites without evaluating if they preferentially populate specific wing sites (RUDNICK, 1960; KOLENATI, 1859; BECK, 1966; RADOVSKY, 1967).

According to Marshall (1982), size and structure of ectoparasite populations may change depending on host size, sex, age, species-specific traits that include morphology and physiology, and external factors such as climate. In addition to these variables, food availability and parasitic mode of feeding may explain why mite populations show distinct preferences for certain locations on the host body. Furthermore, Gannon & Willig (1995), showed

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that bat ectoparasites infest microhabitats that are suitable for the completion of one or more stages of their life cycle, facilitate coexistence with other ectoparasites, and reduce the possibility of being injured, killed, or dislodged by the host during self- or allogrooming. Host factors such as hairiness, integument thickness and microclimatic conditions, may further contribute to the distribution of ectoparasites (BECK, 1966).

These very specific distribution patterns and extreme adaptability of mites, including spinturnicids, may result from a long period of association. Bats and their ectoparasites might, therefore, provide a good model for the study of host-parasite co-evolution, which warrants a more detailed understanding. In this paper, we document the host site locations on the phyllostomid bat *Artibeus lituratus* (Olfers, 1818) that are infested by the spinturnicid mite *Periglischrus iheringi* (Oudemans, 1902) in an Atlantic Forest region of southeastern Brazil.

Materials and Methods

Samples were collected once a month, from June 2009 to June 2010, at Fazenda Marambaia (22° 56' 24.69" S / 43° 36' 37.71" W) and Colônia Juliano Moreira, Parque Estadual da Pedra Branca (22° 56' 39.33" S / 43° 24' 57.55" W), both areas of Atlantic Forest in the state of Rio de Janeiro, southeastern Brazil. Bats were captured using 2.5 × 12.0 m mist nests with a 36 mm mesh (Avinet^{R}) placed across small streams and trails, from 5:00 a.m. to 12:00 p.m.

Artibeus lituratus were examined alive and subsequently released. For each bat, wing membranes and the uropatagium were schematically divided into seven regions, according to Reis et al. (2007), as shown in Figure 1: propatagium (region 1); dactylopatagium brevis (region 2); dactylopatagium minus (region 3); dactylopatagium medius (region 4); dactylopatagium major (region 5); plagiopatagium (region 6); and uropatagium (region 7). We made no distinction between dorsal and ventral parts, and measurements of the seven surface area averages were recorded for 100 bats with digital calipers (mm).

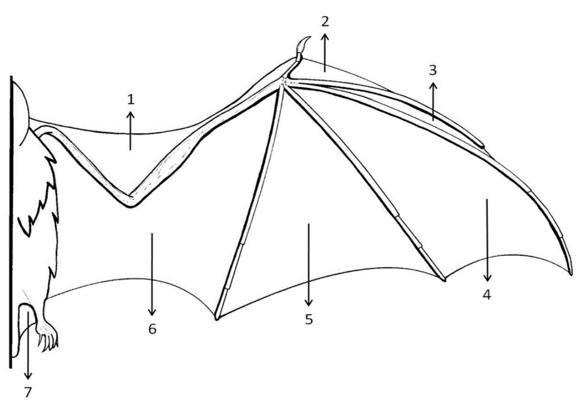

Figure 1. Anatomical wing regions compared in the phyllostomid bat, *Artibeus lituratus*, Southeastern Brazil (Region 1 - propatagium; region 2 – dactylopatagium brevis; region 3 – dactylopatagium minus; region 4 – dactylopatagium medius; region 5 – dactylopatagium major; region 6 – plagiopatagium; region 7 – uropatagium).

Ectoparasites were removed manually from the host body with forceps and fine-tipped brushes moistened with alcohol. The ectoparasites were then fixed in 70% ethanol in individual containers labeled according to the anatomical region of the host from which they were collected. Mites were mounted on permanent slides in Hoyer´s medium and identification was carried out with the aid of light microscopy, according to Herrin & Tipton's (1975) taxonomic key. *Periglischrus iheringi* vouchers were deposited at Acarological Collection in Oswaldo Cruz Institute, Fiocruz (Rio de Janeiro, Brazil).

We used linear regression to test whether *P. iheringi* show preferences for specific regions on the wing membrane and uropatagium of *A. lituratus*. The potential correlation between average patagium area (cm^2) and the number of *P. iheringi* was assessed through the coefficient of correlation test. One-Way Analysis of Variance (ANOVA) was used to compare the results – area (cm^2) and number of mites – found on each of the seven studied areas. Differences were considered significant at a $p< 0.05$. To assess mite density, we divided the number of mites per cm^2 and multiplied by 100 to facilitate the discussion, so densities are shown as mites/100cm^2.

Results and Discussion

We collected a total of 78 *P. iheringi* mites from the wings of 140 *A. lituratus* spatially distributed as shown in Table 1, which also shows average surface areas of wing regions. *P. iheringi* were more prevalent ($F=5.3176$) in the plagiopatagium, where 49% of mites were found, and region size directly influenced infestation ($r= 0.9744$). Comparing area versus number of mites collected in each region, we found no significant differences between the plagiopatagium (Region 6) and dactylopatagium major (Region 5), showing that there is no mite preference between these two areas. However, significant differences were found when we compared Regions 5 and 6 with the propatagium (Region 1), dactylopatagium minus (Region 3) and uropatagium (Region 7). In other words, *P. iheringi* is more often collected from the two largest wing areas, Regions 6 and 5, respectively. Significant differences were also found when comparing the dactylopatagium medius (Region 4) with the propatagium and uropatagium (Regions 1 and 7), showing again that region size is an important factor for mite choice. No significant differences were found among the regions dactylopatagium minus, propatagium and uropatagium. The number of mites per 100 cm^2 in each anatomical area is shown in Table 1. On average, the wings of analyzed bats had 4 mites/100cm^2, the same average density found in the plagiopatagium and dactylopatagium major. The dactylopatagium minus had 6.5% of the total parasites collected but had the highest number of mites, 10/100cm^2.

Previous studies on ectoparasites and their preference for specific host body segments often focus on ticks, lice and fleas, because of their medical and veterinary importance (CASTRO et al., 1990). For example, Bittencourt & Rocha (2002) showed that ticks select places in rodents with greater food availability and lower chances of being removed by the hosts. Such detailed studies are rarely conducted for mites and their preferential sites on bats. Few authors have documented host location as did Kolenati (1859),

Table 1. *Periglischrus iheringi* infestation of different wing anatomical areas in *Artibeus lituratus* from Southeastern Brazil.

Host body region	Surface area in cm²	% of total skin surface	N (%) of mites	Density of mites/100cm²
Propatagium (Region 1)	191.4	9.0	2 (2.6)	1
Dactylopatagium brevis (Region 2)	7.9	0.4	0 (0)	–
Dactylopatagium minus (Region 3)	51.5	2.4	5 (6.4)	10
Dactylopatagium medium (Region 4)	328.6	15.4	11 (14.1)	3
Dactylopatagium major (Region 5)	454.0	21.2	20 (25.6)	4
Plagiopatagium (Region 6)	988.1	46.2	38 (48.7)	4
Uropatagium (Region 7)	115.0	5.4	2 (2.6)	2
Totals	2,136.5	100.0	78 (100.0)	4

who observed *Periglischrus interruptus* (Kolenati, 1856) on the uropatagium, and Vitzthum (1931), who showed the genus *Meristaspis* Kolenati, 1857 (Spinturnicidae) on the eyelid and patagium area of bats.

A single study detailed preferential bat infestation sites of the macronyssid mite *Chiroptonyssus robutipes* (Ewing, 1925) (Acari, Macronyssidae) (SPEARS et al., 1999). In that analysis, the wing of *Tadarida brasiliensis* (I. Geoffroy, 1824) was divided into five areas, head and dorso were investigated as well, and samples from ventral and dorsal parts were separated. Although our study was carried out with a different mite family, our results closely match those from Spears et al. (1999). *P. iheringi* and *C. robutipes* showed distinct preferences for certain anatomical areas on their respective hosts. Both sets of data show that mites are more often collected near the body, on the proximal wing regions plagiopatagium and dactylopatagium major. In our study, approximately 75% of mites were on these regions; for Spears et al. (1999), this number was 64%. That paper also showed that infestation on the ventral side of the wing is more severe than on the dorsal side.

In addition to the correlation between infestation size and severity, the plagiopatagium and dactylopatagium major regions may have other characteristics that favor ectoparasite choice, e.g., higher and more stable temperature and humidity near the host body, which would prevent desiccation of these small-bodied arthropods (BECK, 1966). High vascularization of these regions might also explain the preferential distribution of blood-feeding mites such as the ones studied in the current work. Finally, location choice may represent an adaptation to reduce risk of displacement, both during bat flight and bouts of grooming (RADOVSKY, 1967).

In the present study, the dactylopatagium minus had the highest mite density (10 mites/100cm²), contrasting with the most parasitized regions (5 and 6), which had 4 mites/100cm², possibly because the larger areas allow for a more dispersed infestation. The highest densities of *C. robutipes* were found on the plagiopatagium and dactylopatagium major (SPEARS et al., 1999). In absolute terms, we collected only 5 mites from the dactylopatagium minus, and this small sample size may create distortions that do not allow us to discuss the high density and the difference between studies.

Currently, our scarce knowledge of the interactions between ectoparasites and bats shows that there are indeed preferences for specific host sites that might result from a long evolutionary association. Future studies should probe into the factors that determine site choice and further validate this model of host-parasite co-evolution.

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