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Article

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Chewing lice (Insecta: Phthiraptera) from estrildid finches (Aves: Passeriformes: Estrildidae) and louse-flies (Insecta: Diptera: Hippoboscidae) from birds in Senegal, with descriptions of three new species of the genus *Brueelia*

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Abstract

Descriptions and illustrations are given for three new species of the genus *Brueelia* Kéler from estrildid finches (Estrildidae) from Senegal. They and their type hosts are: *B. fasciata* from *Amadina fasciata*, *B. senegala* from *Lagonosticta senegala* and *B. cantans* from *Euodice cantans*. Records of three other louse species of the genus *Myrsidea* Waterston from estrildid finches and records of louse-flies (Hippoboscidae) from birds in Senegal are also given.

Key words: *Brueelia*, Chewing lice, Estrildidae, Hippoboscidae, louse-flies, *Myrsidea*, Passeriformes, Phthiraptera, Senegal

Introduction

The family Estrildidae comprising waxbills, munias and allies represents a relatively large family of passerine birds. About 141 species of these gregarious and often colonial seed-eaters are distributed in the Old World tropics and Australasia, of which 23 occur in Senegal (Fry & Keith 2004, Lepage 2009, according to taxonomy in Clements 2007). Data concerning records of chewing lice from Senegalese Estrildidae are scarce. To date, only four described species of chewing lice are likely to occur in Senegal, and they have been reported from five host species (Clay 1970, Price 1975, Tendeiro & Mendes 1994). However, there are no published records of those estrildid louse species from Senegal. The aim of this paper is to present data on species of chewing lice found on estrildid finches in Senegal, including descriptions of three new species. We also include data on Hippoboscidae (louse-flies) found on birds examined by us in Senegal.

Material and methods

We collected chewing lice from estrildid hosts from 30 January to 28 February 2005 and from 7 to 18 September 2007 in five separate localities in Senegal: Lengué Kountou (13° 04′ N, 13° 01′ W), Simenti (13° 02′ N, 13° 18′ W) and Dar Salam (13° 15′ N13° 12′ W) in Niokolo Koba National Park, Matam (15° 37′ N, 13° 20′ W), and Kaolack (14° 09′ N, 16° 06′ W). Birds were mist-netted, identified, sexed and aged according to Fry & Keith (2004). Chewing lice and louse-flies were collected by use of a fumigation chamber method (Clayton & Drown 2001), complemented with visual search of the head. Birds were released back into the wild as quickly as possible to minimize disturbance. Lice as well as louse-flies were stored in 70% ethanol in the field. Lice were subsequently slide-mounted in laboratory in Canada balsam as permanent

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slides, following the technique of Palma (1978). Identifications of the lice were based on Ansari (1958), Tendeiro & Mendes (1994), and Rékási & Saxena (2005), and on a comparative study of lice from the collections of the Museum für Naturkunde (Humboldt-Universität, Berlin, Germany) and the Essig Museum of Entomology (University of California, Berkeley, California, USA). Identifications of the louse-flies were based on Maa (1963) and Maa & Peterson (1987). Nomenclature of the lice follows Price *et al.* (2003) and taxonomy of the birds follows Clements (2007).

In the following louse descriptions, all measurements are in millimeters. Abbreviations for dimensions are PAW, preantennal width; PAL, preantennal length; TW, temple width; POL, postantennal length; HL, head length; PW, prothorax width; MW, metathorax width; AWV, abdomen width at level of segment V; TL, total length; GW, male genitalia width at level of base of parameres. The naming of the new species is attributed to the first author. The names of the new species were taken from those of the type hosts. The types of the new species described in this paper are deposited at the Moravian Museum Brno, Czech Republic and at the Natural History Museum in London, UK.

Results

Chewing lice. A total of 104 individuals of 6 species of estrildid finches were examined. Thirty-three of these birds (32%), among 5 species were parasitized by chewing lice, comprising 6 species (Table 1). Three of these lice represent new species of *Brueelia* and are described below. The other louse species belong to the genus *Myrsidea*; they may also represent new species but are not described here.

TABLE 1. List of hosts and their lice.

Bird species	P[a]	E[b]	Phthiraptera[c]	♂	♀	Nymphs	Location
Amadina fasciata (Gmelin)	10	12	*Brueelia fasciata* Sychra, **n. sp.**	7	7	56	Matam
Estrilda caerulescens (Vieillot)	0	1		-	-	-	Simenti
Euodice cantans (Gmelin)	3	4	*B. cantans* Sychra, **n. sp.**	6	12	16	Matam
Estrilda melpoda (Vieillot)	2	9	*Myrsidea* sp. 1	0	1	1	Lengué Kountou
Lagonosticta senegala (L.)	10	31	*B. senegala* Sychra, **n. sp.**	13	21	7	Lengué Kountou
	5	30	*B. senegala* Sychra, **n. sp.**	2	10	5	Simenti
	0	7		-	-	-	Matam
	1	31	*Myrsidea* sp. 2	1	0	0	Lengué Kountou
Uraeginthus bengalus (L.)	2	7	*Myrsidea* sp. 3	2	0	2	Lengué Kountou
	0	3		-	-	-	Kaolack, Dar Salam

[a] Number of birds parasitized; [b] Number of birds examined; [c] All host-parasites associations are new.

Louse-flies. A total of 551 individuals of 68 species of birds from 32 families and 10 orders (Ciconiformes, Falconiformes, Galliformes, Charadriiformes, Columbiformes, Cuculiformes, Coraciiformes, Psittaciformes, Piciformes and Passeriformes) were examined. Eight of these birds (1.5 %) among 6 species were parasitised by 2 species of louse-flies (Insecta: Diptera: Hippoboscidae): *Pseudolynchia canariensis* (Macquart in Webb & Berthelot) and *Ornithophila metallica* (Schiner). Infestations were not clearly correlated with the relationships of the six bird species (Table 2). No louse-fly was found on estrildid finches.

TABLE 2. List of hosts and their louse-flies.

Bird order, family, species	P[a]	E[b]	Louse-flies	♂	♀	Location
Cuculiformes: Cuculidae						
Centropus senegalensis (L.)	1	2	*Pseudolynchia canariensis* (Macquart in Webb and Berthelot)	2	1	Simenti
Coraciiformes: Alcedinidae						
Halcyon malimbica (Shaw)	1	4	*Pseudolynchia canariensis* (Macquart in Webb and Berthelot)	-	1	Lengué Kountou
Piciformes: Picidae						
Campethera punctuligera (Wagler)	1	4	*Ornithophila metallica* (Schiner)	-	1	Dar Salam
Passeriformes: Muscicapidae						
Melaenornis edolioides (Swainson)	1	1	*Ornithophila metallica* (Schiner)	1		Lengué Kountou
Passeriformes: Prionopidae						
Prionops plumatus (Shaw)	1	4	*Ornithophila metallica* (Schiner)	-	2	Dar Salam
Passeriformes: Turdidae						
Turdus pelios Bonaparte	1	1	*Pseudolynchia canariensis* (Macquart in Webb and Berthelot)	1		Simenti
	1	5	*Ornithophila metallica* (Schiner)	-	1	Dar Salam

[a]Number of birds parasitized; [b] Number of birds examined;

Taxonomy

Brueelia fasciata Sychra, new species

(Figs. 1, 3–4, 12–13)

Type host: *Amadina fasciata* (Gmelin): cut-throat finch.

Male (n = 5). Head triangular with straight-sided forehead (Fig. 12). Preantennal region longer than postantennal region. Lateral sides of preantennal region almost straight with marginal carina interrupted in midline. Clavi triangular, diaphanous, longer than the first antennal segment. Pronotum with 1 seta on each posterolateral corner; metanotum with 7 setae (3 long, 4 short) on each posterolateral margin. Metathorax with straight lateral sides (Fig. 3). All abdominal tergites divided centrally. Tergal setae on each side as follows: tergites II (first apparent tergite)–IV, 0; V, 3–5; VI–VII, 5–7; VIII, 4–5; IX 5–6 (Fig. 1), terminally with 6 setae. Abdominal sterna with a pair of setae. Male genitalia as in Fig. 4. Endomeral complex contains a pair of broad sacs of rectangular shape, with smooth posterior margin.

Dimensions: PAW, 0.21–0.22; PAL, 0.17–0.18; TW, 0.26–0.28; POL, 0.15–0.18; HL, 0.33–0.36; PW, 0.18–0.19; MW, 0.30–0.33; AWV, 0.43–0.44; TL, 1.29–1.35; GW, 0.075–0.085.

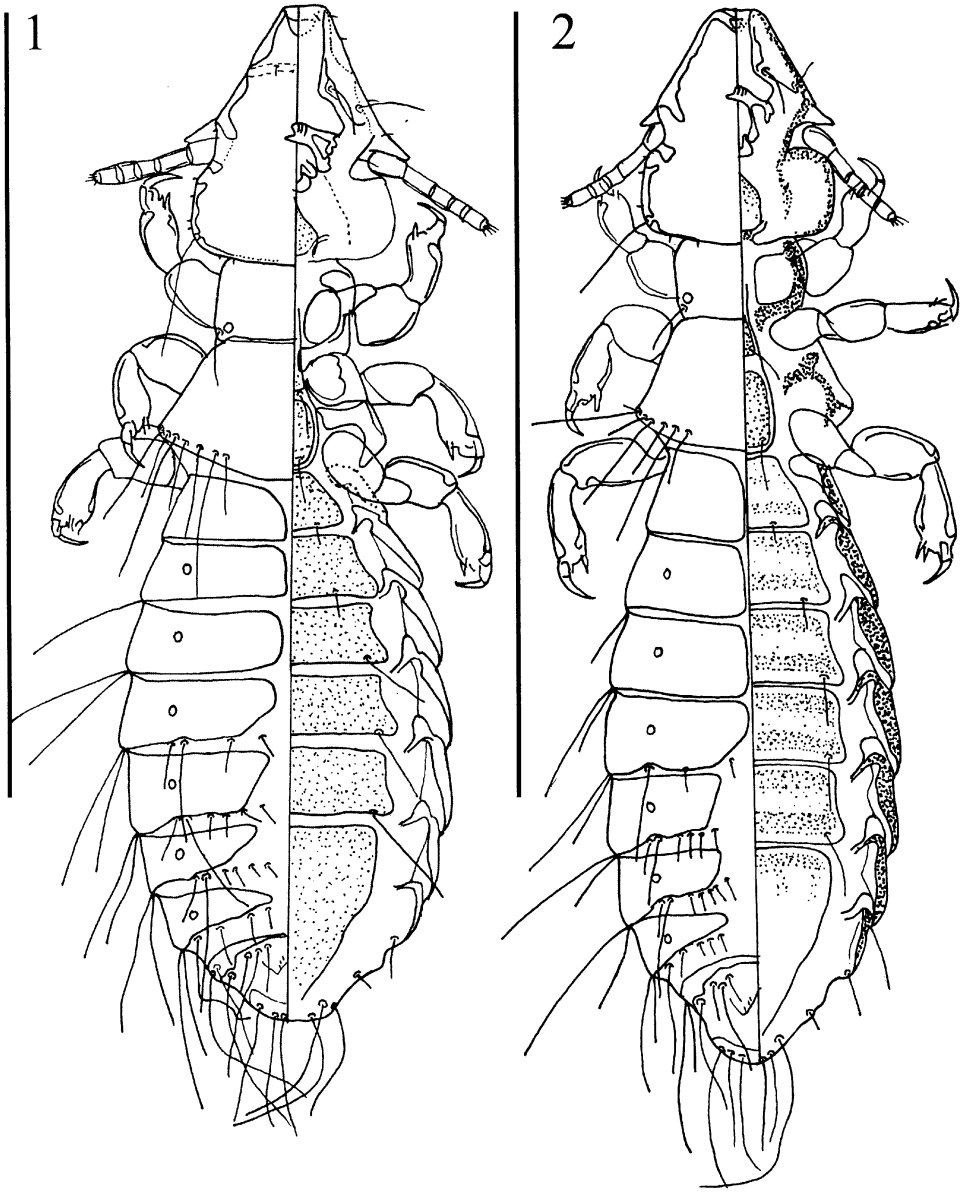
Female (n = 2). Similar to male (Fig. 12) except tergal setae on each side of abdominal segments as follows: II–IV, 0; V, 1; VI–VIII, 1; IX, 4 (2 long, 2 short). Subgenital plate (Fig. 13) wide, slightly convex posteriorly with medial part almost straight.

Dimensions: PAW, 0.25; PAL, 0.22; TW, 0.30–0.31; POL, 0.16–0.19; HL, 0.38–0.41; PW, 0.20; MW, 0.33–0.34; AWV, 0.50; TL, 1.76–1.84.

Type material. Male holotype, from *Amadina fasciata*, SENEGAL: Matam (15° 37′ N, 13° 20′ W), 6 September 2007, Literák, Čapek & Koubek leg. Paratypes: 3 males, 1 female with same data as holotype, deposited in the Moravian Museum, Brno, Czech Republic (MZM) (O.Sychra-SE55–SE58); 1 male, 1 female, same data as holotype, deposited in the Natural History Museum, London (NHML) (O.Sychra-SE59–SE60).

Remarks. A characteristic feature of *Brueelia* lice from estrildid hosts is a triangular head with a straight-sided forehead, and the lateral sides of the marginal carina interrupted in the midline. *Brueelia fasciata* is

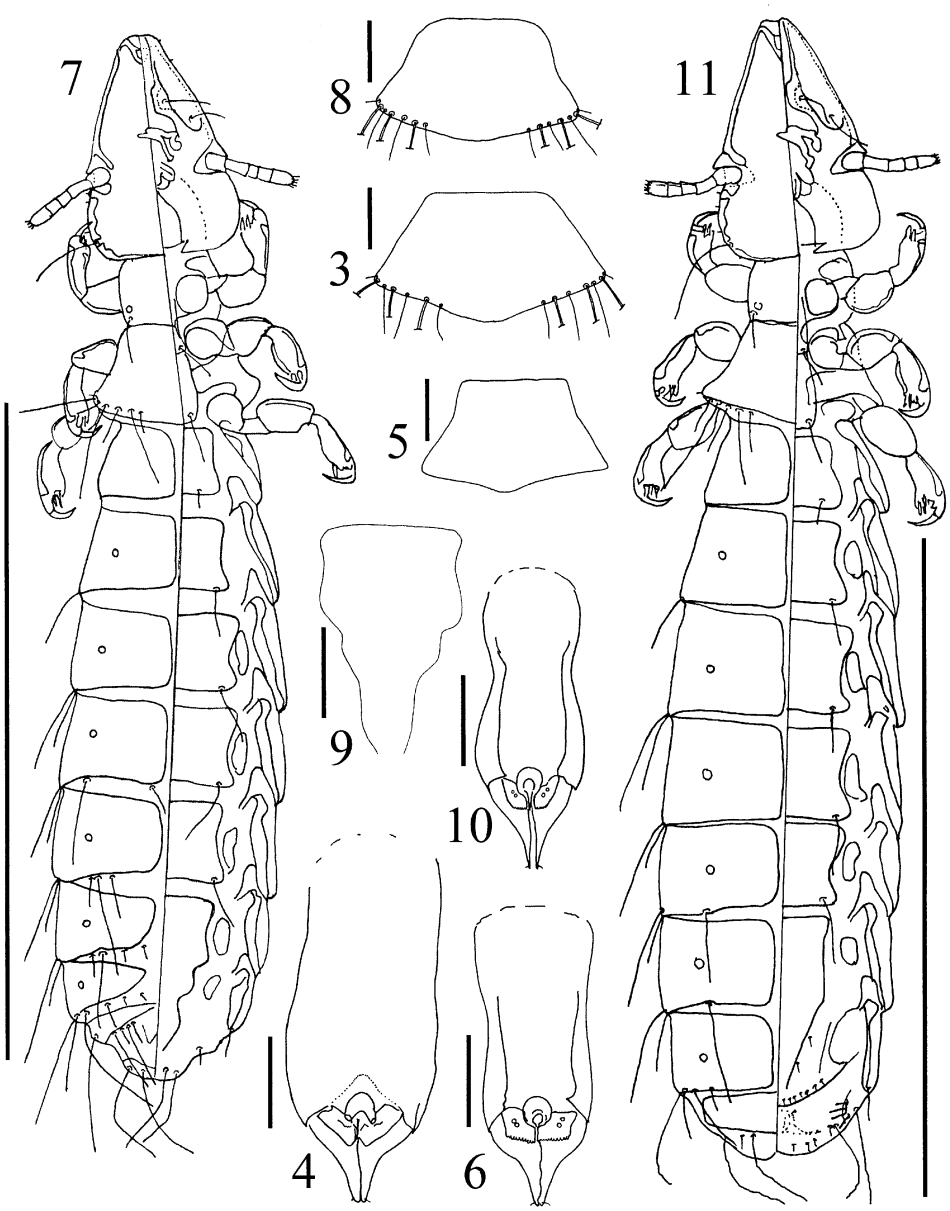
morphologically similar to five species from estrildid hosts: *B. stenozona* (Kellogg & Chapman, 1902); *B. eichleri* Lakshminarayana, 1969; *B. astrildae* Tendeiro & Mendes, 1994; *B. lonchurae* Tendeiro & Mendes, 1994 and *B. amandavae* Rékási & Saxena, 2005. However, *B. fasciata* can be separated from them by the following combination of features: 1) absence of setae on tergite II–IV of male; 2) male genitalia with broad endomeral complex with smooth posterior margin (male of *B. stenozona* has endomeral complex strongly serrated and male of *B. amandavae* has slender endomeral complex; the other species of *Brueelia* were described on the basis of single females); 3) female subgenital plate wide, slightly convex posteriorly with medial part almost straight (females of other estrildid *Brueelia* have subgenital plate with conspicuously convex margin medially); 4) broad head with temple width at least 0.30 mm.



FIGURES 1–2. Males. 1, *Brueelia fasciata* Sychra, **n. sp.** 2, *Brueelia cantans* Sychra, **n. sp.** Scales 1 mm. Dorsal side on left, ventral side on right.

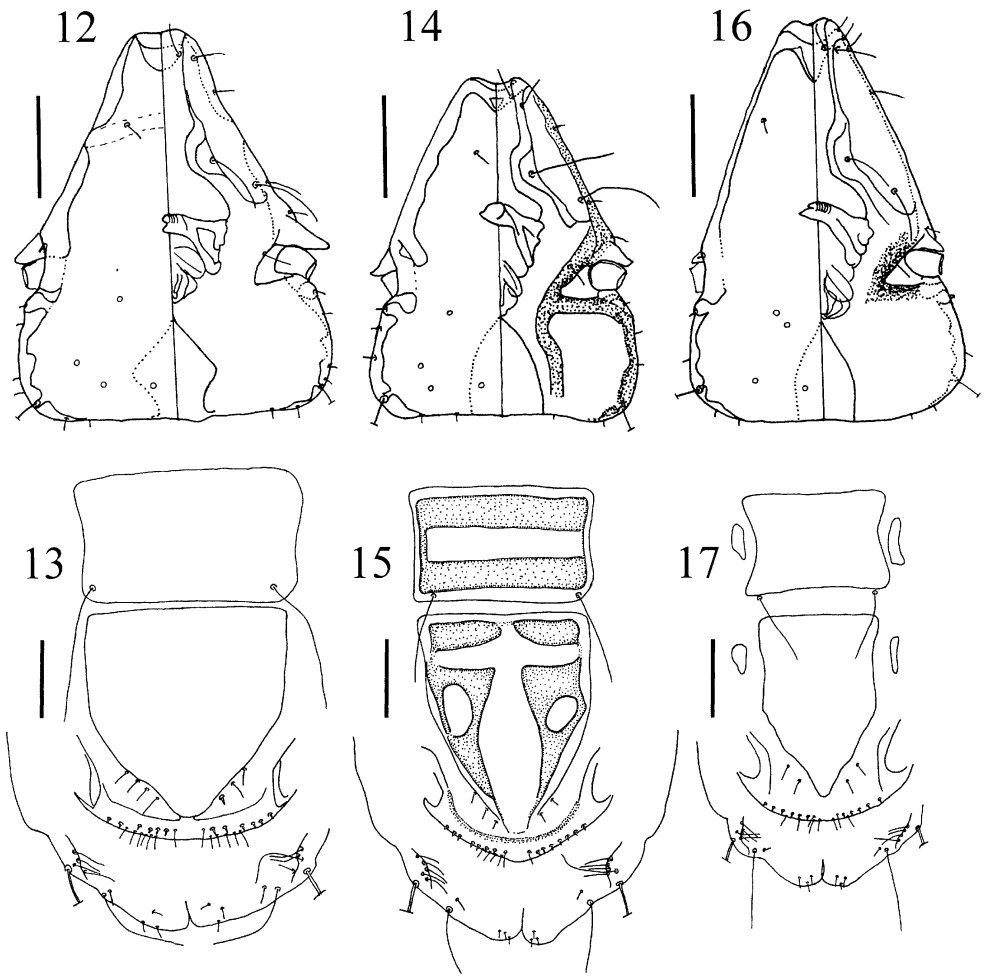
***Brueelia cantans*, Sychra, new species**
(Figs. 2, 5–6, 14–15)

Type host: *Euodice cantans* (Gmelin): African silverbill.



FIGURES 3–11. 3–4, *Brueelia fasciata* Sychra, **n. sp.** 3, Prothorax. 4, Male genitalia. 5–6, *Brueelia cantans* Sychra, **n. sp.** 5, Prothorax. 6, Male genitalia. 7–11, *Brueelia senegala* Sychra, **n. sp.** 7, Male. 8, Prothorax. 9, Male subgenital plate. 10, Male genitalia. 11, Female. Scales 1 mm (Figs 7, 11), 0.10 mm (Figs. 3, 5, 8, 9), 0.05 mm (Figs. 4, 6, 10). For Figs. 7 and 11, dorsal side on left, ventral side on right.

Male (n = 6). Typical pattern of sclerotization and pigmentation involving head, gular and ventral thoracic plates, sternites and pleurites. Preantennal region as long as postantennal region. The entire marginal carina uninterrupted with lateral side almost straight. In spite of this, head rather egg-shaped than triangular (Fig. 14). Metasternal plate pigmented, without central unpigmented "hole". Pronotum with 1 seta on each posterolateral corner; metanotum with 7 setae (3 long, 4 short) on each posterolateral margin. Metathorax with concave lateral sides (Fig. 5). All abdominal tergites divided centrally, tergites VI–VII of characteristic shape (Fig. 2). Tergal setae on each side as follows: tergites II–IV, 0 (only one male with single seta on one side of tergite IV); V, 3; VI–VII, 6–8; VIII, 4–6; IX, 4–5 (Fig. 2), terminally with 6 setae. Post-spiracular sensillus present on tergites II–VII. Abdominal sterna with a pair of setae. Male genitalia as in Fig. 6. Parameres narrow and quite long, each with a very short subapical seta on the lateral margin. Endomeral complex contains a pair of sacs of square shape, with two small medial circular spots and denticulated posterior margin.



FIGURES 12–17. 12–13, *Brueelia fasciata* Sychra, **n. sp.** 12, Female head. 13, Female sternite VII and subgenital plate. 14–15, *Brueelia cantans* Sychra, **n. sp.** 14, Female head. 15, Female sternite VII and subgenital plate. 16–17, *Brueelia senegala* Sychra, **n. sp.** 16, Female head. 17, Female sternite VII and subgenital plate. Scales 0.10 mm.

Dimensions: PAW, 0.20; PAL, 0.14–0.15; TW, 0.25; POL, 0.14–0.15; HL, 0.28–0.30; PW, 0.15–0.17; MW, 0.23–0.29; AWV, 0.33–0.38; TL, 1.29–1.37; GW, 0.065–0.075.

Female (n = 7). Similar to male except tergal setae on each side of abdominal segments as follows: II–V, 0; VI–VIII, 1; IX, 4 (2 long, 2 short). Subgenital plate (Fig. 15) wide, slightly convex posteriorly, with characteristic pigmentation as shown.

Dimensions: PAW, 0.21–0.24; PAL, 0.16–0.18; TW, 0.26–0.28; POL, 0.14–0.17; HL, 0.30–0.34; PW, 0.17–0.19; MW, 0.28–0.30; AWV, 0.44–0.49; TL, 1.75–1.82.

Type material. Male holotype, female allotype, from *Euodice cantans*, SENEGAL: Matam (15° 37′ N, 13° 20′ W), 6 September 2007, Literák, Čapek & Koubek leg. Paratypes: 4 males, 5 females with the same data as holotype, deposited in the Moravian Museum Brno, Czech Republic (MZM) (O.Sychra-SE61–SE65); paratypes: 1 male, 1 female, same data as holotype, deposited in the Natural History Museum, London (NHML) (O.Sychra-SE66).

Remarks. An egg-shaped head with uninterrupted marginal carina distinguishes *B. cantans* from all other *Brueelia* from estrildids except *B. munia* Ansari that has an oval preantenal region. *Brueelia cantans* can be separated from the latter by a higher number of setae on tergite V–VIII of male and different male genitalia. The typical pattern of sclerotization and pigmentation involving head, gular and ventral thoracic plates and sternites places *B. cantans* close to *Brueelia* known from weavers (Ploceidae)—*B. plocea* Lakshminarayana and an undescribed *Brueelia queleae* Sychra & Barlev (Sychra *et al.*, 2010). *Brueelia cantans* differs from

both species by 1) straight lateral sides of preantennal region, 2) endomeral complex of male with a pair of sacs of square shape, 3) light brown pigmentation involving sternites and subgenital plate (*B. plocea* as well as *B. queleae* have very dark brown pigmentation forming conspicuous stripes).

***Brueelia senegala* Sychra, new species**
(Figs. 7–11, 16–17)

Type host: *Lagonosticta senegala* (Linnaeus): red-billed firefinch

Male (n = 4). Head similar to *B. fasciata*, but with uninterrupted marginal carina (Fig. 16). Pronotum with 1 seta on each posterolateral corner; metanotum with 7 setae (3 long, 4 short) on each posterolateral margin. Metathorax with concave lateral sides and rounded apically (Fig. 8). All abdominal tergites divided centrally. Tergal setae on each side as follows: tergites II–IV, 0; V, 1–2; VI, 2–3; VII, 4–5; VIII, 3–4; IX 5 (Fig. 7), terminally with 4 setae. Abdominal sterna with a pair of setae. A pair of small oval-shaped plates placed between sternal and pleural plates on sternites III–VII (Fig. 7). Subgenital plate of characteristic shape (Fig. 9). Male genitalia as in Fig. 10, basal apodeme with conspicuous concave lateral margin.

Dimensions: PAW, 0.20; PAL, 0.18–0.21; TW, 0.24–0.25; POL, 0.15; HL, 0.33–0.36; PW, 0.17; MW, 0.26–0.27; AWV, 0.34–0.36; TL, 1.50–1.68; GW, 0.065.

Female (n = 4). Similar to male except tergal setae on each side of abdominal segments as follows: II–V, 0; VI–VIII, 1; IX, 4 (2 long, 2 short) (Fig. 11). Subgenital plate (Fig. 17) wide, slightly convex posteriorly.

Dimensions: PAW, 0.21–0.23; PAL, 0.20–0.23; TW, 0.26–0.27; POL, 0.15–0.17; HL, 0.35–0.40; PW, 0.18; MW, 0.28–0.31; AWV, 0.38–0.42; TL, 1.81–2.00.

Type material. Male holotype, female allotype, from *Lagonosticta senegala*, SENEGAL: NP Niokolo Koba, Lengué Kountou (13° 04′ N, 13° 01′ W), 30 January 2005, Procházka & Koubek leg. Paratypes: 2 males, 2 females, same data as holotype, deposited in the Moravian Museum Brno, Czech Republic (MZM) (O.Sychra-SE67–SE69); 1 male, 1 female, same data as holotype, deposited in the Natural History Museum, London (NHML) (O.Sychra-SE70).

Remarks. *Brueelia senegala* is morphologically similar to *B. fasciata* but its triangular head with uninterrupted marginal carina, small oval-shaped plates placed between sternal and pleural plates and a subgenital plate of characteristic shape distinguish *B. senegala* from all other estrildid *Brueelia*.

Discussion

According to Clements (2007), 141 species of Estrildidae are currently known. Despite a relatively high number of potential hosts, only 12 species of chewing lice have been described from this bird family: six species of *Brueelia*, four of *Myrsidea*, one *Machaerilaemus* and one *Menacanthus* (Price *et al*. 2003, Rékási & Saxena 2005). In the course of this study, several species of two louse genera—*Brueelia* and *Myrsidea*—were identified from birds of the family Estrildidae.

Clay (1970) treated three species of *Myrsidea* and Tendeiro (1993) described the fourth. Our records of *Myrsidea* from estrildid hosts from Senegal represent new louse-host associations, as well as first louse records from *Lagonosticta senegala* (Linnaeus), *Estrilda melpoda* (Vieillot) and *Uraeginthus bengalus* (Linnaeus). These *Myrsidea* probably represent new species but, unfortunately, having single male or female specimens is insufficient for an adequate description of new species.

A typical feature of *Brueelia* from estrildid hosts is a triangular head with a straight-sided forehead and lateral sides of the marginal carina interrupted in the midline (Rékási & Saxena 2005). Eichler (1957) wrote that estrildid *Brueelia* are rather remote from *Brueelia sensu stricto* (occurring on other families of Passeriformes), and predicted that it would be necessary to separate them generically. Balakrishnan & Sorenson (2007) reconstructed a phylogeny of lice from parasitic finches (Viduidae) and their estrildid hosts and found that *Brueelia* from estrildid finches represent an evolutionarily independent clade (clade D). However, this clade was nested within genus *Brueelia* (*sensu stricto*).

Three species of *Brueelia—B. munia, B. senegala* **n. sp.** and *B. cantans* **n. sp.**—are easily distinguished morphologically from other estrilidid *Brueelia*. Johnson *et al.* (2002) constructed a phylogeny of *Brueelia* and found that their phylogeny does not reflect host phylogeny, suggesting that this result implicated phoretic dispersal as playing a major role in breaking down levels of cospeciation between species of *Brueelia* and their hosts. Balakrishnan & Sorenson (2007) suggested that nonspecific transfer of estrildid lice could occur also in mixed-species feeding flocks during the nonbreeding season. In addition, mixed-species colonial breeding or takeover of nests may play an important role, because many estrildids often use old nests of other estrildid species (Sorenson & Payne 2001). Clayton (1990) showed that sharing of lice by unrelated species of owls was restricted to cases involving sympatric host species with overlapping microhabitat. Weckstein (2004) and Bueter *et al.* (2009) supported the hypothesis that sympatry or syntopy of hosts may provide an opportunity for lice to switch hosts.

Brueelia munia and *B. cantans* **n. sp.** are morphologically similar to *Brueelia* from weavers (Ploceidae). In particular, *B. cantans* has the same type of abdominal sclerotization and pigmentation as ploceid *Brueelia* (type "d" in Johnson *et al.* 2002). Estrildid finches are very closely related to weavers (Sorenson & Payne 2001, Ericson & Johansson 2003). Although mixed-species colonial breeding and conspecific nest parasitism are more frequent in ploceids than estrildids, nest takeover is quite common in estrildid finches (Sorenson & Payne 2001). Some use nests built by other species, and several species (including *Lonchura malabarica* (Linnaeus) and *Euodice cantans* - type hosts of *B. munia* and *B. cantans*, respectively) use old weaver nests more often than they build their own nests (Sorenson & Payne 2001). In the Indian silverbill (*L. malabarica*), for example, more than one female sometimes lay eggs in nests that are appropriated from other species (Dhindsa 1983). In some species even intraspecific brood parasitism is also known (Dhindsa 1983, Birkhead *et al.* 1990). As shown by Balakrishnan & Sorenson (2007) in the case of indigobirds (Viduidae), these parasitic finches generally do not acquire lice from their host species. On the other hand, these authors described one example in which a louse was transferred to an indigobird at the host nest. Such an occasional intraspecific horizontal transfer is reported also by Lindholm *et al.* (1998) and Hahn *et al.* (2000). We suggest the three "untypical" estrildid *Brueelia* probably originated from such a host switching either during mixed-species colonial breeding or during intraspecific brood parasitism. Moreover, *Lagonosticta senegala* is known as a host of the parasitic finch *Vidua chalybeata* (Muller) (Sorenson *et al*. 2004). Since *B. senegala* is morphologically similar to several undescribed viduid *Brueelia* (Balakrishnan & Sorenson 2007) and three females collected by us from *V. macroura* (Pallas) in Senegal (Sychra *et al.*, unpubl. data), the question arises whether *B. senegala* may have originated from the parasitic finch. However, no louse is yet known from *V. chalybeata* (see Price *et al.* 2003). The finding of nymphs shows that both *Brueelia senegala* and *B. cantans* have successfully bred on their estrildid hosts.

The importance of phoresis in the evolutionary history of these louse species needs to be mentioned, since we also found a few louse-flies during our study of estrildid and ploceid hosts in Senegal. Although we did not observe any phoresis of lice on the louse-flies we collected, this phenomenon is well documented for the louse-flies *Pseudolynchia canariensis* and *Ornithophila metallica* (Keirans 1975, Macchioni *et al.* 2005, Harbison *et al.* 2009).

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Literature cited

Ansari, M.A.R. (1958) Studies on ischnoceran Mallophaga infesting birds in the Panjab. *Indian Journal of Entomology*, 20, 46–62.

Balakrishnan, C.N. & Sorenson, M.D. (2007) Dispersal ecology versus host specialization as determinants of ectoparasite distribution in brood parasitic indigobirds and their estrildid finch hosts. *Molecular Ecology*, 16, 217–229.

Birkhead, T.R., Burke, T., Zann, R., Hunter, F.M. & Krupa, A.P. (1990) Extrapair paternity and intraspecific brood parasitism in wild zebra finches, *Taeniopygia guttata*, revealed by DNA fingerprinting. *Behavioral Ecology and Sociobiology*, 27, 315–324.

Bueter, C., Weckstein, J., Johnson, K.P., Bates, J.M. & Gordon, C.E. (2009) Comparative phylogenetic histories of two louse genera found on *Catharus* thrushes and other birds. *Journal of Parasitology*, 95, 295–307.

Clay, T. (1970) Species of *Myrsidea* (Insecta: Mallophaga) parasitic on the Estrildidae (Aves). *H.D. Srivastava Commen.* Volume: 561–570.

Clayton, D.H. (1990) Host specificity of *Strigiphilus* owl lice (Ischnocera, Philopteridae), with the description of new species and host associations. *Journal of Medical Entomology*, 27, 257–265.

Clayton, D.H. & Drown, D.M. (2001) Critical evaluation of five methods for quantifying chewing lice (Insecta: Phthiraptera). *Journal of Parasitology*, 87, 1291–1300.

Clements, J.F. (2007) *The Clements Checklist of Birds of the World. 6th edition.* Cornell University Press. 855 pp.

Dhindsa, M.S. (1983) Intraspecific nest parasitism in the white-throated munia. *Notornis*, 30, 87–92.

Eichler, W. (1957) Notes on the *Brueelia* group of Mallophaga (feather-lice), with descriptions of four new species. *Journal of the Bombay Natural History Society*, 54, 577–580.

Ericson, P.G.P. & Johansson, U.S. (2003) Phylogeny of Passerida (Aves: Passeriformes) based on nuclear and mitochondrial sequence data. *Molecular Phylogenetics and Evolution*, 29, 126–138.

Fry, C. H. & Keith, S., eds. (2004) *The Birds of Africa. Vol. VII.* Christopher Helm, London, 666 pp.

Hahn, D.C., Price, R.D. & Osenton, P.C. (2000) Use of lice to identify Cowbird hosts. *Auk*, 117, 943–951.

Harbison, C.W., Jacobsen, M.V. & Clayton, D.H. (2009) A hitchhiker's guide to parasite transmission: The phoretic behaviour of feather lice. *International Journal of Parasitology*, 39, 569–575.

Johnson, K.P., Adams, R.J. & Clayton, D.H. (2002) The phylogeny of the louse genus *Brueelia* does not reflect host phylogeny. *Biological Journal of the Linnean Society*, 77, 233–247.

Keirans, J.E. (1975) A review of the phoretic relationship between Mallophaga (Phthiraptera: Insecta) an Hippoboscidae (Diptera: Insecta). *Journal of Medical Entomology*, 12, 71–76.

Kellogg, V.L. & Chapman, B.L. (1902) Mallophaga from birds of the Hawaiian Islands. *Journal of the New York Entomological Society*, 10, 155-169.

Lakshminarayana, K.V. (1969) Mallophaga Indica III. New name proposed for *Brueelia muniae* Eichler. *Angewandte Parasitologie*, 10, 62.

Lepage, D. (2009) Avibase – Bird Checklists of the World: Senegal. In Web page Avibase – the world bird database. URL: http://avibase.bsc-eoc.org/ [accessed 2 October 2009].

Lindholm, A.K., Venter, G.J. & Ueckermann, E.A. (1998) Persistence of passerine ectoparasites on the diederik cuckoo *Chrysococcyx caprius*. *Journal of Zoology (London)*, 244, 145–153.

Maa, T.C. (1963) Genera and species of Hippoboscidae (Diptera): types, synonymy, habitats and natural groupings. *Pacific Insects Monograph* 6, 186 pp.

Maa, T.C. & Peterson, B.V. (1987) Hippoboscidae, pp. 1271–1281. *In*: McAlpine, J.F., Peterson, B.V., Shewell, G.E., Teskey, H.J., Vockeroth, J.R. & Wood, D.M. (eds.) *Manual of Nearctic Diptera*. Volume 2. Agriculture Canada Monograph 28: i-vi, 675–1332.

Macchioni, F., Magi, M., Mancianti, F. & Perrucci, S. (2005) Phoretic association of mites and mallophaga with the pigeon fly *Pseudolynchia canariensis*. *Parasite*, 12, 277–279.

Palma, R.L. (1978) Slide mounting of lice: a detailed description of the Canada balsam technique. *New Zealand Entomologist*, 6, 432–436.

Price, R.D. (1975) The *Menacanthus eurysternus* complex (Mallophaga: Menoponidae) of the Passeriformes and Piciformes (Aves). *Annals of the Entomological Society of America*, 68, 617–622.

Price, R.D., Hellenthal, R.A. & Palma, R.L. (2003) World checklist of chewing lice with host associations and keys to families and genera, pp. 1–448. *In*: Price, R.D., Hellenthal, R.A., Palma, R.L., Johnson, K.P. & Clayton, D.H. *The Chewing Lice: World Checklist and Biological Overview.* Illinois Natural History Survey Special Publication 24. x + 501 pp.

Rékási, J. & Saxena, A.K. (2005) A new Phthiraptera species (Philopteridae) from the red avadavat (*Amandava amandava*). *Aquila*, 112, 87–93.

Sorenson, M.D. & Payne, R.B. (2001) A single ancient origin of brood parasitism in African finches: implications for

host-parasite co-evolution. *Evolution*, 55, 2550–2567.
Sorenson, M.D., Balakrishnan, C.N. & Payne, R.B. (2004) Clade-limited colonization in brood parasitic finches (*Vidua* spp.). *Systematic Biology*, 53, 140–153.
Sychra, O., Barlev, E., Literák, I., Čapek, M., Koubek, P. & Procházka, P. (2010) The chewing lice (Phthiraptera) of Red-billed Quelea (*Quelea quelea*) in Senegal, with a description of a new species. *African Entomology*, 18, 17–22.
Tendeiro, J. (1993) On the terrestrial and riverine faune of the Democratic Republic of São Tóme e Príncipe. Mallophaga from São Tóme. I Description of three new species of the genus *Myrsidea* Waterston. *Garcia de Orta, Série Zoologia*, 19, 55–60.
Tendeiro, J. & Mendes, L.F. (1994) Sobre a fauna terrestre e ribeirinha da República Democrática de São Tomé e Príncipe. Malófagos. II - Espécies encontradas e notas adicionais sobre a fauna malofágica de São Tomé e Príncipe. *Garcia de Orta, Série Zoologia*, 20(1–2), 113–129.
Weckstein, J.D. (2004) Biogeography explains cophylogenetic patterns in toucan chewing lice. *Systematic Biology*, 53, 154–164.