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Six new feather mite species (Acari: Astigmata) from the carolina parakeet *Conuropsis carolinensis* (Psittaciformes: Psittacidae), an extinct parrot of North America

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Abstract

We describe six new feather mite species collected from museum skins of the carolina parakeet *Conuropsis carolinensis* Linnaeus, 1758, which lived in North America and became extinct at the beginning of the 20th century: *Genoprotolichus simplex* sp. n., *Lopharalichus beckeri* sp. n., *Neorhytidelasma conuropsis* sp. n. (Pterolichidae: Pterolichinae), *Chiasmalgas carolinensis* sp. n. (Psoroptoididae: Pandalurinae), *Fainalgas gracilitarsus* sp. n., and *Protonyssus proctorae* sp. n. (Xolalgidae: Ingrassiinae). Brief comments on the current systematic state and host associations of these feather mite genera are provided.

Keywords: *Conuropsis carolinensis*, feather mites, new species, parrots, systematics

Introduction

Among non-passerine orders of birds, parrots (Psittaciformes) are characterized by a taxonomically and morphologically diverse feather mite fauna. In the past 20 years, the feather mite fauna of New World parrots has been extensively and purposefully explored (Atyeo 1985, 1988, 1989a, 1989b, 1989c; Ayeo and Pérez 1988a, 1988b, 1990; Ayeo et al. 1984, 1988). To a lesser extent, feather mites associated with parrots from Africa (Gaud 1980) and Australia and the Indo-Malaya region (Gaud 1968; Ayeo and Pérez 1982; Ayeo and Gaud 1987, 1991; Mironov and Galloway 2002; Mironov et al. 2003) have also been investigated. In the course of these studies, it was discovered that the feather mite fauna associated with psittaciforms is extremely rich in diversity of higher-ranking taxa and in richness of mite species inhabiting each parrot species. In total, representatives of 10 feather mite families from two superfamilies have been recorded from the order Psittaciformes (Gaud and Ayeo 1996). Most studies of common and widely distributed

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parrot species have shown that one host species may harbour more than 15 mite species occupying very specific locations in the plumage (Pérez and Atyeo 1984; Pérez 1995, 1996). In spite of investigations carried out so far, the diversity of feather mites associated with psittaciforms in both hemispheres has been only superficially explored, and the mite fauna of many parrot species is still completely unknown.

In the course of our current project on biodiversity, systematics and phylogeny of feather mites associated with parrots, we have had the rare opportunity to collect feather mites from the carolina parakeet *Conuropsis carolinensis* Linnaeus, 1758. This endemic North American parrot species was once widely distributed in the south-eastern USA. Due to persecution in the name of food crop protection and the destruction of the forest habitat of the carolina parakeet, this parrot was rendered extinct by the beginning of the 20th century (Brooks 2000). Although this species has been extinct for less than 100 years, no feather mites have ever been described from it. The present paper gives descriptions of six new feather mite species collected from the carolina parakeet and belonging to six different genera of the families Pterolichidae (Pterolichoidea), Psoroptoididae and Xolalgidae (Analgoidea). These species represent two distinct ecological groups of feather mites in regard to their location in the plumage of the host. Three of the described mite species of the family Pterolichidae represent the ecological group of feather mites specialized for inhabiting feathers with well-developed vanes (flight and tail feathers and wing coverts), while the mites of the families Psoroptoididae and Xolalgidae are commonly located among down feathers and downy parts of body covert feathers.

Material and methods

The material was collected by the authors from a dry museum skin of the carolina parakeet *Conuropsis carolinensis* (access number 1440), deposited in the Übersee Museum (Bremen, Germany). Mites were extracted from the sample according to the scratching method of Gaud and Atyeo (1996) and preserved in 70% ethanol. For light microscope study mites were mounted on slides in Faure medium (Evans 1992). Before mounting, mites were softened and cleared in 10% lactic acid at +60°C for 2–3 days.

The descriptions of new taxa follow the standard schemes used for respective taxa of feather mites (Gaud and Atyeo 1996; Mironov et al. 2003). The nomenclature of idiosomal chaetotaxy follows Griffiths et al. (1990) and leg chaetotaxy is that of Atyeo and Gaud (1966). Measurements in the descriptions are given in micrometres (µm); measurements of a distance between idiosomal setae of different pairs imply a distance between transverse rows formed by setal pairs. The taxonomic system, Latin and common names of hosts in the present study follow those of del Hoyo et al. (1997).

Type materials are deposited at the following institutions: AMU, A. Mickiewicz University, Poznań, Poland; UMB, Übersee Museum, Bremen, Germany; ZISP, Zoological Institute, Russian Academy of Sciences, St Petersburg, Russia.

PTEROLICHOIDEA Gaud and Atyeo, 1978
PTEROLICHIDAE Trouessart and Mégnin, 1884
PTEROLICHINAE Trouessart and Mégnin, 1884
Lopharalichus Gaud and Atyeo, 1996

The genus *Lopharalichus* belongs to the *Protolichus* generic group (Pterolichinae). With 21 genera, the *Protolichus* group is the most diverse of three pterolichid groups associated

exclusively with parrots. Within this generic group, the genus *Lopharalichus* and four closely related genera, *Aralichus* Gaud, 1966, *Chelomatolichus* Gaud and Atyeo, 1996, *Tanyaralichus* Gaud and Atyeo, 1996, *Scolaralichus* Gaud and Atyeo, 1996, constitute the *Aralichus* generic complex (Gaud and Atyeo 1996). Mites of this complex are restricted to New World parrots (Psittacinae: Arini). The *Aralichus* complex is characterized as follows. In both sexes, the scapular setae *se*, *si* are setiform, very short and subequal in length; the hysteronotal shield is commonly covered with a pattern of numerous pit-like lacunae; apicoventral apophyses on tibiae, genua and femora of legs I, II are commonly well-developed. In males, legs I, II are not hypertrophied; the adanal apodemes are well-developed; genital apodemes are greatly reduced or absent.

By 1990, over 30 species had been recognized within this complex (Atyeo 1985, 1989a, 1989b; Pérez and Atyeo 1986; Atyeo and Pérez 1990), but all were treated as members of a single genus *Aralichus*. Later on, in the world revision of feather mite supraspecific taxa (Gaud and Atyeo 1996), representatives of the genus *Aralichus* were rearranged into five separate genera; two species were included in the new genus *Lopharalichus*. Although two formerly known *Lopharalichus* species have been recorded only from the parrot genera *Forpus* Boie, 1858 and *Pyrhura* Bonaparte, 1856, according to the data of the mentioned experts, this genus is widely distributed on New World parrots. The scheme of description used below follows the most expanded format proposed by Atyeo (1989b).

***Lopharalichus beckeri* sp. n.**

(Figures 1, 2)

Type material

Male holotype (ZISP BR 149-1), two male and five female paratypes from *Conuropsis carolinensis*, immature, North America, before 1869, no other data. Holotype, paratypes: ZISP (registration number ZISP BR 149-1); other paratypes: AMU (registration number AMU 01729-1), UMB (registration number N10296/02.6.30.1).

Description

Male (holotype). Idiosoma length 343, greatest width 210 (idiosomal size in two paratypes 340–350 × 210–215). Prodorsal shield as trapezium, 78 long, 106 wide, with distinct transverse furrow at level of scapular setae, without ornamentation; scapular setae *se*, *si* minute, subequal, about 9–10 in length, setae *se* separated by 86, setae *si* by 29. Vertical setae *vi* extending beyond palpal apices. Setae *c2* bifurcate, with unequal branches. Hysteronotal shield: anterior margin straight, length from anterior margin to bases of setae *h3* 250, surface with numerous pits in anterior three-quarters (Figure 1A). Lateral margin of hysterosoma with very small sparsely situated spines. Terminal cleft almost semicircular, 12 long, 27 wide at level of setae *h3*, its anterior margin membranous, lateral margins with dent at level of setae *h2*. Hysteronotal gland openings *gl* posterior to setae *d2*, cupules *im* between them, cupules *ip* invisible. Setae *e2* spiculiform, with additional basal spine; setae *f2* lanceolate; setae *h2* and *h3* large lanceolate, with long terminal filament; foliform setae *ps1* shaped as parallelogram, greatest length 77, greatest width 22. Distances between hysteronotal setae and setal rows: *c1*–*c1* 55, *d1*–*d1* 72, *e1*–*e1*

Figure 1. *Lopharalichus beckeri* sp. n., male. (A) Dorsal view; (B) ventral view; (C) tarsus IV. Setal designations of idiosoma after Griffiths et al. (1990) and those of legs after Atyeo and Gaud (1966).

53, e2–e2 164, h2–h2 102, h3–h3 83, c1–d1 66, d1–d2 8, d1–e1 115, c2–d2 106, d2–e2 93, e2–h3 55, e1–h3 48.

Genital apparatus narrow, 27 long, 14 wide, genital apodemes as a pair of short and narrow sclerites lateral to genital arch (Figure 1B). Setae *g* anterior to *3b*, setae *3a* posterior to *3b* and situated approximately at level of tips of epimerites IIIa. Distances between ventral setal rows: *3b*–*3a* 15, *g*–*3a* 10, *g*–*4a* 66, *4a*–*ps3* 82. Adanal apodemes with strong internal sclerotization at base. Cupules *ih* small, posterior to level of setae *ps2*. Adanal discs 14 in diameter, with five to six teeth on anterior half of corolla.

Figure 2. *Lopharalichus beckeri* sp. n., female. (A) Dorsal view; (B) ventral view.

Tarsi I, II expanded ventrally; apicoventral apophyses of tibiae and genua I, II acute; blade-like ventral apophyses of femora I, II with three to five acute teeth. Tarsus IV 58 in length, setae *d*, *e* thin thorn-shaped, adjacent to each other (Figure 1C).

Female (paratype). Idiosomal length 395, width 232 (idiosomal size of other four paratypes 370–380 × 220–230). Setae *vi* 46 long, extending beyond palpal apices. Prodorsal shield as in male, 90 × 115, setae *se* and *si* similar in size, about 10 long, distances between scapular setae: *se*–*se* 90, *si*–*si* 31. Hysteronotal shield: anterior margin straight, length from anterior margin to bases of setae *h3* 290. Openings *gl* posterior to *d2*; cupules *im* between levels of *gl* and *d2*; cupules *ih* visible, anterior to setae *e2*; cupules *ip* visible. Setae *f2*, *ps1* foliform, with indented margins (Figure 2A); setae *e2* setiform, very short, 13 long. Distances between hysteronotal setae and setal rows: *c2*–*d2* 122, *d2*–*e2* 115, *e2*–*h3* 66, *h2*–*h2* 64, *c1*–*c1* 57, *d1*–*d1* 90, *e1*–*e1* 68, *e2*–*e2* 139, *c1*–*d1* 73, *d1*–*e1* 71, *d1*–*d2*, 14, *e1*–*h3* 119. Epigynum semicircular, 12 × 33 (Figure 2B). Copulatory extension terminal.

Differential diagnosis

Among the two species previously described (Méglin and Trouessart 1884; Gaud and Atyeo 1996), the new species is more similar to *Lopharalichus cribriformis* (Méglin and Trouessart, 1884) described from the green-rumped parrotlet *Forpus passerinus* Linnaeus, 1758 in Guyana by having simple spine-shaped ventral apophyses on genua I, II and by pronounced pit-like lacunae on hysteronotal shield. Males of *L. beckeri* sp. n. differ from *L. cribriformis* by having parallelogram-shaped setae *ps1* with slightly rounded apex, and setae *e2* subequal in length to setae *f2*; females are distinguished by having triangle-shaped setae *f2*. In males of *L. cribriformis*, the apices of setae *ps1* are acute, setae *e2* are twice as long as *f2*; in females, the setae *f2* are large and foliform, almost circular, and with a vein.

Etymology

This species is named in honour of Dr Peter-René Becker, the head of the Natural History Department in the Übersee Museum (Bremen, Germany).

Remark on chaetotaxy

The assignation of chaetotaxy nomenclature for the ventral coxo-genital setae *3a*, *4a* and *g* in males given in the present paper (Figures 1, 2) differs from that applied for the genera of the *Aralichus* complex by Atyeo and Pérez (Atyeo 1988, 1989a, 1989b, 1989c; Atyeo and Pérez 1990). Comparison of the male ventral chaetome in various representatives of the *Protolichus* group genera and in other representatives of Pterolichidae (Mironov 2003; Mironov et al. 2003) gives clear evidence that the setae disposed slightly mesal to the inner tips of epimerites IIIa should be referred to the coxal setae *3a*, but not *4a* as Atyeo and Pérez suggested, while two median pairs situated anterior and posterior to the genital apparatus should be treated, respectively, as *g* and *4a*.

***Genoprotolichus* Gaud and Atyeo, 1996**

This genus, as the previous one, belongs to the *Protolichus* generic group and currently includes three described species (Favette and Trouessart 1904; Gaud and Atyeo 1996). Mites of the genus *Genoprotolichus* are associated exclusively with New World parrots. Gaud and Atyeo (1996) reported a great number of undescribed species, which they had collected from 50 species of 14 parrot genera. According to these authors, the genus *Genoprotolichus* represents an archaic form of the *Protolichus* group and probably is very close to the common ancestor of the *Protolichus* group.

***Genoprotolichus simplex* sp. n.**

(Figures 3, 5A, B)

Type material

Male holotype (ZISP BR 149-2), two male and eight female paratypes from *Conuropsis carolinensis*, immature, North America, before 1869, no other data. Holotype, paratypes: ZISP (registration number ZISP BR 149-2); other paratypes: AMU (registration number AMU 01729-2), UMB (registration number N10297/02.6.30.2).

Figure 3. *Genoprotolichus simplex* sp. n., male. (A) Dorsal view; (B) ventral view; (C) tarsus IV, antaxial view; (D) tarsus IV, paraxial view.

Description

Male (holotype). Idiosoma length excluding membrane on lobar apices 505, greatest width 320 (idiosomal size in two paratypes 506–510 × 320–325). Prodorsum completely sclerotized (Figure 3A), rectangular area anterior to scapular setae slightly more sclerotized than the remaining part of prodorsum. Scapular setae *si* spiculiform, 45 long, distance between scapular setae: *se–se* 72, setae *si–si* 35. Hysteronotal shield: anterior margin straight, length from anterior margin to bases of setae *h3* 350, width at anterior margin 213, surface without ornamentation, supranal concavity indistinct. Lateral sclerotized bands separated from hysteronotal shield in its anterior one-third and fused with humeral shields and lateral sclerites of epimerites IV. Terminal cleft almost semicircular, 67 long, 94 wide (at level of setae *ps1*), with wide entire interlobar membrane spreading along all the cleft margin and forming short rounded terminal extensions on lobar apices; median incision in interlobar membrane triangular, 74 in length. Cupules *im* posterior to openings *gl*, cupules *ip* invisible. Setae *c2* spiculiform, 25 long; *d2* setiform 32 long; setae *e2* thick spiculiform, 65 long; setae *f2* foliform, bent in L-shape; setae *ps1* foliform, ovate. Distances between hysteronotal setae and setal rows: *c1–c1* 118, *d1–d1* 92, *e1–e1* 95, *e2–e2* 151, *h2–h2* 156, *h3–h3* 143, *c2–d2* 105, *d2–e2* 173, *e2–h3* 64, *c1–d1* 70, *d1–d2* 22; setae *e1*, *e2* at the same transverse level.

Genital arch narrow, 30 long, 10 wide; anterior end of genital arch extending to posterior margin of trochanters III, not connected with epimerites IIIa (Figure 3B). Setae *g* at level of genital arch apex, setae *3a* posterior to *3b* and situated approximately at level of tips of epimerites IIIa. Distances between ventral setal rows: *3b–3a* 15, *3a–g* 20, *g–4a* 50, *4a–ps3* 105. Cupules *ih* small, at level of setae *ps2*. Adanal discs 25 in diameter, with 14–16 teeth on corolla; adanal membranes present. Tarsus IV shortened, 32 in length, apex with three small indentations and hook-shaped paraxial process; setae *d*, *e* as suckers, with well-developed apical disc (Figure 3C, D).

Female (paratype). Idiosoma length 500, greatest width 312 (idiosomal size of five paratypes 495–510 × 305–320). Prodorsal shield almost rectangular, with rounded angles, not extending to scapular setae, without ornamentation, 93 long, 78 wide (Figure 5A); scapular setae *si* thin spiculiform, 35 long; distances between scapular setae: *se–se* 84, *si–si* 40. Hysteronotal shield rectangular, not extending to posterior end of opisthosoma, 272 in length, 205 in width at anterior margin; lateral bands separated only from anterior quarter of the shield; surface uniformly dotted, with weakly expressed longitudinal lacunae in posterior half. Pygidial shield covers only terminal extension of opisthosoma, about 35 long, 108 wide. Lateral hysterosomal setae *c2–e2* setiform, short; length of these setae: *c2* 20, *d2* 9, *e2* 22. Cupules *im* and openings *gl* at the same transverse level, cupules *ip* not visible. Terminal margin of opisthosoma between setae *h3* with very short copulatory extension, about 6 long. Distances between dorsal setae and setal rows: *c1–c1* 99, *d1–d1* 86, *e1–e1* 62, *e2–e2* 173, *h2–h2* 93, *c2–d2* 100, *d2–e2* 170, *e2–h3* 66, *c1–d1* 74, *d1–d2* 15, *e1–h3* 62–72. Epimerites I free. Epigynium bow-shaped, 27 × 75, folds of oviporus weakly sclerotized (Figure 5B).

Differential diagnosis

Among three previously described species, the males of the new species are most similar to those of *Genoprotolichus major* (Favette and Trouessart, 1904) described from the austral parakeet *Enicognathus ferrugineus* (Müller, 1776) in Patagonia by lacking ornamentation on

the hysteronotal shield. The males of *G. simplex* sp. n. differ from that species by having completely sclerotized prodorsum without any striation, and much smaller idiosomal size, 506–510; females are distinguished by weakly expressed narrow longitudinal lacunae in posterior half of the hysteronotal shield and also by idiosomal size less than 510. In the males of *G. major*, the prodorsal shield is rectangular, extending slightly beyond the row of scapular setae, while the remaining part of prodorsum is striated and weakly sclerotized, the length of idiosoma is 630–650; the females have clear longitudinal striation in lateral parts of hysteronotal shields, and their idiosomal length is 610–630.

Etymology

Specific name (Latin *simplex*, simple) points out a monotonously punctured surface of the hysteronotal shields.

Neorhytidelasma Mironov and Pérez, 2003

The genus *Neorhytidelasma* belongs to the *Rhytidelasma* generic group, which with 33 species, nine genera takes second place in number of known taxa among three pterolichine generic groups associated with parrots (Gaud and Atyeo 1996; Mironov and Pérez 2003; Mironov et al. 2003). As for the two previous genera, representatives of *Neorhytidelasma* are restricted to New World parrots. Based mainly on morphological features of males, Atyeo and co-authors (Aty eo and Pérez 1988a, 1988b; Atyeo et al. 1988) recognized five species groups (*cornigera*, *forficiventris*, *mesomexicana*, *tritiventris*, *ulocerca*) among eight primarily described species and numerous collected but undescribed species of *Neorhytidelasma*. These studies have also shown that representatives from different species groups may co-inhabit the same host species, occupying different locations in the flight feathers. A review and key to all previously known species were provided by Mironov and Pérez (2003).

Neorhytidelasma conuropsis sp. n.

(Figures 4, 5C, D)

Type material

Male holotype (ZISP BR 149-3), two male and two female paratypes from *Conuropsis carolinensis*, immature, North America, before 1869, no other data. Holotype, paratypes: ZISP (registration number ZISP BR 149-3); other paratypes: AMU (registration number AMU 01729-3), UMB (registration number N10298/02.6.30.3).

Male (holotype). Idiosomal length excluding terminal lamellae 260, width 154 (idiosomal size in two paratypes 253–260 × 128–132). Prodorsal shield: greatest length 80, width at posterior margin about 112, with extending anterolateral projection, posterior angles fused with scapular shields and demarcated from them by two to three striae. Distances between scapular setae: *se-se* 62, *si-si* 41. Hysteronotal shield: greatest length 172, width of anterior part 132, anterior margin straight, anterior part fused with humeral shield, surface without ornamentation (Figure 4A). Cupules *im* visible, situated posterior to gland openings *gl*. Setae *f2* absent; setae *h1* thin setiform, situated mesal to bases of macrochaetae *h2*; setae *ps2* setiform, thick. Lateral margins of opisthosoma with wide, bluntly rounded lateral extensions. Terminal cleft semi-ovate, with narrow membrane along its margin, supranal concavity completely fused with terminal cleft, length of the cleft from bases of setae *h3* to its anterior end 22. Terminal lamellae leaf-shaped, obliquely directed to midline, with five

Figure 4. *Neorhytidelasma conuropsis* sp. n., male. (A) Dorsal view; (B) ventral view; (C) tarsus IV.

to six transverse crests (five to seven in paratypes), length from base of setae *h3* to apices 25–28, greatest width 9–10; incision formed by free margin of interlobar membrane and inner margins of terminal lamellae ovate. Distances between hysteronotal setae and setal rows: *c1*–*c1* 60, *d1*–*d1* 68, *e1*–*e1* 20, *h1*–*h1* 46, *h3*–*h3* 47, *c1*–*d2* 58, *c2*–*d2* 63, *d2*–*e1* 53, *d2*–*h1* 102. Epimerites I fused as a Y, with narrow sclerotization around them. Genital apparatus in normal position about 15×9 , branches of genital arch very short and thin (Figure 4B). Genital apodemes with well-expressed posteromedian angle, extending by anterior ends to level of genital arch apex. Setae *3a* slightly anterior to *3b*, setae *g* posterior to tips of epimerites IIIa and distant from each other as anterior ends of genital apodemes. Anal discs slightly ovate, longitudinal diameter 16, surrounded by wide punctured membrane. Ventral measurements: *3a*–*g* 28, *g*–*4a* 18, *4a*–*ps3* 44. Tarsus IV 28 in length,

Figure 5. Females of pterolichid mites. (A) *Genoprotolichus simplex* sp. n., dorsal view; (B) *Genoprotolichus simplex* sp. n., oviporal region; (C) *Neorhytidelasma conuropsis* sp. n., dorsal view; (D) *Neorhytidelasma conuropsis* sp. n., oviporal region.

with distal paraxial claw and longitudinal crest on paraxial surface bearing five to six small teeth (Figure 4C).

Female (paratype). Idiosomal length 406, width 156 (idiosomal size in other paratype 410×180). Prodorsal shield as in the male, length 98, width 118. Distance between scapular setae: *se-se* 69, *si-si* 49. Hysteronotal shield: greatest length 285, width of anterior part 143, anterior margin straight, surface without transverse striation, pygidial part of the shield not separated. Hysteronotal gland openings *gl* posterior to setae *d2*; cupules *im* between levels of setae *d2* and gland openings, approximately equidistant from them; setae *f2* absent; setae *e1* and *h1* arranged in inverted low trapezium, setae *e1* posterior to *h1* (Figure 5C). Supranal concavity visible, ovate. Posterior end of opisthosoma with narrowed terminal extension, carrying setae *h2*, *h3*, *ps1*, *ps2*. Margin of opisthosoma between setae *h3* concave. Distances between hysteronotal setae and setal rows: *c1-c1* 80, *d1-d1* 81, *e1-e1* 13, *h1-h1* 73, *h3-h3* 24, *c1-d2* 93, *c2-d2* 99, *d2-e1* 117, *d2-h1* 123, *h1-e1* 13.

Epimerites I fused as in the male. Epigynium semicircular, 27×51 , almost completely anterior to level of setae *c2* (Figure 5D). Ambulacral discs as in the male.

Differential diagnosis

Neorhytidelasma conuropsis sp. n. belongs to the *mesomexicana* species group, which is characterized by the following combination of characters: in both sexes, the anterior end of prodorsal shield lacking spine-shaped projections; in males, opisthosoma with lateral blunt-angular extension, the terminal lamellae with widely separated bases, obliquely directed by apices to midline and bearing transverse crests, setae *h1* are close to bases of macrochaetae *h2* (Atyeo et al. 1988; Mironov and Pérez 2003). Among two species previously referred to this group, the new species is most similar to *N. mesomexicana* (Atyeo et al., 1988) described from the green parakeet *Aratinga holochlora* (Sclater, 1859) in Mexico by having the prodorsal shield completely fused with the scapular shields. In *N. bicostata* (Atyeo and Pérez, 1988) known from the subspecies of orange-fronted parakeet *A. canicularis clarae* Moore, 1937 in Mexico, these shields are independent from each other. Males of the new species differ from *N. mesomexicana* by having setae *g* situated posterior to tips of epimerites IIIa and distant to each other (Figure 4B); females are distinguished by the position of epigynium, which is almost completely anterior to the level of setae *c2*, and well-expressed supranal concavity. In the males of *N. mesomexicana*, the genital setae *g* are situated at the level of epimerites IIIa and the distance between them is twice shorter than between setae *4a* situated on inner margins of genital apodemes; in the females of this species, the anterior margin of epigynium is approximately at the level of setae *c2*, and the supranal concavity is not expressed.

Etymology

Specific name is directly derived from the generic name of the host.

ANALGOIDEA Trouessart and Mégnin, 1884

PSOROPTOIDIDAE Gaud, 1958

PANDALURINAE Gaud and Atyeo, 1982

Chiasmalgae Gaud and Atyeo, 1967

The taxon *Chiasmalgae* was originally established as a genus (Gaud and Atyeo 1967), but subsequently these authors (Gaud and Atyeo 1996) proposed to treat it as a subgenus of

the genus *Mesalgoides* Gaud and Atyeo, 1967. However, Pérez and Ramirez (1996) continued to consider *Chiasmalges* as a genus. According to recent partial generic revision of the subfamily Pandalurinae (Mironov 2004), the generic rank of *Chiasmalges* is strongly supported. The genus *Chiasmalges* is restricted to parrots and has included up to now only three described species: *Chiasmalges annahofmannae* Pérez and Ramirez, 1996, *Ch. hirsutus* (Trouessart, 1899) and *Ch. polyplectrus* Gaud and Atyeo, 1967.

***Chiasmalges carolinensis* sp. n.**

(Figure 6)

Type material

Male holotype (ZISP BR 149-4) from *Conuropsis carolinensis*, immature, North America, before 1869, no other data. Holotype: ZISP (registration number ZISP BR 149-4).

Description

Male (holotype). Idiosomal length 465, width 285. Prodorsal shield as trapezium, posterior angles rounded, length along median line 133, greatest width 160, setae *se* separated by 150. Hysteronotal shield: anterior angles obliquely cut, greatest length (from anterior margin to level of setae *h3* 335, greatest width (at level of humeral shields) 223. Supranal concavity ovate. Inner margins of terminal cleft with rectangular ledge carrying setae *ps1* and small spine, terminal lobar digit (apical part of lobe between levels of setae *ps1* and *h3*) elongated, with knife-like terminal lamella. Total length of terminal cleft from anterior end to lobar apices (level of setae *h3*) 73, length of anterior part of the cleft (anterior end—setae *ps1*) 44; length of terminal lobar digit 33; width of terminal lobar digit 22, width of lobe at base 36; length of postero-lateral clefts of the lobe 47; length of lateral lobar digit along inner margin 29; length of terminal lamellae 28, width of lamellae at base 11 (Figure 6A). Distances between hysteronotal setae and setal rows: *c2–d2* 73, *d2–e2* 100, *e2–f2* 72, *h3–h3* 80, *ps1–ps1* 33.

Epimerites I fused as a Y and surrounded by ovate sclerotized area. Coxal fields II almost completely sclerotized, with narrow incision in sclerotized area along epimerites II. Aedeagus thin and long, extending to setae *g*, length from its anterior bend to apex 45 (Figure 6B). Distance between ventral hysterosomal setae and setal rows: *g–g* 15, *3a–4a* 36, *3a–g* 55, *g–ps3* 91. Adanal apodemes not fused at anterior ends. Length of antaxial spur of tibia III 13, length of paraxial spur 11; length of tarsus III 84. Legs III extending beyond the level of terminal membrane tips by almost whole tarsus III (about three-quarters). Tarsus IV with two dorsobasal spines (Figure 6C).

Female. Female unknown.

Differential diagnosis

The new species is most closely related to *Chiasmalges polyplectrus* described from *Aratinga holochlora* (Sclater, 1859) in Mexico (Gaud and Atyeo 1967). The male of *Ch. carolinensis* sp. n. differs from that species by the following characters: legs III extends beyond the apices of terminal lamellae by distal three-quarters of tarsus and the aedeagus extends only

Figure 6. *Chiasmalges carolinensis* sp. n., male. (A) Dorsal view; (B) ventral view; (C) tarsus IV.

to the genital setae *g* (Figure 6A, B). In males of *Ch. polyplectrus*, the legs III extend beyond the terminal lamella apices by whole tarsus III, and the aedeagus is much longer and extends to the anterior tips of adanal apodemes.

Etymology

The specific epithet derives from the specific name of the type host.

Remark on chaetotaxy

Among publications of authors dealing with descriptions of pandalurine mites, there is discordance in the chaetotaxy nomenclature for three pairs of setae situated on the lateral margins of opisthosomal lobes in males, *f2*, *h2*, *ps2*, because their homology to those in other representatives of Analgoidea is not completely clear (Gaud and Atyeo 1967; Černý 1974; Faccini et al. 1976; Pérez and Ramirez 1996; Mironov 1997, 2004; Mironov and Pérez 2002). In the present paper, we follow the assignation of setal nomenclature originally used by Faccini et al. (1976).

XOLALGIDAE Dubinin, 1953
INGRASSIINAE Gaud and Atyeo, 1981
Protonyssus Trouessart, 1916

The genus is specific to parrots and currently includes only three described species, two of which are known from South America and one from the Philippines (Trouessart 1885, 1916; Gaud and Atyeo 1981). Mites of the genus *Protonyssus* represent large-sized forms of the family Xolalgidae distributed on parrots.

Protonyssus proctorae sp. n.
 (Figures 7, 8)

Type material

Male holotype (ZISP BR 149-5), one male and four female paratypes from *Conuropsis carolinensis*, immature, North America, before 1869, no other data. Holotype, paratypes: ZISP (registration number ZISP BR 149-5); other paratypes: AMU (registration number AMU 01729-5), UMB (registration number N10299/02.6.30.4).

Description

Male (holotype). Anterior end of idiosoma with acute rostral projection (Figure 7A). Idiosoma length from rostral apex to bases of setae *h3* 504, greatest width 245 (in paratype 480 × 245). Setae *se* separated by 106. Prodorsal, scapular, humeral, and hysteronotal shields fused to form idiosomal shield covering almost whole dorsal surface of idiosoma. Length of hysterosoma 335. Humeral setae *cp* blade-like, 144 long, 16 wide; setae *c3* short setiform. Opisthosomal lobes narrow, slightly divergent posteriorly, terminal cleft very wide, with narrow and long median extension, greatest length of the cleft 82, greatest width (distance between setae *h3*) 133. Whole terminal cleft occupied by interlobar membrane, free margin of membrane slightly concave, median incision in the membrane narrow slit-shaped, about 22 long. Supranal concavity well-developed, closed, its anterior end extending to mid-level of trochanters IV. Distances between hysteronotal setal rows: *c2*–*d2* 53, *d2*–*e2* 161, *e2*–*h3* 112.

Coxal fields III open in anteromedian angle, anterior ends of epimerites IIIa wide. Coxal fields IV almost completely sclerotized. Genital apparatus narrow, 33 × 9, genital apodemes fused into narrow arch about 50 long (Figure 7B). Genital shield represented by narrow longitudinal sclerite bearing setae *g* in anterior end. Adanal shield bow-shaped, bearing

Figure 7. *Protonyssus proctorae* sp. n., male. (A) Dorsal view; (B) ventral view; (C) tarsus III; (D) tarsus IV.

Figure 8. *Protonyssus proctorae* sp. n., female. (A) Dorsal view; (B) ventral view.

setae *ps3*, separated from genital shield. Setae *3a* anterior to *3b*. Distances between ventral setal rows: *3a–3b* 16, *3a–g* 47, *g–ps3* 77.

Setae *mG* of femorogenua II blade-like, 69 long, 9 wide; setae *cG* II with very small additional basal spine. Legs III extending beyond lobar apices by tarsus and distal quarter of tibia. Setae *sR* of trochanters III thickened in basal part, with small basal spine. Tarsus III with apical hook-shaped process (Figure 7C). Tarsus IV with apical extension bearing four small teeth (Figure 7D). Legs III (femorogenu, tibia, tarsus): 124, 113, 90; legs IV: 78, 66, 36.

Female (paratype). Anterior end of idiosoma with rostral projection as in the male. Idiosomal length 424, greatest width 170 (idiosomal size in three other paratypes

435–440 × 165–170). Anterior part of prodorsal shield (anterior to row of scapular setae) triangular, 82 in length along median line, 84 in width at posterior margin; setae *se* separated by 86; posterior part of prodorsal shield and hysteronotal shield fused into entire shield stretching from level of scapular setae to level of setae *e2* and having long median sclerotized ridge, length of this shield along median line 280, greatest width 126 (Figure 8A); only posterior one-quarter of hysterosoma with relatively soft striated tegument. Pair of small pygidial shields at bases of setae *h2*, *h3*. Length of hysterosoma 254. Humeral setae *cp* large blade-like with very thin and acute apex and indented inner margin, 166 long, 14 wide; setae *d2* very thick setiform, 56 long; setae *e2* thin setiform, setae *f2* bifurcated, with divergent apices, 27 long; setae *ps1* narrowly lanceolate, 29 long. Distances between hysteronotal setae and setal rows: *c2*–*d2* 131, *d2*–*e2* 88, *e2*–*h2* 55, *h2*–*h2* 56. Epigynium as elongated arch, 58 long, 70 wide; sclerotized lips of oviporus extending to mid-level of trochanters III (Figure 8B). Femorogenua I, II with small lateroapical spine, setae *cG* II with additional basal spine, setae *mG* II as in the male; setae *sR* of trochanter III thickened, with small basal tooth, 58 long. Tibiae III, IV greatly elongated, 1.8–1.9 times longer than the length of respective trochanters+femorogenua. Legs III (femorogenu, tibia, tarsus): 42, 69, 58; IV: 44, 136, 66.

Differential diagnosis

The new species seems to be most closely related to *Protonyssus larva* (Trouessart, 1885) described from the scarlet macaw *Ara macao* (Linnaeus, 1758) in Guyana by having lanceolate setae *cp* in both sexes and median sclerotized ridge in females. Males of *P. proctorae* sp. n. differ from that species by having the terminal cleft with a narrow median extension originated from its bottom, slit-shaped incision in interlobar membrane, and by the absence of terminal extensions of lobar membrane; females are distinguished by smooth and straight median sclerotized dorsal ridges on dorsal idiosomal shield, indentations on inner margin of setae *cp* and setiform setae *e2*. In males of *P. larva*, the terminal cleft is almost semicircular, the incision in interlobar membrane is absent, while the posterior ends of this membrane form two acute extensions projecting beyond the lobar apices; in females, the median ridge of the hysteronotal shield has seven to eight additional transverse ribs on each side, the margins of setae *cp* are smooth, and setae *e2* are enlarged, sickle-shaped.

Etymology

Species is named in a honour of Dr Heather C. Proctor, University of Alberta, Canada, well-known expert of aquatic and feather mites.

Fainalges Gaud and Berla, 1964

This genus currently includes 13 species known exclusively from New World parrots (Gaud and Berla 1964; Gaud and Atyeo 1981; Mejía-Gonzalez and Pérez 1988; Pérez 1996). In contrast to the previous genus, *Fainalges* represents small-sized forms of ingrassiine mites living on parrots. This genus demonstrates impressive cases of multiple speciations where several closely related *Fainalges* species are specialized for inhabiting different locations in the plumage of one host species (Pérez and Atyeo 1984; Pérez 1995, 1996).

***Fainalges gracilitarsus* sp. n.**
(Figures 9, 10)

Type material

Male holotype (ZISP BR 149-6) from *Conuropsis carolinensis*, immature, North America, before 1869, no other data. Holotype: ZISP (registration number ZISP BR 149-6).

Description

Male (holotype). Idiosoma length excluding terminal membrane extensions 263, greatest width 195. Prodorsal shield: greatest length 69, width at posterior margin 53, posterior margin with weakly expressed median extension, setae *se* on most posterior margin of the shield, separated by 42. Hysteronotal shield completely fused with scapular shields, anterior margin weakly convex, greatest length of the shield (from anterior end to level of setae *h3*) 174, surface with a pair of longitudinally striated patches mesal to setae *cp*

Figure 9. *Fainalges gracilitarsus* sp. n., male. (A) Dorsal view; (B) ventral view.

Figure 10. *Fainalges gracilitarsus* sp. n., tarsi I–IV of male. (A) Tarsus I; (B) tarsus II; (C) tarsus III; (D) tarsus IV.

(Figure 9A). Setae $c2$ slightly anterior to margin of hysteronotal shield. Terminal cleft ovate, length (from anterior end to bases of $h3$) 26, greatest width (distance between $ps1$) 40. Median longitudinal sclerotization originating from the anterior end of terminal cleft long, extending to level of setae $e2$. Interlobar membrane well-developed, incision in the membrane triangular, 38 in length, terminal extensions short and rounded. Setae $d2$ extending to apices of opisthosomal lobes. Distances between dorsal hysteronotal setal rows: $c2$ – $d2$ 41, $d2$ – $e2$ 62, $e2$ – $h3$ 66.

Sternum long and narrow, remnants of epimerites IIa present. Coxal fields IV closed. Genital arch 21×7 , epandrium and shortened genital apodemes fused into semicircular arch, 19 long, 22 wide, genital shield rectangular, adanal shield bow-shaped, bearing setae $ps3$ (Figure 9B). Setae $3a$ and $3b$ situated at the same transverse level, setae $3b$ extending to lobar apices. Distance between ventral setal rows: $3a$ – g 28, g – $ps3$ 31. Tarsus I with all ventral setae setiform (Figure 10A), solenidion $\sigma 1$ of femorogenu I 42. Tarsus II with seta s lanceolate at base, with seta wa sickle-shaped (Figure 10B); femorogenu II with seta mG twice as long as vF . Legs III extending beyond lobar apices by tarsus and distal half of tibia; measurements of segments: femorogenu 56, tibia 83, tarsus 96. Tarsus III with setae w about half and setae f about three-quarters of the tarsus (Figure 10C); setae kT of tibia III long, extending to mid-level of tarsus III. Tarsus IV curved, with bidentate apical extension (Figure 10D).

Female. Female unknown.

Differential diagnosis

Male of the new species is most similar to *Fainalges apicosetiger* Mejía-Gonzalez and Pérez, 1988 described from *Aratinga canicularis clarae* Moore, 1937 in Mexico by having spine-shaped setae s of tarsi II, very thin and long tarsus III, and by similar form of prodorsal shield (Figure 9). The male of *Fainalges gracilitarsus* sp. n. is distinguished from this species by having longer dorsal setae $d2$ and coxal setae $3b$, both extending to lobar apices, and setae w of tarsus III reaching about half length of the tarsus. In *F. apicosetiger*, setae $d2$ and $3b$ do not extend to bases of opisthosomal lobes, and seta w are only about one-third of tarsus III.

Etymology

Contraction of *gracilis* (Latin slim) and *tarsus* to point out very thin tarsi III.

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