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THREE NEW SPECIES OF *DENNYUS* NEUMANN, 1906 (PHTHIRAPTERA, AMBLYCERA, MENOPONIDAE) PARASITIC ON SWIFTS (AVES, APODIFORMES, APODIDAE) IN BRAZIL

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ABSTRACT

Descriptions and illustrations are given for three new species of the chewing louse genus Dennyus on Brazilian Swifts. They and their type hosts are: D. pichorimi ex Streptoprocne biscutata seridoensis (Biscutate Swift) from the State of Rio Grande do Norte, D. pascoliae ex Streptoprocne zonaris zonaris (White-collared Swift) from the state of Minas Gerais, D. malagonensis ex Cypseloides senex (Great Dusky Swift) also from Minas Gerais. These lice are the first published records of Dennyus species from Brazil. A key for the identification of the Dennyus subgenera, and a table listing species of Dennyus recorded in other countries from hosts occurring in Brazil are given.

KEY-WORDS: *Dennyus*; Chewing louse; *Streptoprocne*; *Cypseloides*; Swift; Menoponidae; Apodidae; New species; Taxonomy; Brazil.

INTRODUCTION

Species of the genus *Dennyus* Neumann, 1906 are chewing lice, obligate ectoparasites of Swifts and Swiftlets (Aves: Apodidae), distributed throughout the world with their hosts. This genus comprises 49 species belonging to four subgenera: *Dennyus sensu stricto*, *Collodennyus* Ledger, 1970, *Ctenodennyus* Ewing, 1930 and *Takamatsuia* Uchida, 1926 (Price *et al.*, 2003; Clayton *et al.*, 2006). Systematic revisions of some of these subgenera have been published by: Price & Clayton (1997) on *Ctenodennyus*, Emerson & Price (1968) on *Takamatsuia*, and Clayton *et al.* (1996, 2006) on *Collodennyus*. The nominal subgenus *Dennyus sensu stricto*, the only one found in South America, is still lacking a comprehensive revision of the scattered descriptions and regional reviews published by Carriker (1954), Emerson & Pratt (1956),

Price & Beer (1962), and Ledger (1968, 1970, 1971). The only publication dealing with Neotropical species of *Dennyus* does not include any material from Brazil (Carriker, 1954).

In this paper I describe three new species in the genus *Dennyus sensu stricto* and compare them with their morphologically closest relatives. I also provide a key to the subgenera of *Dennyus*, as well as a list of *Dennyus* species recorded in other Neotropical countries from hosts that also occur in Brazil

MATERIAL AND METHODS

The lice, which were fixed in 70% ethanol, mounted on slides following the Canada balsam technique (Palma, 1978), and deposited in the Museu de Zoologia da Universidade de São Paulo, São Paulo,

Brazil (MZUSP). The number associated with each specimen is the unique identifier for the specimen in the SophiA® database for the Phthiraptera collection at MZUSP.

Images were taken using a Leica DFC295 digital camera associated with a Leica DM5000 B optical microscope, and were taken using the software *Leica Application Suite (LAS) v.4.1.0*. All measurements are in millimeters and were taken from slide-mounted specimens they are identified by the following abbreviations: temple width, **TW**; preocular width (at level of *dhs11*), **PoW**; head length at midline, **HL**; prothorax width, **PW**; prosternal plate length, **PrL**; prosternal plate width (at its anterior portion), **PrW**; metathorax width, **MW**; femur II length, **FeII**; femur III length, **FeIII**; abdomen length at midline, **AL**; abdomen width at segment IV, **AW**; genitalia length, **GL**; paramere length, **PaL**; genital sclerite length, **GSL**; anus width, **AnW**; total length, **TL**.

Setal nomenclature and counts follow Clay (1966). The metanotal setal count does not include the most postero-lateral setae; the tergal setal counts include the variable setae between the postspiracular complex located on the tergal plates, which are the postspiracular seta plus the lateral setae associated with it (*b* of Clay, 1970). In the pro- and mesosternal counts, the minute antero-lateral setae are excluded. The tergo-central setae of segment I includes all marginal setae except the postspiracular seta; the tergo-central setae of segments II-VIII exclude the postspiracular seta as well as the seta (*b*) associated with it. Abdominal sternal setae are given as either posterior or anterior, but do not include the two very short anterior setae on each side of the sternite II, or the setae in the brushes on sternites V-VII. The latter are given separately.

Host classification below order follows that of Dickinson (2003). Most of the morphological terms and characters used herein for lice are those used and recommended by Clayton *et al.* (1996).

RESULTS

Order Phthiraptera Haeckel, 1896
Suborder Amblycera Kellogg, 1896
Family Menoponidae Mjöberg, 1910
Genus *Dennyus* Neumann, 1906

Nitzschia Denny, 1842. *Mon. Anopl. Brit.*: 320 (*nec* Baer, 1827).

Dennyus Neumann, 1906. *Bull. Soc. Zool. Fr.*, 20: 60.
Nomen novum for *Nitzschia* Denny.

All the 49 named species of *Dennyus* are ectoparasites of birds of the family Apodidae (Apodiformes), and are divided into four subgenera: *Dennyus* (19 spp.), *Collodennyus* (25 spp.), *Ctenodennyus* (3 spp.), *Takamatsuia* (2 spp.) (Price *et al.*, 2003: 282). *Dennyus* is morphologically related to *Niethammerella* Eichler, 1954, *Myrsidea* Waterston, 1915, *Ramphasticola* Carriker, 1949 and *Eureum* Nitzsch, 1818 based on: alveoli of *dhs26* and *dhs27* not closely associated, and the presence of only two anterior mesonotal setae. The following combination of characters make *Dennyus* distinct from the abovementioned genera: (1) prosternum with more than two central setae; (2) head with ventral truncated-ovoid invagination at level of the clypeo-frontal suture (*sensu* Symmons, 1952) with thickened anterior rim; (3) gular plate not horseshoe-shaped; (4) marginal temporal carina and temporal carina well developed; and (5) tibiae I-III with pseudo-articulation at its posterior third.

Host distribution: Order Apodiformes; family Apodidae; genera: *Aerodramus* Oberholser, *Aeronautes* Hartert, *Apus* Scopoli, *Chaetura* Stephens, *Collocalia* Gray, *Cypseloides* Streubel, *Cypsiurus* Lesson, *Hirundapus* Hodgson, *Hydrochous* Brooke, *Streptoprocne* Oberholser, *Tachornis* Gosse, *Tachymarptis* Roberts.

Geographical range:

Dennyus (*Dennyus*): Africa (Cameroons, Cape Verde, Congo, Kenya, Nigeria, Somalia, South Africa, Zimbabwe); Asia (Afghanistan, China, India, Malaysia, Sri Lanka, Thailand), Central America (Costa Rica, Jamaica, Nicaragua); Europe (England, Germany, Lithuania, Scotland, Spain, Switzerland); North America (Mexico and USA); South America (Argentina, Bolivia, Colombia, Peru, Trinidad and Tobago, Venezuela).

References: Ewing (1930), Büttiker (1954), Thompson (1948), Carriker (1954), Emerson & Pratt (1956), Ledger (1968, 1971)

Dennyus (*Ctenodennyus*): Asia (Fiji, Indonesia, Malaysia, Philippines); North America (Canada and USA); Oceania (New Guinea).

Reference: Price & Clayton (1997)

Dennyus (*Collodennyus*): Africa (Mauritius, Seychelles); Asia (Fiji, Indonesia, Java, Malaysia, Philippines, Thailand); Oceania (Australia, French Polynesia, New Guinea, Samoa, Solomon Islands, Vanuatu).
References: Ledger (1970), Clayton *et al.* (1996, 2006)

Dennyus (Takamatsuiia): Asia (India, Japan, Philippines).

Reference: Emerson & Price (1968).

Key to the subgenera of *Dennyus*

1. Abdominal segment IX deeply indented into VIII, shaped as a wide and inverted U, forming a distinct postero-lateral distention with a tuft of at least 10 long setae *Dennyus (Takamatsuiia)*
Abdominal segment VIII and IX not as above, similar to segment VII 2
2. Prosternal plate with no more than four slender and long setae; sternite I with at most two slender setae; tarsi I without claws..... *Dennyus (Collodennyus)*
Prosternal plate with 2 or 4 slender and long setae, plus some slender, spiniform or peg-like setae present on middle of the plate; sternite I with more than 2 slender setae, short anterior setae present; tarsi I with claws 3
3. Abdominal tergites bearing a posterior marginal row of normal to spine-like setae; prosternal plate with central setae slender or spine-like..... *Dennyus (Dennyus)*
Some abdominal tergites (at least I-III) bearing a posterior marginal row of normal setae alternating with peg-like setae; prosternal plate with some central peg-like setae *Dennyus (Ctenodennyus)*

***Dennyus (Dennyus) pichorimi* sp. nov.**
(Figs. 1-9)

Type host: *Streptoprocne biscutata seridoensis* Sick, 1991 – Biscutate Swift (Apodiformes: Apodidae)

Holotype: Male (MZUSP #2495), ex *Streptoprocne biscutata seridoensis*, BRAZIL: Rio Grande do Norte, Acari, Serra do Bico da Arara, Fazenda Ingá [06°28'40"S; 36°36'05"W], 26.VIII.2007, M. Pichorim coll.

Paratype: 1 Female (MZUSP #2496), same data as the holotype but collected from a different host individual.

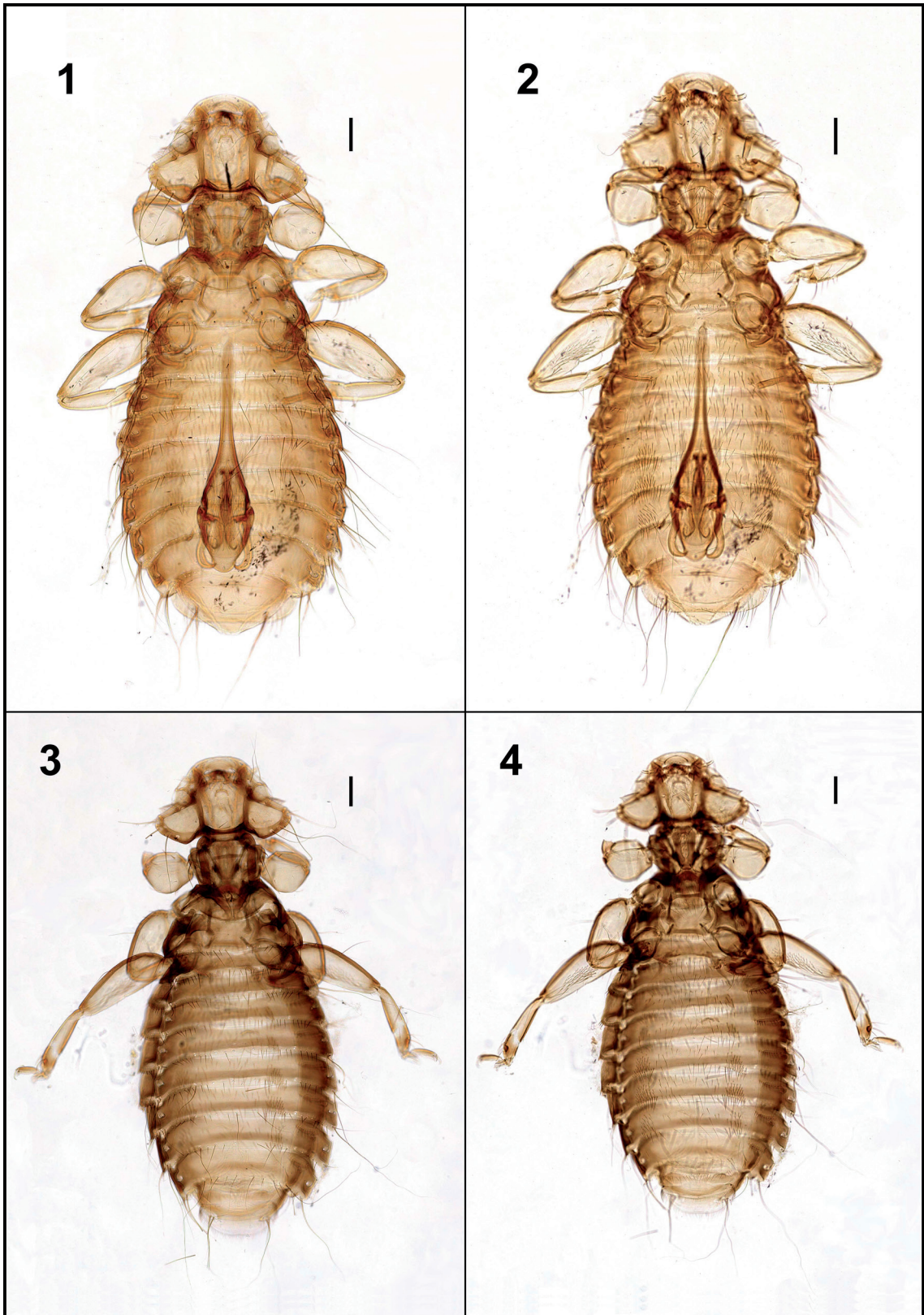
Etymology: The species epithet is a noun in the genitive case dedicated to the Brazilian ornithologist Mauro Pichorim, in recognition of his efforts collecting bird ectoparasites and for his long-term studies on Biscutate Swift in Brazil.

Diagnosis: *Dennyus (Dennyus) pichorimi* is morphologically close to a group of four species which have: (1) prosternal plate with numerous short and thickened setae set in the center of the plate (not only on its anterior half), plus an antero-lateral pair of long and thin setae (Fig. 6); (2) lateral margin of the pronotum with two short spine-like setae and one long thin seta (rather than all three short spine-like setae) (Figs. 1 and 3); and (3) gular plate mostly pale with a U-shaped band of sclerotization (Fig. 6). The type hosts and localities are for these species: *D. (D.) brunneitorques* Carriker, 1954 (ex *Streptoprocne rutila brunneitorques* (Lafresnaye), Peru); *D. (D.) rotundocapitis* Carriker, 1954 (ex *Streptoprocne zonaris albicincta* (Cabanis), Colombia); *D. (D.) semicollaris* Price & Beer, 1962 (ex *Streptoprocne semicollaris* (DeSaussure), Mexico); and *D. (D.) spininotus* Carriker, 1954 (ex *Cypseloides fumigatus* (Streubel), Colombia).

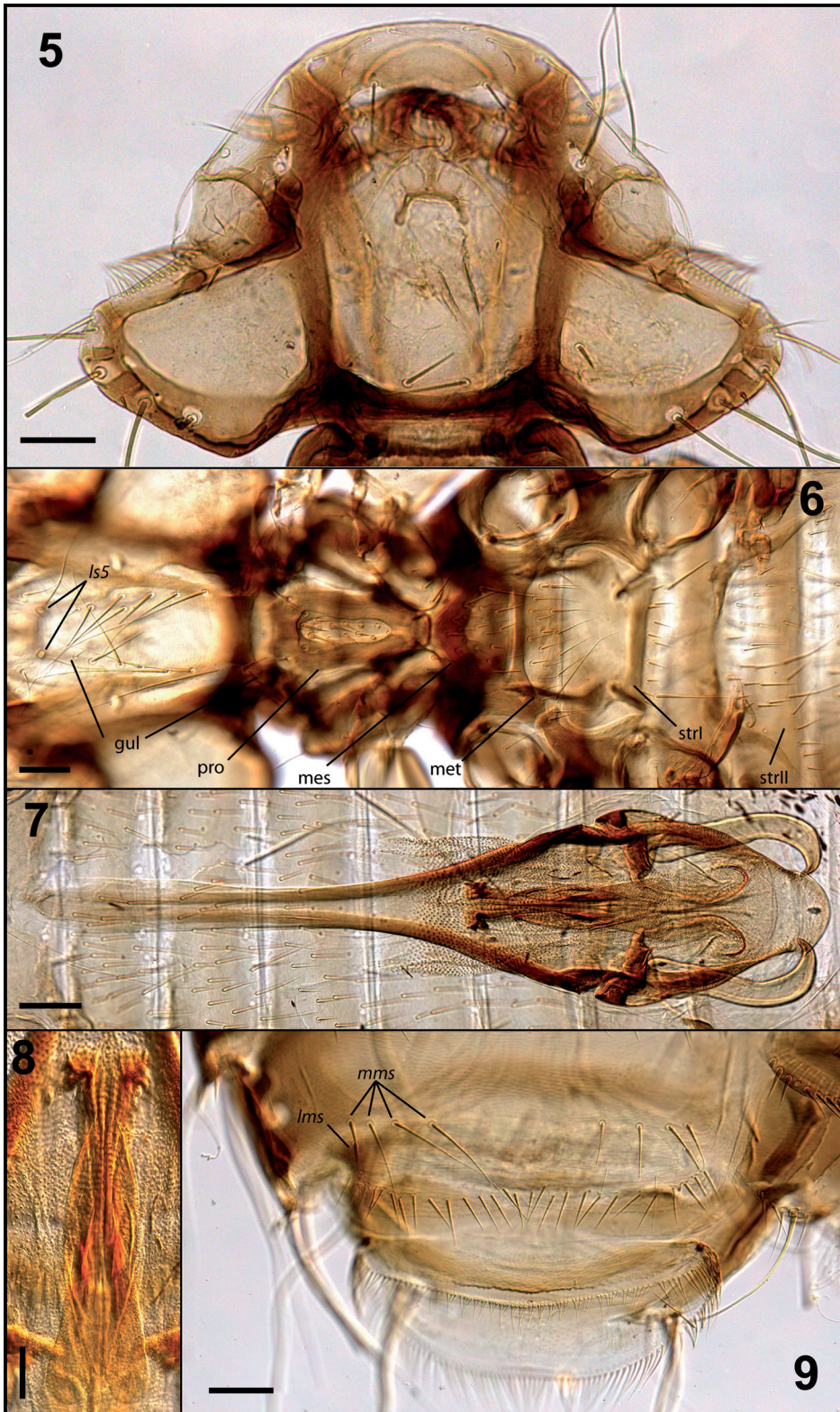
Dennyus (D.) pichorimi is easily distinguished from the species with known males (*D. (D.) rotundocapitis* and *D. (D.) semicollaris*) by the shape of its parameres (Fig. 7). The slender parameres of *D. (D.) rotundocapitis* are quite distinct from the robust parameres of *D. (D.) pichorimi* (Figs. 1, 2, 7). In the other known species with robust parameres (*D. (D.) semicollaris*), these are not curved as in the new species (Fig. 7). Also the sternal plate II of *D. (D.) pichorimi* is medially divided (Fig. 6), as in *D. (D.) semicollaris* and *D. (D.) rotundocapitis*. The genital sclerite of *D. (D.) pichorimi* is also distinctive and unique (Fig. 8).

The female of *D. (D.) pichorimi* has a sclerotized median sternal plate on segments I and II (Fig. 6), but these plates are indistinct in females of *D. (D.) spininotus* and *D. (D.) brunneitorques*. The head shape of the new species is similar to that of *D. (D.) spininotus*, both with truncated and angulated temporal regions (Fig. 5), while those of *D. (D.) brunneitorques* are distinctly rounded. However, *D. (D.) spininotus* has short spine-like setae on the posterior margin of abdominal tergites, while those setae in *D. (D.) pichorimi* are slightly thick but normal in shape. Also, *D. (D.) spininotus* has more metanotal setae (28 vs. 16 in *D. (D.) pichorimi*) and tergal setae on the first three abdominal segments (30 on I; 36 on II; 38 on III vs. 24, 24, 26, respectively in *D. (D.) pichorimi*). Furthermore, *D. (D.) pichorimi* is one of the largest within *Dennyus (Dennyus)*, with over 3 mm in TL.

Both sexes of *D. (D.) pichorimi* can be promptly distinguished from the new species described below by the number of outer dorsal (10 vs. 3 and 7, in *D. (D.) pascoliae* and *D. (D.) malagonensis*, respectively) and ventral (5 vs. 4 in *D. (D.) pascoliae*) setae on first tibia.



FIGURES 1-4: *Dennyus (D.) pichorimi* sp. nov.: male holotype in dorsal (1) and ventral (2) views; female paratype in dorsal (3) and ventral (4) views. Scale bars = 0.2 mm



FIGURES 5-9: *Dennyus (D.) pichorimi* sp. nov.: female head, in dorsal view (5); female gular, thoracic sternites and abdominal sternites I and II (6); male genitalia (7); detail of the male genital sclerite (8); female subgenital, vulvar and ventral anal setae (9). lms = lateral marginal setae; mms = median marginal setae (both on the subgenital plate); gul = gular plate; pro = prosternal plate; mes = mesosternal plate; met = metasternal plate; strI = sternite I; strII = sternite II. Scale bars = 0.1 mm (Figs. 5-7, 9); = 0.05 mm (Fig. 8).

Description

Male: Habitus dorsal and ventral as in Figs. 1-2, respectively. Head approximately two times wider than long, cephalic index 0.58 (length/width). Preantennal margin smoothly rounded, temporal and occipital margins distinctly angulated (as in Fig. 5). Dorsal head seta 5 (*dhs5*) short and slender; *dhs14*, *dhs28*, and one unnamed setae between the *dhs29* and *dhs31* short and spiniform. Labial setae 5 (*ls5*) 0.28 long (as in Fig. 6). Gular plate with 9+7 setae.

First tibia with 5 outer lateral ventral and 10 dorsal setae. Prosternal plate with 15 short setae, plus an anterior pair of long setae; mesosternal plate with 23 setae; metasternal plate with 31 setae. Femoral brush III with 59-60 setae. Metapleura with 3-4 long setae on each side; metathorax with 15 setae on posterior margin; median anterior metanotal setae transversely aligned with respect to anterior lateral setae.

Tergal setae, posterior row: I, 19; II, 22; III, 22; IV, 25; V, 28; VI, 24; VII, 24; VIII, 19. Setae on tergites II-VII becoming progressively longer towards the posterior segments, with two or three shorter setae between the longer ones, which reach across the following segment (3+3 on each segment, most of them missing in type series). Relative lengths of median long setae on tergite IV, about 3-6 longer than others of the same segment (0.06-0.10 long); length of longest median setae 0.28-0.36. Sternite I with a pair of long setae (one on each latero-posterior side) and 13 short anterior setae. Sternal plate II medially divided (as in Fig. 6). Sternal setae, posterior row: II, 15; III, 18; IV, 21; V, 12; VI, 11; VII, 6. Anterior sternal rows: II, 35; III, 41; IV, 39; V, 26; VI, 25; VII, 8. Sternites I-VII with two irregular anterior rows of setae; sternites V-VII with a large brush of setae on their lateral margins, less distinct in the posterior segments. Sternal brush setae (left and right, respectively): V, 35+35; VI, 47+43; VII, 26+24 (Fig. 2). Anterior and posterior setae in brush on sternite VI similar to each other. Sternite VIII with a single row of 10 medium long setae. Lateral plates wide and heavily sclerotized, with 8-11 setae on the posterior margin of segments III-VII (4-5 outermost setae thin and long, nearly of the same length of respective postspiracular setae); dorsal portion of pleurites II-VIII with characteristic incassations (Fig. 1).

Genitalia as in Fig. 7, with robust parameres inwardly curved and genital sclerite with toothed apex (Fig. 8).

Measurements (n = 1): TW, 0.93; PoW, 0.62; HL, 0.54; PW, 0.53; PrL, 0.29; PrW, 0.21; MW, 0.94;

FeII, 0.50; FeIII, 0.65; AL, 1.76; AW, 1.28; GL, 1.29; PaL, 0.38; GSL, 0.34; TL, 3.03.

Female: Habitus dorsal and ventral as in Figs. 3-4, respectively. Similar to the male, except in dimensions and morphology of terminalia. Head as in the male, cephalic index 0.58. Labial setae 5 (*ls5*) 0.36 long (Fig. 6). Gular plate with 8+9 setae.

First tibia with 5 and 10 outer lateral ventral and dorsal setae, respectively. Prosternal plate with 13 short spine-like setae, plus an anterior pair of long setae; mesosternal plate with 20 setae; metasternal plate with 24 setae (Fig. 6). Femoral brush III with 54-55 setae. Metapleura with 2-3 long setae on each side; metathorax with 16 setae on its posterior margin.

Tergal setae with only a posterior row: I, 24; II, 24; III, 26; IV, 24; V, 23; VI, 24; VII, 20; VIII, 17. Sternite I with a pair of long setae, one on each latero-posterior side, and 10 short anterior setae (Fig. 6). Sternal plate II medially divided (Fig. 6). Sternal setae, posterior row: II, 16; III, 18; IV, 19; V, 13; VI, 11; VII, 4. Anterior sternal rows: II, 24; III, 32; IV, 41; V, 24; VI, 28; VII, 15. Sternal brush setae: V, 41+38; VI, 44+42; VII, 22+20 (Fig. 4). Subgenital plate without medio-anterior setae; with short (0.10-0.12) lateral marginal setae (*lms*, Fig. 9) on subgenital plate; roughly similar in size and shape to the median marginal setae (0.12-0.20 long) (*mms*, Fig. 9), with 4 on each postero-lateral side. Ventral anal fringe with 85 and dorsal anal fringe with 89 setae; without any setae anterior to anal fringe. A regular row of 28 setae on vulvar margin (Fig. 9).

Measurements (n = 1): TW, 0.95; PoW, 0.63; HL, 0.55; PW, 0.54; PrL, 0.31; PrW, 0.21; MW, 0.98; FeII, 0.52; FeIII, 0.65-0.67; AL, 1.93; AW, 1.35; AnW, 0.52; TL, 3.29.

Remarks

Price *et al.* (2003: 284) did not list chewing lice from either subspecies of *Streptoprocne biscutata*. The nominal subspecies occurs from SE Brazil to Paraguay and NE Argentina, while *S. b. seridoensis* – the type host of the new louse species described here – occurs in NE Brazil only. There are highly supported morphological differences among species of *Dennyus* from different host subspecies (e.g., *Aerodramus brevis* (Horsfield), *Collocalia linchi* Horsfield & Moore) (Clayton *et al.*, 1996). Therefore, assuming the high host-specificity between *Dennyus* species and their hosts (see Tompkins & Clayton, 1999).

D. (D.) pichorimi could be an endemic Brazilian species. Studies of louse samples from the nominal subspecies of *Streptoprocne biscutata* are necessary to confirm or otherwise falsify such endemism.

***Dennyus (Dennyus) pascoliae* sp. nov.**

(Figs. 10-13, 18, 19, 21, 23, 25)

Type host: *Streptoprocne zonaris zonaris* (Shaw, 1796) – White-collared Swift (Apodiformes: Apodidae)

Holotype: Male (MZUSP #2701), ex *Streptoprocne zonaris zonaris*, BRAZIL: Minas Gerais, Uberlândia, Cachoeira do Malagone, Rio Uberabinha [18°40'46"S; 48°30'03"W, 600 m], .XI.2008, G.V.T. Pascoli coll.

Paratypes: 1 Male and 2 Females (MZUSP #2702-2703), same data as holotype.

Additional specimens not-regarded as types: 3 Males (MZUSP #2705-2707), ex *Cypseloides senex* (Temminck, 1826), BRAZIL: Minas Gerais, Uberlândia, Cachoeira do Malagone, Rio Uberabinha [18°40'46"S; 48°30'03"W, 600 m], .XI.2008, G.V.T. Pascoli coll. 1 Female (MZUSP #2708), *Cypseloides senex* (same individual for *D. (D.) malagonensis* described below), BRAZIL: Minas Gerais, Uberlândia, Cachoeira do Malagone, Rio Uberabinha [18°40'46"S; 48°30'03"W, 600 m], .XI.2008, G.V.T. Pascoli coll.

Etymology: The species epithet is a noun in the genitive case dedicated to the Brazilian veterinarian Graziela V.T. Pascoli, in honor of her studies and collection of Swift ectoparasites in Brazil.

Diagnosis: The new species belongs to the same group as described above for *D. (D.) pichorimi*. However, *D. (D.) pascoliae* is also morphologically close to *D. (D.) brunneitorques* based on head shape and chaetotaxy of the prosternal plate. Both species have three spine-like and two long setae along the anterior border of the prosternal plate (Fig. 19) and *D. (D.) pascoliae* has a pair of distinct sternal plates on abdominal segments I-II (Fig. 23) (absent in *D. (D.) brunneitorques*), and larger body measurements (TL: 3.27 vs. 2.30 in *D. (D.) brunneitorques*). The male genital sclerite of *D. (D.) pascoliae* (Fig. 21) is quite distinctive among Neotropical species of the subgenus (*Dennyus*) with known males (see Carriker 1954).

Both sexes of *D. (D.) pascoliae* can be promptly distinguished from *D. (D.) malagonensis* by the number

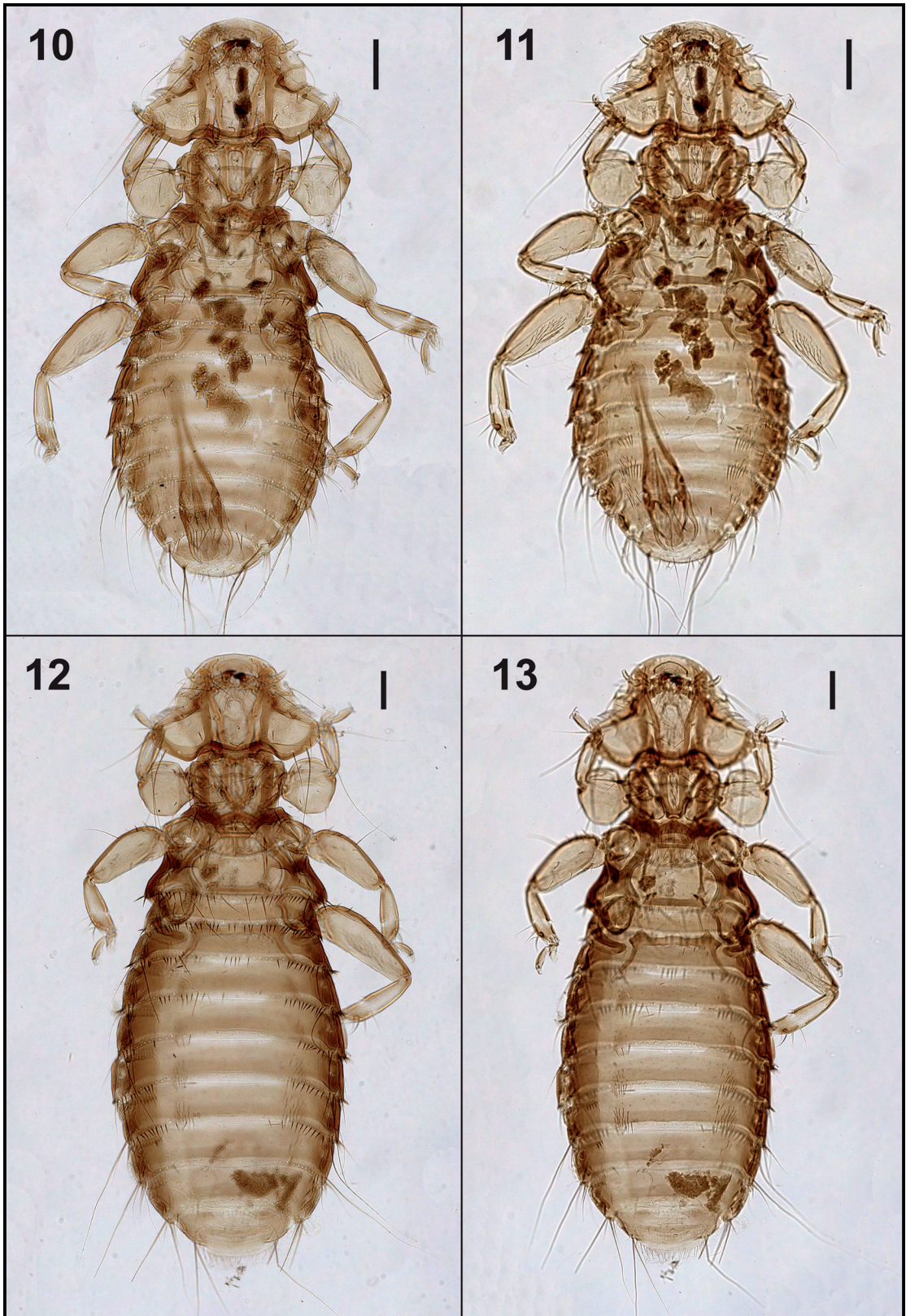
of outer dorsal (3 vs. 7 and 10, in *D. (D.) malagonensis* and *D. (D.) pichorimi*, respectively) and ventral (4 vs. 5 in *D. (D.) pichorimi* and *D. (D.) malagonensis*) setae on first tibia.

Description

Male (additional specimens in parenthesis): Habitus dorsal and ventral as in Figs. 10-11, respectively. Head wider than long, cephalic index 0.62 (much as in Fig. 18). Preantennal margin smoothly rounded, temporal and occipital margins slightly angulated (as in Fig. 10). Dorsal head seta 5 (*dhs5*) short and slender; *dhs14*, *dhs28*, and one unnamed short and spiniform seta between *dhs29* and *dhs31*. Labial setae 5 (*ls5*) 0.10 long. Gular plate with 7+6 setae (6+7; 7+7), the two most posterior setae set outside the gular band, other setae inside the gular plate; the most anterior setae always very short.

First tibia with 4 and 3 outer lateral ventral and dorsal setae, respectively. Prosternal plate with 10 (11-12) short setae within clear area of the plate and 3 anterior set on the marginal band, plus a anterolateral pair of long setae (Fig. 19); mesosternal (21) and metasternal (25-27) plates with 20 setae each. Femoral brush III with 32-34 (37-40) setae. Metapleura with 3 setae on each side, the innermost 4x longer than the outer ones; metathorax with 16-19 (19-20) setae on posterior margin, of which 3+3 long; median anterior metanotal setae transversely aligned with respect to anterior lateral setae.

Tergal setae (most missing in the holotype), posterior row: I, 25-28 (27-29); II, 26 (25-28); III, 26-30 (24-25); IV, 27-30 (24-30); V, 27-29 (23-33); VI, 29-30 (25-30); VII, 25-26 (21-25); VIII, 20-21 (16-19). Sternite I with a pair of long setae (one on each latero-posterior side) and 9 short anterior setae. Sternal plate II entire (as in Fig. 23). Sternal setae, posterior row: II, 12-14 (11-13); III, 15-18 (16-19); IV, 15-16 (14-16); V, 10-11 (7-10); VI, 9-9 (9-11); VII, 4 (4). Anterior sternal rows: II, 12-14 (13-22); III, 16-18 (21-27); IV, 13-14 (21-22); V, 12 (14-14); VI, 11 (13-14); VII, 2-6 (2-4). Sternites I-VII with two irregular anterior rows of setae; sternites V-VII with a small brush of setae on their lateral margins, less distinct in VII. Sternal brush setae (left and right, respectively): V, 16+17 / 17+17 (26+21; 18+16); VI, 19+19 / 21+18 (24+25; 21+21); VII, 11+11 / 9+8 (11+12; 9+8) (Fig. 11). Anterior and posterior setae in brush on sternite VI similar to each other. Sternite VIII with a single row of 5-8 (5-6) short setae. Lateral plates wide and heavily sclerotized, with 8-11 setae on



FIGURES 10-13: *Dennyus (D.) pascoliae* sp. nov.: male holotype in dorsal (10) and ventral (11) views; female paratype in dorsal (12) and ventral (13) views. Scale bars = 0.2 mm

the posterior margin of segments III-VII (1-2 outermost setae thin and long); dorsal portion of pleurites II-VIII with characteristic incassations (Fig. 10).

Genitalia as in Fig. 25, with broad parameres lightly curved inward and genital sclerite with distinctive shape (Fig. 21).

Measurements (n = 2): TW, 0.78-0.79; PoW, 0.56-0.57; HL, 0.49; PW, 0.48-0.49; PrL, 0.26; PrW, 0.18; MW, 0.81-0.83; FeIII, 0.36-0.39; FeIIIL, 0.47-0.49; AL, 1.19-1.21; AW, 0.88-0.95; GL, 0.81-0.86; PaL, 0.27-0.28; GSL, 0.29-0.31; TL, 2.33-2.37.

Measurements for additional specimens (n = 3), ex *Cypseloides senex*: TW, 0.79-0.81; PoW, 0.56-0.58; HL, 0.49; PW, 0.46-0.47; PrL, 0.24-0.27; PrW, 0.18-0.19; MW, 0.78-0.82; FeIII, 0.38-0.39; FeIIIL, 0.49-0.51; AL, 1.19-1.25; AW, 0.91; GL, 0.81-0.84; PaL, 0.29-0.34; GSL, 0.29-0.30; TL, 2.28-2.38.

Female (additional specimens in parenthesis): Habitus dorsal and ventral as in Figs. 12-13, respectively. Similar to male, except in dimensions and morphology of terminalia. Head as in Fig. 18, cephalic index 0.59. Labial setae 5 (*ls*5) 0.09 long. Gular plate with 6+7 (6+7) setae.

First tibia with 4 and 3 outer lateral ventral and dorsal setae, respectively. Prosternal plate with 8-12 (10) short setae within clear area of plate and 3 anterior set on marginal band, plus an antero-lateral pair of long setae (Fig. 19); mesosternal plate with 19 (22) setae; metasternal plate with 23 (38) setae. Femoral brush III with 42 (46) setae. Metapleura with 3 setae on each side, as in males; metathorax with 25 (21) setae on its posterior margin, 3+3 longer than others.

Tergal setae with only a posterior row: I, 34-36 (35); II, 34 (33); III, 34-36 (35); IV, 35-36 (36); V, 34 (32); VI, 31-33 (32); VII, 26-27 (28); VIII, 18-20 (18). Sternite I with a pair of long setae, one on each latero-posterior side, and 10 short anterior setae. Sternal plate II entire (Fig. 23). Sternal setae, posterior row: II, 14-16 (18); III, 19-20 (21); IV, 18-21 (24); V, 13-14 (15); VI, 10-11 (11); VII, 4 (4). Anterior sternal rows: II, 23 (26); III, 26-31 (34); IV, 32-40 (42); V, 18-24 (25); VI, 12-21 (21); VII, 2-5 (5). Sternal brush setae: V, 28+28 / 27+28 (26+33); VI, 28+31 / 30+32 (34+35); VII, 0+8 / 10+10 (13+11) (Fig. 13). Subgenital plate without medio-anterior setae; with long (0.19) lateral marginal setae (*lms*, as much for Fig. 9) on subgenital plate; median marginal setae (*mm*s) all missing in both paratypes, with 3 on each postero-lateral side. In additional female *mm*s 0.15-0.17 long. Ventral and dorsal anal fringe with

48-50 setae each; without any setae anterior to anal fringe. A regular row of 21-23 setae on vulvar margin.

Measurements (n = 2): TW, 0.89-0.91; PoW, 0.62-0.64; HL, 0.53; PW, 0.53-0.56; PrL, 0.28-0.30; PrW, 0.20-0.21; MW, 0.94-1.00; FeIII, 0.46-0.47; FeIIIL, 0.58-0.61; AL, 1.84-1.97; AW, 1.18-1.23; AnW, 0.42-0.43; TL, 3.15-3.27.

Measurements of additional female (n = 1), ex *Cypseloides senex*: TW, 0.86; PoW, 0.61; HL, 0.51; PW, 0.51; PrL, 0.27; PrW, 0.20; MW, 0.92; FeIII, 0.42-0.47; FeIIIL, 0.55-0.56; AL, 1.68; AW, 1.11; AnW, 0.40; TL, 2.91.

Remarks

Although only few louse specimens have been collected from two host species at the same place, it is reasonable to accept *Cypseloides senex* as a natural host for *D. (D.) pascoliae*, because the two samples (1 female/3 males) were made independently from two distinct localities.

Dennyus (Dennyus) malagonensis sp. nov. (Figs. 14-17, 20, 22, 24, 26)

Type host: *Cypseloides senex* (Temminck, 1826) – Great Dusky Swift (Apodiformes: Apodidae)

Holotype: Male (MZUSP #2711), ex *Cypseloides senex*, BRAZIL: Minas Gerais, Uberlândia, Cachoeira do Malagone, Rio Uberabinha [18°40'46"S; 48°30'03"W, 600 m], .XI.2008, G.V.T. Pascoli coll.

Paratype: 1 Female (MZUSP #2712), same data as the holotype.

Etymology: The species name is derived from the name of its type locality, the Malagone waterfall in the Uberabinha River. It is an adjective in the nominative case.

Diagnosis: The new species belongs to the same group as described above for *D. (D.) pichorimi*. However, *D. (D.) malagonensis* is morphologically close to *D. (D.) rotundocapitis* based on the shape of sternite II and male genitalia. These species have sternite II medially divided (Fig. 24), and males have slender and slightly sinuous parameres (Fig. 26). However, *D. (D.) malagonensis* has more angulated head temples (much as in Fig. 18) (rounded in

D. (D.) rotundocapitis), and a pair of long setae on the antero-lateral margin of the prosternal plate (Fig. 20) (absent in *D. (D.) rotundocapitis*). The male genital sclerite of *D. (D.) malagonensis* (Fig. 22) is quite distinctive among Neotropical species of the subgenus (*Dennyus*) with known males (see Carriker 1954).

Both sexes of *D. (D.) malagonensis* can be promptly distinguished from the new species described above by the number of outer dorsal (7 vs. 3 and 10, in *D. (D.) pascoliae* and *D. (D.) pichorimi*, respectively) and ventral (5 vs. 4 in *D. (D.) pascoliae*) setae on first tibia.

Description

Male: Habitus dorsal and ventral as in Figs. 14-15, respectively. Head wider than long, cephalic index 0.63. Preantennal margin smoothly rounded, temporal and occipital margins slightly angulated (much as in Fig. 18). Dorsal head seta 5 (*dhs5*) short and slender; *dhs14*, *dhs28*, and one unnamed seta between the *dhs29* and *dhs31* short and spiniform. Labial setae 5 (*ls5*) 0.11 long. Gular plate with 8+7 setae.

First tibia with 5 and 7 outer lateral ventral and dorsal setae, respectively. Prosternal plate with 11 short setae within clear area of the plate and 1 anterior set on the marginal band, plus an anterior pair of long setae (Fig. 20); mesosternal plate with 17 setae; metasternal plate with 23 setae. Femoral brush III with 53 setae. Metapleura with 3 setae on each side, the innermost 4x longer than outer ones; metathorax with 12 setae on posterior margin; median anterior metanotal setae transversely aligned with respect to anterior lateral setae.

Tergal setae (most missing in holotype), posterior row: I, 17; II, 18; III, 23; IV, 19; V, 22; VI, 12 (abnormal specimen lacking setae on its right side); VII, 17; VIII, 10. Sternite I with a pair of long setae (one on each latero-posterior side) and 8 short anterior setae. Sternal plate II medially divided (as in Fig. 24). Sternal setae, posterior row: II, 13; III, 16; IV, 18; V, 9; VI, 9; VII, 4. Anterior sternal rows: II, 13; III, 18; IV, 19; V, 8; VI, 9; VII, 2. Sternites I-VII with two irregular anterior rows of setae; sternites V-VII with a small brush of setae on their lateral margins, less distinct in posterior segments. Sternal brush setae (left and right, respectively): V, 30+33; VI, 33+35; VII, 12+10 (Fig. 15). Anterior and posterior setae in brush on sternite VI similar to each other. Sternite VIII with a single row of 6 medium long setae. Lateral plates wide and heavily sclerotized, with 8-10 setae on posterior margin of segments III-VII (1-2 outermost

setae thin and long); dorsal portion of pleurites II-VIII with characteristic incassations (Fig. 14).

Genitalia as in Fig. 26, with slender parameres inwardly curved and genital sclerite with distinctive shape (Fig. 22).

Measurements (n = 1): TW, 0.70; PoW, 0.52; HL, 0.44; PW, 0.42; PrL, 0.22; PrW, 0.17; MW, 0.64; FeIIL, 0.33; FeIIIL, 0.40-42; AL, 1.17; AW, 0.78; GL, 0.76; PaL, 0.24; GSL, 0.22; TL, 2.14.

Female: Habitus dorsal and ventral as in Figs. 16-17, respectively. Similar to the male, except in dimensions and morphology of terminalia. Head as in male, cephalic index 0.62. Labial setae 5 (*ls5*) 0.13 long. Gular plate with 6+7 setae.

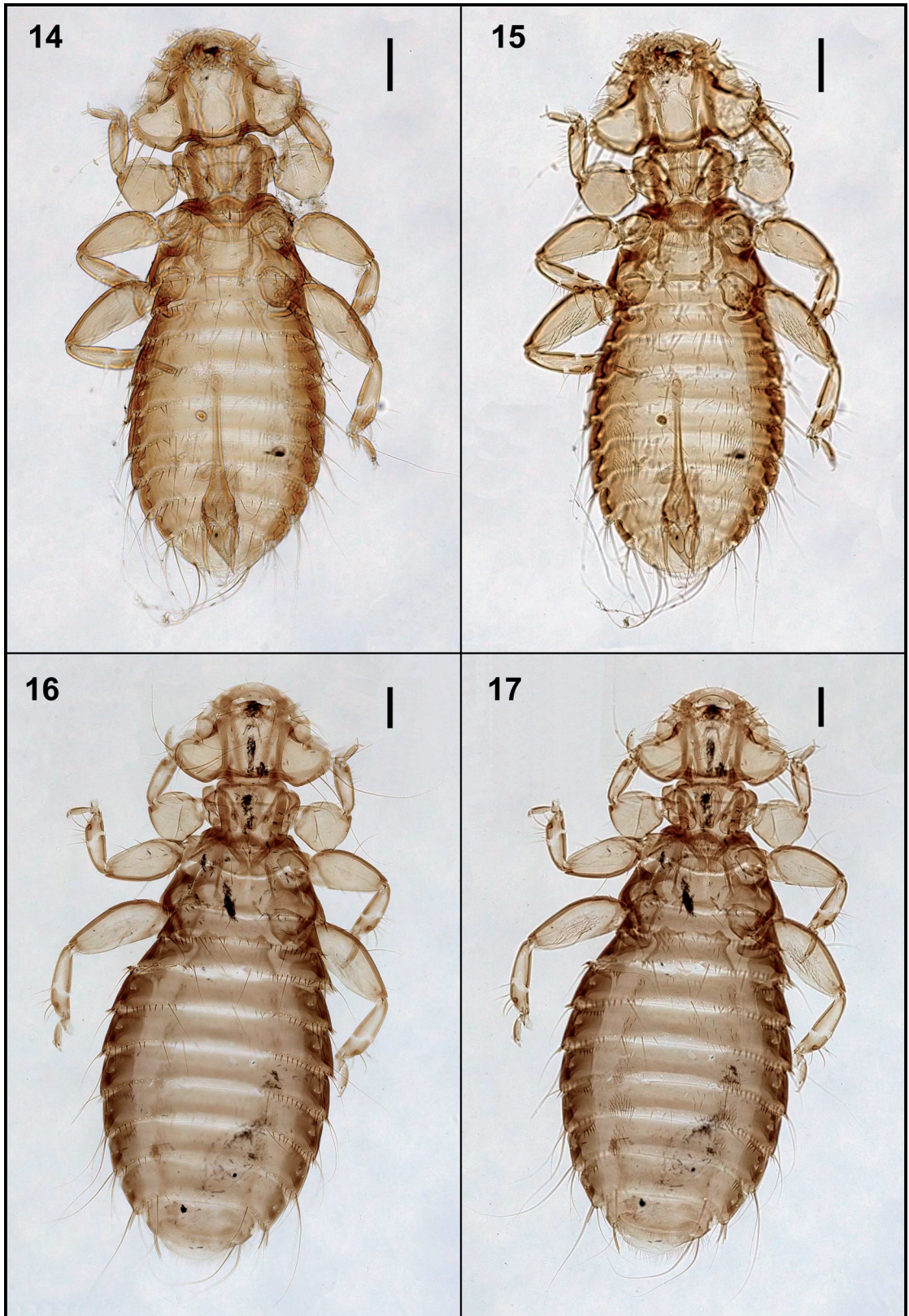
First tibia with 5 and 7 outer lateral ventral and dorsal setae, respectively. Prosternal plate with 11 short setae within clear area of plate and 1 anterior set on marginal band, plus an antero-lateral pair of long setae; mesosternal plate with 17 setae; metasternal plate with 21 setae. Femoral brush III with 61 setae. Metapleura with 3 setae on each side, as in males; metathorax with 17 setae on its posterior margin.

Tergal setae with only a posterior row: I, 28; II, 28; III, 31; IV, 32; V, 35; VI, 33; VII, 23; VIII, 15. Sternite I with a pair of long setae, one on each latero-posterior side, and 11 short anterior setae. Sternal plate II medially divided. Sternal setae, posterior row: II, 14; III, 20; IV, 21; V, 10; VI, 10; VII, 5. Anterior sternal rows: II, 18; III, 31; IV, 36; V, 17; VI, 21; VII, 7. Sternal brush setae: V, 45+42; VI, 46+41; VII, 16+18 (Fig. 17). Subgenital plate without medio-anterior setae; with lateral marginal setae (*lms*) and median marginal setae (*mms*) all missing in paratype on subgenital plate; with 3 and 2 on each postero-lateral side. Ventral and dorsal anal fringe with 68 and 61 setae each, respectively; without any setae anterior to anal fringe. A regular row of 24 setae on vulvar setae margin.

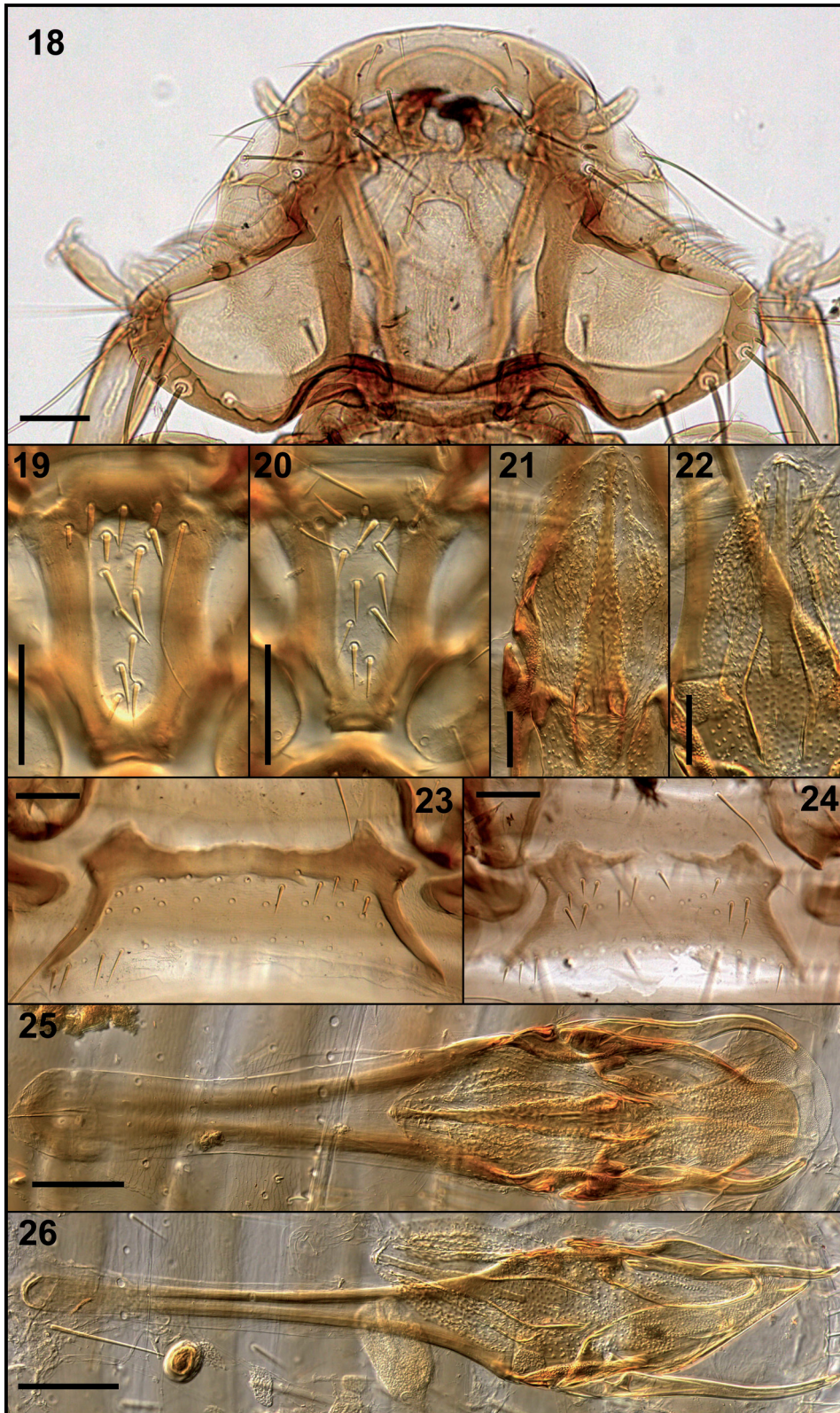
Measurements (n = 1): TW, 0.78; PoW, 0.56; HL, 0.48; PW, 0.48; PrL, 0.24; PrW, 0.18; MW, 0.83; FeIIL, 0.39-0.42; FeIIIL, 0.52; AL, 1.71; AW, 1.14; AnW, 0.42; TL, 2.87.

Remarks

Although the single pair comprising the type series for *D. (D.) malagonensis* was collected from the same host individual as one female of *D. (D.) pascoliae*, the two females can be separated by these



FIGURES 14-17: *Dennyus (D.) malagonensis* sp. nov.: male holotype in dorsal (14) and ventral (15) views; female paratype in dorsal (16) and ventral (17) views. Scale bars = 0.2 mm



FIGURES 18-26: *Dennyus (D.) pascoliae* sp. nov.: female head, in dorsal view (18); prosternal plate (19); male genital sclerite (21); sternal plate II (23); male genitalia (25). *Dennyus (D.) malagonensis* sp. nov.: prosternal plate (20); male genital sclerite (22); sternal plate II (24); male genitalia (26). Scale bars = 0.1 mm (Figs. 18-20, 23-26); = 0.05 mm (Figs. 21, 22).

TABLE 1: Hosts and geographical distribution of *Dennyus* (*Dennyus*) species that are parasitic on hosts occurring in Brazil.

Brazilian species of Apodidae*	Named species of <i>Dennyus</i>	Distribution	References
<i>Cypseloides cryptus</i> Zimmer, 1945	—	—	—
<i>C. fumigatus</i> (Streubel, 1848)	<i>D. (D.) spininotus</i> Carriker, 1954 ‡	Colombia	Carriker (1954)
<i>C. senex</i> (Temminck, 1826)	<i>D. (D.) malagonensis</i> sp. nov. †	Brazil	present study
	<i>D. (D.) pascoliae</i> sp. nov.	Brazil	present study
<i>Streptoprocne phelpsi</i> (Collins, 1972)	—	—	—
<i>S. zonaris zonaris</i> (Shaw, 1796)	<i>D. (D.) pascoliae</i> sp. nov. †	Brazil	present study
<i>S. biscutata biscutata</i> (Sclater, 1866)	—	—	—
<i>S. b. seridoensis</i> Sick, 1991	<i>D. (D.) pichorimi</i> sp. nov. †	Brazil	present study
<i>Chaetura spinicaudus</i> (Temminck, 1839)	—	—	—
<i>C. cinereiventris</i> Sclater, 1862	—	—	—
<i>C. egregia</i> Todd, 1916	—	—	—
<i>C. chapmani</i> Hellmayr, 1907	—	—	—
<i>C. viridipennis</i> Cherrie, 1916	<i>D. (D.) intonsus</i> Carriker, 1954 ‡	Colombia	Carriker (1954)
<i>C. meridionalis</i> Hellmayr, 1907	—	—	—
<i>C. brachyura brachyura</i> (Jardine, 1846)	<i>D. (D.) brevicapitis</i> Carriker, 1954 ‡	Trinidad and Tobago	Carriker (1954)
<i>Aeronautes montivagus</i> (d'Orbigny & Lafresnaye, 1837)	—	—	—
<i>Tachornis squamata</i> (Cassin, 1853)	—	—	—
<i>Panyptila cayennensis</i> (Gmelin, 1789)	—	—	—

* host species based on primary list of CBRO (2011), subspecies based on Dickinson (2003)

‡ based on holotype specimen only

† based on pair of type specimens

features: (1) *D. (D.) malagonensis* has only one spine-like seta on the anterior margin of the prosternal plate (Fig. 20), while *D. (D.) pascoliae* has three of these setae (Fig. 19); (2) *D. (D.) malagonensis* has 5 outer ventral and 7 dorsal setae on first tibia, *D. (D.) pascoliae* has 4 and 3, respectively; (3) the shape of the sternal plate I in *D. (D.) malagonensis* is narrower than in *D. (D.) pascoliae*; (4) sternal plate II in *D. (D.) malagonensis* medially divided (Fig. 24), but distinctly entire in *D. (D.) pascoliae* (Fig. 23); and (5) the female of *D. (D.) pascoliae* collected with specimens of *D. (D.) malagonensis* is morphological identical to the female paratypes of that species.

DISCUSSION

These are the first published records of *Dennyus* species from Brazil. The Brazilian avifauna includes 11 species/subspecies of swifts for which chewing lice have not been recorded. Based on current louse taxonomic literature, and the species/subspecies of Apodidae recorded from Brazil, I expect that there are at least three named *Dennyus* species from the nominal subgenus waiting to be recorded in this country (see Table 1; see Price *et al.* 2003). Furthermore, the Brazilian avifauna includes an additional 11 species/subspecies of swifts that have not yet been recorded in association with chewing lice, nor have they been sought out.

Although characterized as host specific (*e.g.*, Tompkins & Clayton, 1999), *Dennyus*, from some closely related host species share the same species of chewing lice (Price *et al.*, 2003). Thus, among the 48 species of Apodidae recorded as hosts of a *Dennyus* species, eight have two species of *Dennyus* recorded from them (*e.g.*, *Cypseloides senex* in Table 1), three have three species, and two have four, while the remainder have single species each (Price *et al.*, 2003; Clayton *et al.*, 2006). The finding of two species on the same host individual is not surprising, considering that two host species were nesting in the same location, and that the Brazilian louse fauna is practically unexplored. Therefore, it is important to emphasize the need for collecting as many samples of ectoparasites as possible from a large number of swifts representing each host colony, rather than casual visual examination of only some individual hosts. Collection methods could be improved by using an appropriate quantitative technique, such as discussed elsewhere in the literature (*e.g.*, Walther & Clayton, 1997; Clayton & Drown, 2001; Arzua & Valim, 2010). Considering the lack of information on the Brazilian swift and swift louse fauna, it is reasonable to expect that more *Dennyus* species will be recorded and described from swifts in Brazil. Although few specimens were secured for this study (Table 1), their quality and distinct male genitalia justify the description of all new species.

RESUMO

Descrições e ilustrações são apresentadas para três novas espécies de malófagos do gênero *Dennyus* de andorinhões brasileiros. Eles e os seus hospedeiro tipo são: *D. pichorimi* ex *Streptoprocne biscutata seridoensis* (Taperuçu-de-coleira-falha) do Estado do Rio Grande do Norte, *D. pascoliae* ex *Streptoprocne zonaris zonaris* (Taperuçu-de-coleira-branca) do estado de Minas Gerais, *D. malagonensis* ex *Cypseloides senex* (Taperuçu-velho), também de Minas Gerais. Esses piolhos representam as primeiras espécies de *Dennyus* registrados no Brasil. Uma chave para a identificação dos sub-gêneros de *Dennyus*, e uma tabela com a listagem das espécies *Dennyus* registradas em outros países a partir de hospedeiros que ocorrem no Brasil são também apresentadas.

PALAVRAS-CHAVE: *Dennyus*; malófago; *Streptoprocne*; *Cypseloides*; andorinhão; Menoponidae; Apodidae; nova espécie; taxonomia; Brasil

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