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# Feather mites (Acari: Astigmata) of captive Psittaciformes in Brazil

[*Ácaros de pena (Acari: Astigmata) de Psittaciformes de cativeiro do Brasil*]

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## ABSTRACT

Feather samples were obtained from the following Psittaciformes birds: *Amazona amazonica*, *Amazona aestiva*, *Aratinga jandaya*, *Brotogeris* spp., *Ara ararauna* and *Ara chloropterus* (total of 37 individuals). These birds were housed at the Wild Animal Screening Center of Maranhão, São Luís, Brazil. Four feathers were taken from the following regions: head, back, wings, belly/breast, thighs, and tail/covert. Mites were found on 17 birds (45.94%). Astigmatid mites belonging to the genera *Fainalges* (Xolalgidae), *Chiasmalges* (Psoroptoididae) and *Tanyaralichus* (Pterolichidae) were identified. The highest dominance coefficient was for the mite *Fainalges* sp. (DC= 96.29). *Chiasmalges* sp. was obtained only from *Ara chloropterus*, and *Tanyaralichus* was found in *A. aestiva*. The genus *Fainalges* was obtained from all the species of Psittaciformes studied, except for *A. ararauna*. In evaluating mite density according to body region, statistical differences were found between the back and wing regions (P= 0.041), back and thighs (P= 0.02), wings and tail (P= 0.002), belly and tail (P= 0.031) and thighs and tail (P= 0.001). The morphological variations observed in *Fainalges* spp. suggested the existence of three species that probably have not been described yet. This was the first record of the genus *Tanyaralichus* in Brazil.

Keywords: birds, acari, captive

## RESUMO

*As amostras de penas foram obtidas das seguintes aves da ordem Psittaciformes:* Amazona amazonica, Amazona aestiva, Aratinga jandaya, Brotogeris *spp*., Ara ararauna e Ara chloropterus, *totalizando 37 aves, alojadas no Centro de Triagem de Animais Silvestres do Maranhão, São Luís, Brasil. Colheram-se quatro penas de cada uma das regiões: cabeça, dorso, asas, ventre/peito, coxas e cauda/crisso. Verificou-se a presença de ácaros em 17 aves (45,94%). Foram identificados ácaros Astigmata, pertencentes aos gêneros* Fainalges *(Xolalgidae),* Chiasmalges *(Psoroptoididae) e* Tanyaralichus (Pterolichidae), *sendo o maior coeficiente de dominância correspondente ao ácaro* Fainalges *sp. (CD= 96,29).* Chiasmalges *sp. foi obtido apenas de* Ara chloropterus, *e* Tanyaralichus *foi encontrado em* A. amazônica. *O gênero* Fainalges *foi obtido de todas as espécies de Psittaciformes estudadas, exceto em* A. ararauna. *Na avaliação da densidade de ácaros por região do corpo, verificou-se diferença estatística entre regiões dorsal e asas (P= 0,041), dorsal e coxas (P= 0,02), asas e caudal (P=0,002), ventral e caudal (P= 0,031) e coxas e caudal (P= 0,001). Variações morfológicas observadas em* Fainalges *spp., sugerem a existência de três espécies provavelmente ainda não descritas. Este é o primeiro registro do gênero* Tanyaralichus *no Brasil.*

*Palavras-chave: aves, acari, cativeiro*

## INTRODUCTION

The family Psittacidae encompasses 332 species that are mainly distributed in the Neotropical region, Africa, southern Asia and Oceania (Collar, 1997). There are 72 species in Brazil (Sick, 1997).

Feather mites are arthropods that occur in all bird groups and each bird order has its own specific mite fauna (Gaud and Atyeo, 1979). These mites

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can be found inside the calamus, on the surface of the feather or on the skin. Mites on the feather surface have preferences for specific microhabitats, which might be the dorsal or ventral surface or the distal, medial, or proximal parts of the feather (Dabert and Mironov, 1999).

Great diversity of feather mites may occur among Psittaciformes (Gaud and Atyeo, 1996) and many genera may be limited to these birds, such as *Aralichus*, *Genoprotolichus*, *Lopharalichus*, *Psittophagus*, *Rhytidelasma* (Pterolichidae) and *Protonyssus* (Xolalgidae) (Gaud and Atyeo, 1996). Pérez (1995) observed the presence of seven species of the genus *Fainalges* (Xolalgidae) in the psittacid *Aratinga holochlora*, along with almost 20 other mite species.

Some studies have demonstrated that feather mites may cause damage to birds (Collof *et al.*, 1997; Mironov, 2013; Soares *et al*., 2016). Conditions of captivity may give rise to increased numbers of feather mites in a host, through restrictions on flight and physical contact between birds, which may trigger pruritus, lesions and secondary infections (Proctor, 2003; Mironov, 2013).

However, increased numbers of mites seem to be beneficial to the host in certain situations (Blanco and Frias, 2001; Davis and Cornelius, 2013). Therefore, quantitative studies are becoming increasingly necessary in order to understand the behavior of mite populations in their natural habitat.

Most quantitative studies have been conducted mainly on free-living birds of the order Passeriformes (Rojas, 1979; Roda and Farias, 1999; Lyra-Neves *et al.*, 2003; Storni *et al.*, 2005; Roda and Farias, 2007; Kanegae *et al.*, 2008). In Brazil, only Albuquerque *et al*. (2012) conducted a quantitative study that was solely on birds of the order Psittaciformes. Valdebenito *et al.* (2015) studied the parasite fauna associated with two psittacids of the genus *Enicognathus* in Chile.

The objective of the present study was to identify feather mites of birds of the order Psittaciformes living in captivity and correlate the quantities of mites with different regions of the hosts' bodies.

## MATERIALS AND METHODS

Samples of feathers were obtained from the following birds of the order Psittaciformes: *Amazona amazonica* (L. 1766), *Amazona aestiva* (L. 1758), *Aratinga jandaya* (Gmelin, 1788), *Brotogeris* spp., *Ara ararauna* (L. 1758) and *Ara chloropterus* Gray 1859 (total of 37 individuals). These birds were housed at the Wild Animal Screening Center of Maranhão (CETAS-MA), São Luís, Brazil, which is located at the coordinates 2º34'S/44º12'W. These birds originated from municipalities in the state of Maranhão, such as Caxias and São Luís, and had been sent to CETAS-MA either voluntarily or through surveillance on wild animal trafficking activity and illegal possession, or through rescue actions in urban and periurban areas.

The feathers were obtained by gently pulling them, after physical containment of the birds. Four feathers were collected from each of the following regions: head, back, wings, belly/breast, thighs, and tail/covert.

The samples, consisting of four feathers per body region from each bird, were placed in separate vials containing 70% alcohol for subsequent analysis regarding the presence of feather mites.

The adult mites were quantified according to the region of the body. The density of each sample was obtained by dividing the number of mites by the number of feathers collected per region of the body, i.e. the quantity of mites per region of the body (Q) was divided by 4 (density = Q/4). The mites were clarified in 30% lactic acid and then mounted in Hoyer's medium (Flechtmann, 1975).

The mites were identified in accordance with the taxonomic key of Gaud and Atyeo (1996) for the taxa of superfamily, family and genus, and this analysis was complemented through other studies (Pérez, 1995).

The dominance coefficient (DC), prevalence coefficient (PC), abundance index (AI) and mean parasitism index (MPI) were determined. The statistical analysis consisted of using the nonparametric Kruskal-Wallis and Mann-Whitney tests to compare mite densities between body regions.

The present work was approved by UEMA Ethics Committee (CEUA 015/2014)

## RESULTS

Mites were found in 17 birds (prevalence of 45.94%). Astigmatid mites belonging to the genera *Fainalges* (Xolalgidae), *Chiasmalges* (Psoroptoididae) and *Tanyaralichus* (Pterolichidae) were identified. The highest dominance coefficient was for the genus *Fainalges* (DC= 96.29).

*Chiasmalges* sp. was obtained only from *Ara chloropterus*, and *Tanyaralichus* was found in *A. aestiva* (Figure 1C, D). The genus *Fainalges* (Figure 2, 3) was obtained from all the species of Psittaciformes studied, except for *A. ararauna*.

In using the identification key and articles describing species of feather mites, a variety of morphospecies of *Fainalges* spp. were observed: species with an apophysis on tarsus II (Figure 3A, B) and species without such apophyses (Figure 2, 3C, D); females with long pre-tarsus III and IV and seta *d* (Figure 2D) and females in which these structures were short (Figure 2B, 3B, D); males with a longitudinal genital sclerite (Figure 2A, 3C), males without this longitudinal sclerite (Figure 2C, 3A) and males without a longitudinal sclerite in association with presence of apophyses on tarsus II (Figure 3A, B). The morphological variation observed in *Fainalges* spp. suggested the existence of three species that probably have not been described yet.

From the total number of mites obtained and the total number of birds examined, the abundance index was determined to be 7.3. Correlation between the total number of mites obtained and the total number of birds infested showed that the mean parasitism intensity index was 16. In addition to adult mites, immature forms such as eggs, larvae and nymphs were observed in several regions of the body. Regarding the adult forms, the tail and back regions of the hosts presented the largest numbers of mites. The head and thighs presented small numbers.

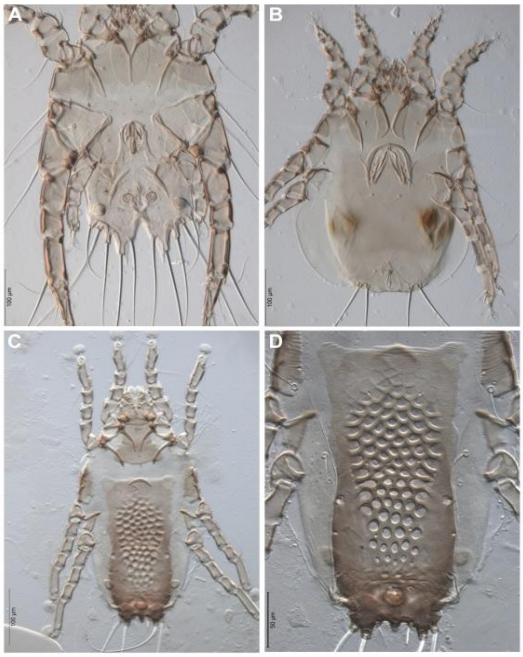


Figure 1**.** *Chiasmalges* sp. (Psoroptoididae) ex *Ara chloropterus*, ventral view of male (A) and female (B); *Tanyaralichus* sp. (Pterolichidae) ex *Amazona aestiva*, ventral view of female (C), and hysterosoma dorsal (D).

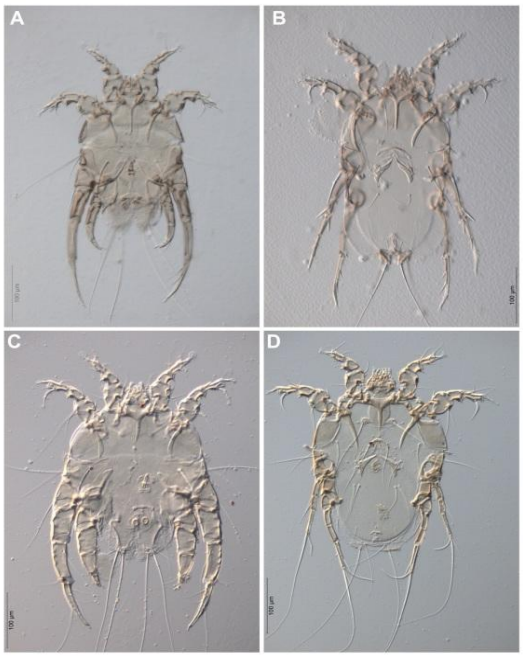


Figure 2. *Fainalges* sp. (Xolalgidae) ex *Ara chloropterus*, ventral view of male (A) and female (B); *Fainalges* sp. ex *Aratinga jandaya*, ventral view of male (C) and female (D).

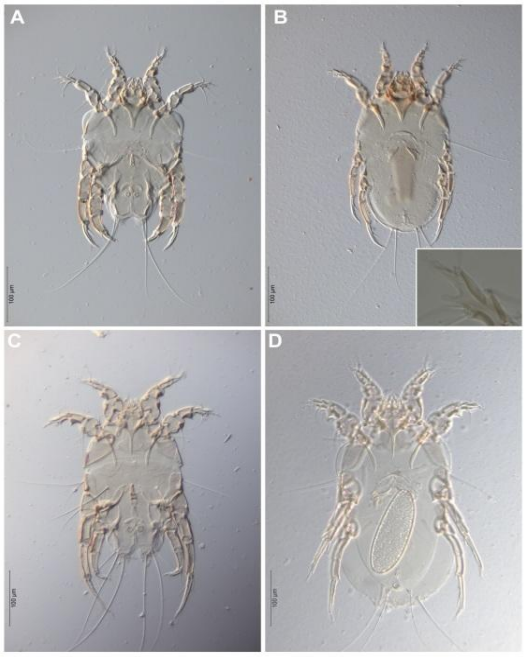


Figure 3. *Fainalges* sp. A (Xolalgidae) ex *Amazona aestiva*, ventral view of male (A) and female (B), detail of tarsus II; *Fainalges* sp. B ex *A. aestiva*, ventral view of male (C) and female (D).

From evaluating the mite density according to body region, by means of the nonparametric Kruskal-Wallis and Mann-Whitney tests, statistical differences were found between the back and wing regions (P= 0.041), back and thighs (P= 0.02), wings and tail (P= 0.002), belly and tail (P= 0.031) and thighs and tail (P= 0.001).

## DISCUSSION

According to Valim *et al.* (2011), there are still relatively few studies on feather mites in Brazil, considering the great diversity of birds in this country. This emphasizes the need to conduct more studies in this field.

Most of the infections found in the present study were due only to *Fainalges* spp. According to Valim *et al.* (2011), the only records of species of *Fainalges* spp. in Brazilian birds so far have consisted of *F. trichocheylus* in *Melanerpes flavifrons* (Picidae) in the state of Espírito Santo (Gaud and Berla, 1964) and *F. annulifer* in *Deroptyus accipitrinus fuscifrons* (Psittacidae) in the state of Pará (Pérez, 1996). However, since other species of this genus have only been recorded in birds of the order Psittaciformes (Gaud and Atyeo, 1981; Mejía-Gonzalez and Pérez, 1988; Pérez, 1996; Mironov *et al.*, 2005), we believe that the record of only one male and one female originally reported as Piciformes by Gaud and Berla (1964) was accidental.

Feather mites of the genus *Fainalges* were found in *Amazona aestiva*, *A. amazonica*, *Ara chloropterus* and *Aratinga jandaya*. This genus was dominant in comparison with the other genera of feather mites encountered (DC= 96.29%). Thus, this genus can be characterized as a group that is well adapted to the order Psittaciformes and which has a wide variety of species (Gaud and Atyeo, 1996; Mironov *et al.*, 2005; Proctor, 2003).

Two species of *Fainalges* were observed in *A. jandaya*. A similar occurrence was observed in another species of the same host genus (*Aratinga holochlora*), in which seven species of *Fainalges* were identified (Pérez, 1995).

Thus, these studies demonstrated that this genus is complex and that additional studies are needed, including in different regions of Brazil. Out of the 72 species of Psittaciformes that occur in Brazil (Sick, 1997), records of species of *Fainalges* only exist for one of them (*Deroptyus accipitrinus*) (Pérez, 1996). There are 13 known species of *Fainalges* (Gaud and Berla, 1964; Gaud and Atyeo, 1981; Mejía-Gonzalez and Pérez 1988; Pérez 1995, 1996; Mironov *et al.*, 2005) and this is one of the groups of feather mites that probably presents speciation that is independent of host diversification. Further clarification regarding the coevolution of *Fainalges* with birds of the order Psittaciformes is needed, given that it remains unknown whether mites have diversified in their hosts or whether the different species originated from other specific hosts (Proctor, 2003).

*Chiasmalges* sp. was obtained from *A. chloropterus* (Psittaciformes: Psittacidae). Only four species are known in this genus and all of them are associated with birds of the family Psittacidae (Mironov, 2004; Mironov *et al.*, 2005). There are few studies relating to the genus *Chiasmalges* in Brazil, and only one species has so far been recorded: *Chiasmalges hirsutus* (Trouessart, 1899). This has been identified in

several species of Psittacidae (*Aratinga solstitialis*, *A. canicularis*, *Pyrrhura leucotis*, *P. picta*, *Nandayus nenday*, *Pionites melanocephala* and *Brotogeris chiriri)* in Brasil, Guyana, Colombia and Mexico (Trouessart, 1899; Bonnet, 1924).

A single female specimen of *Tanyaralichus* sp. (Pterolichidae; Pterolichinae) was found in the host *Amazona amazonica*. Only one species is known in this genus: *T. elongatus* (Pérez and Atyeo 1989). This species has been found in several hosts of the genera *Amazona*, *Pionus*, *Pionopsitta* and *Pyrilia* (= *Gypopsitta*) in the New World (Gaud and Atyeo, 1996). This study provides the first record of this genus in Brazil.

The present study is one of the few on feather mites among birds in captivity in Brazil. Albuquerque *et al*. (2012) conducted a study on feather mites in a species of Psittacidae, but this species was introduced (*Nymphicus hollandicus*) from the Australasian region. Hernandes (2017) described a new species from this latter host in Brazil. Jardim *et al.* (2012) conducted a study on mites of the calamus in birds of the order Psittaciformes in captivity in Brazil.

Studies on wild birds in captivity are very important because even though most feather mites seem not to cause damage to their hosts when these are free-living (Proctor, 2003), conditions in captivity may favor increased populations of feather mites, thus causing pruritus, lesions, and secondary infections (Mironov, 2013).

The prevalence of infestation with feather mites among these birds of the order Psittaciformes was moderate (45.94%). This demonstrated that these mites are present in wild birds in captivity in Brazil, as also observed by Albuquerque *et al.* (2012), and that dissemination between hosts occurs. This dissemination might be through contact between the birds but might also occur through handling them or by means of fomites.

Despite birds in captivity may present high levels of infestation with feather mites due to restrictions on flight (Proctor, 2003), the observed infestation rate was low, as shown by the abundance index of 7.3 and mean parasitism intensity index of 16 that were calculated. According to Clayton and Tompkins (1995), most birds have few parasites, and this is due to their natural strategies for combating ectoparasites (Clayton *et al.*, 2010).

From evaluating mite densities according to body region, by means of the nonparametric Kruskal-Wallis and Mann-Whitney tests, statistical differences were found between the back and wing regions (P= 0.041), back and thighs (P= 0.02), wings and tail (P= 0.002), belly and tail (P= 0.031) and thighs and tail (P= 0.001). The highest densities of feather mites were found in the tail and back regions.

Only a few quantitative studies on feather mites specifically focusing on Brazil like the present study have been conducted, although these few have made contributions towards understanding the biology of mites and their interactions with their hosts. The study by Albuquerque *et al.* (2012) on companion birds of the order Psittaciformes in Brazil found greater numbers of mites in the regions of the left and right wings than were observed in the present study.

Roda and Farias (1999) investigated the locations of feather mites in various passerines and found that most of them showed preferences for tail and wing feathers. Rubtsov and Yakimenko (2012) observed that feather mite species showed specific distribution to certain types of feathers, in different species of Passeriformes in Syberia.

This demonstrates that each group of mites may occupy specific sites. Hence, there is a need for further studies aimed towards confirming mites' preferences for certain regions of the body, which are intrinsic to the morphology of each mite species. Moreover, other factors may influence both the abundance and the locations of feather mites, such as seasons of the year, temperature, light, humidity, and the host's body conditions (Proctor, 2003; Pap *et al.*, 2006).

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## CONCLUSION

The morphological variations observed in *Fainalges* spp. suggested the existence of three species that probably have not been described yet. This was the first record of the genus *Tanyaralichus* in Brazil.

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