

Motmotnirmus danielalfonsoi* n. sp., A NEW SPECIES OF CHEWING LOUSE FROM A TURQUOISE-BROWED MOTMOT (*Eumomota superciliosa*), WITH NOTES ON *Motmotnirmus guatemalensis

Motmotnirmus danielalfonsoi* n. sp., una nueva especie de piojo masticador encontrado en el momoto de ceja azul (*Eumomota superciliosa*), con notas sobre *Motmotnirmus guatemalensis

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RESUMEN. - We describe a new species of chewing louse, *Motmotnirmus danielalfonsoi* n. sp., from the Turquoise-Browed Motmot (*Eumomota superciliosa*). It differs from congeneric species in several characters, including the head shape, the abdominal chaetotaxy of the male, and in the characters of the male genitalia. Females differ from congeneric species primarily in the head shape and the shape and size of abdominal plates. Additionally, we suggest that the true host of *Motmotnirmus guatemalensis* is the Lesson's Momot (*Momotus lessonii*), which is also a new host record. Such suggestion is based on examinations of museum specimens of lice from various motmot species. We also provide a key to the species of *Motmotnirmus* and an updated checklist of the genus *Motmotnirmus*.

INTRODUCTION

The motmot group comprises thirteen species in six genera, of which all are endemic to the Neotropics (Clements *et al.* 2019). Only two genera of chewing lice are known to parasitize motmots: *Clayiella* Eichler 1940 and *Motmotnirmus* Mey & Barker 2014. Mey & Barker (2014) erected *Motmotnirmus* and placed four species in this genus. Both these genera are part of the suborder Ischnocera, and within that suborder, *Motmotnirmus* is one of over 30 genera in the *Brueelia* complex (Gustafsson & Bush 2017). Genetic and morphological evidence support that relationship (Bush *et al.* 2016, Gustafsson & Bush 2017). Within this complex, *Motmotnirmus* is distinguishable by having marginal temporal setae 2-3 (*mts2-3*) as macrosetae, and both sexes lack sternal plates II-VI. Here, we describe a fifth species within this genus, *Motmotnirmus danielalfonsoi* n. sp. In addition, we clarify the status of *Motmotnirmus guatemalensis* (Dalglish 1971) by suggesting that the natural host is Lesson's Motmot (*Momotus lessonii*).

MATERIAL AND METHODS

All lice specimens examined for this study were slide-mounted and deposited in the 80s by an unknown donor at the Natural History Museum, London (NHML). We measured specimens by using a Nikon Eclipse E600 microscope fitted with an Olympus DP25 camera and digital measuring software (ImageJ 1.48v, Wayne Rasband). To illustrate specimens, we drew them by hand, using a drawing tube fitted to the same microscope. Line drawings were scanned, collated, and edited in GIMP (www.gimp.org).

Terminology for abdominal chaetotaxy follows Gustafsson & Bush (2017). All measurements are in millimeters (mm) and include total length (along midline including hyaline margin), head length (along midline including hyaline margin), head width (at temples), prothoracic width, pterothoracic width, and abdominal width (at segment V). Host taxonomy follows Clements *et al.* (2019). To avoid confusion, we abbreviated *Motmotnirmus* as *Mot.* and *Momotus* as *Mom.*

We officially registered the nomenclatural acts for *Mot. danielalfonsoi* in ZooBank, the online registration system for the International Code of Zoological Nomenclature (ICZN). The ZooBank LSID (Life Science Identifier) is: urn:lsid:zoobank.org:pub:0A46A47B-4AB7-4199-88B9-89F63C368DCC.

RESULTS

Description

Motmotnirmus Mey & Barker 2014

Motmotnirmus Mey & Barker 2014: 94.

Type species. *Nirmus marginellus* Nitzsch (in Giebel), 1866: 368, by original designation.

Motmotnirmus danielalfonsoi n. sp.

(Fig. 1 and 2).

Type host. *Eumomota superciliosa australis* Bangs, 1906 – Turquoise-browed Motmot (English) or momoto cejiazul (Spanish).

Type locality. Copal, Guanacaste, Costa Rica.

ZooBank LSID: urn:lsid:zoobank.org:act:E6C0E1E2-BBC6-4919-A9B7-17BA8C94A555

Type material. Holotype ♂, Copal, Guanacaste, Costa Rica, 9 Mar. 1986, M.A. Marin, 433, 23553 on reverse (Natural History Museum, London, NHML). Paratypes: 4♂, 6♀, same data as holotype, 23552, 23554-6, 23989-94 on reverse (NHML).

Etymology. The species epithet is in honor of our late colleague Daniel Alfonso González-Acuña (Universidad de Concepción, Chillán, Chile) (1963-2020), in recognition of his long and detailed work with the chewing louse fauna of Chile and nearby regions, culminating in the posthumously published checklist of chewing lice of Chile (González-Acuña & Palma 2021). His death was a significant loss for chewing louse research throughout South America.

Diagnosis. *Motmotnirmus danielalfonsoi* n. sp. is quite different from other species in the genus. It differs from all other described species of *Motmotnirmus* in the following characters (*cf.* Dalglish 1971, Oniki & Emerson 1982, Valim & Cicchino 2015, Mey & Barker 2014, Gustafsson & Bush 2017): pre-antennal head more slender, lateral margins straighter, and frons slenderer (Fig. 2A); ventral section of tergopleurites slender in *Mot. danielalfonsoi* (Fig. 1A-B) but wide in all other species; pre-spir-

acular ridges absent in *Mot. danielalfonsoi*, but present on at least some tergopleurites in all other species.

Motmotnirmus danielalfonsoi is most like *Mot. marginellus*, with which it shares the following characters: proximal mesosome rounded not indented (Fig. 2C), and tergal posterior setae absent from male tergopleurite VI and female tergopleurite VII (Fig. 1A-B). These two species can be distinguished by the characters listed above. In addition, *Mot. danielalfonsoi* and *Mot. marginellus* can be distinguished by the following characters: mesosome slender and oblong in *Mot. marginellus*, but rounded trapezoidal in *Mot. danielalfonsoi* (Fig. 2C); female sub-genital plates differ in shape (Fig. 2E); pre-antennal nodi slenderer in *Mot. danielalfonsoi* (Fig. 2A) than in *Mot. marginellus*; no macrosetae present in setal rows of male tergopleurites VIII-XI+X in *Mot. danielalfonsoi* (Fig. 1A), but two macrosetae present on each tergopleurite in *Mot. marginellus*; posterolateral corner of tergopleurites II-III of both sexes overlapping next segment in *Mot. danielalfonsoi* (Fig. 1A-B), but not in *Mot. marginellus*.

Description. Both sexes. Head triangular, with rounded temples and slightly indented frons (Fig. 2A); lateral margins of pre-antennal head straight. Marginal carina with irregular median margin interrupted submedianly and displaced posteriorly at frons. Hyaline margin long, connected laterally to narrow dorsal pre-antennal suture that reaches aperture of the *dorsal submarginal setae*. The pre-antennal nodi is slender. Head chaetotaxy is as in Figure 2A. Posterolateral corners of tergopleurites II-III extended posteriorly into small triangles overlapping the next tergopleurite.

Male. Thoracic and abdominal structure and chaetotaxy as in Figure 1A; no *tergal posterior setae* on tergopleurite VI. The subgenital plate is roughly oval. Basal apodeme roughly rectangular, slightly constricted at mid-length, distal margin much indented (Fig. 2B). Mesosome as in Figure 2C; proximal end broad, rounded trapezoidal; gonopore wide, posterodistal margins slightly serrated; 1 seta on each side distal to gonopore; distal margin of mesosome highly rugose. Parameres, as in Figure 2D. Measurements (n = 5): total length = 1.69-1.87 mm; head length = 0.47-0.51 mm; head width = 0.47-0.51 mm; prothoracic width = 0.27-0.36 mm; pterothoracic width = 0.41-0.46 mm; abdominal width = 0.57-0.62 mm.

Female. Thoracic and abdominal structure and chaetotaxy as in Figure 2; no *tergal posterior setae* on tergopleurite VII. The subgenital plate is short and broad (Fig. 2E). Vulval margin gently rounded (Fig. 2E), *vulval marginal setae* not visible, maybe sensilla, 2-4 short, thorn-like *vulval submarginal setae* on each side; 6-9

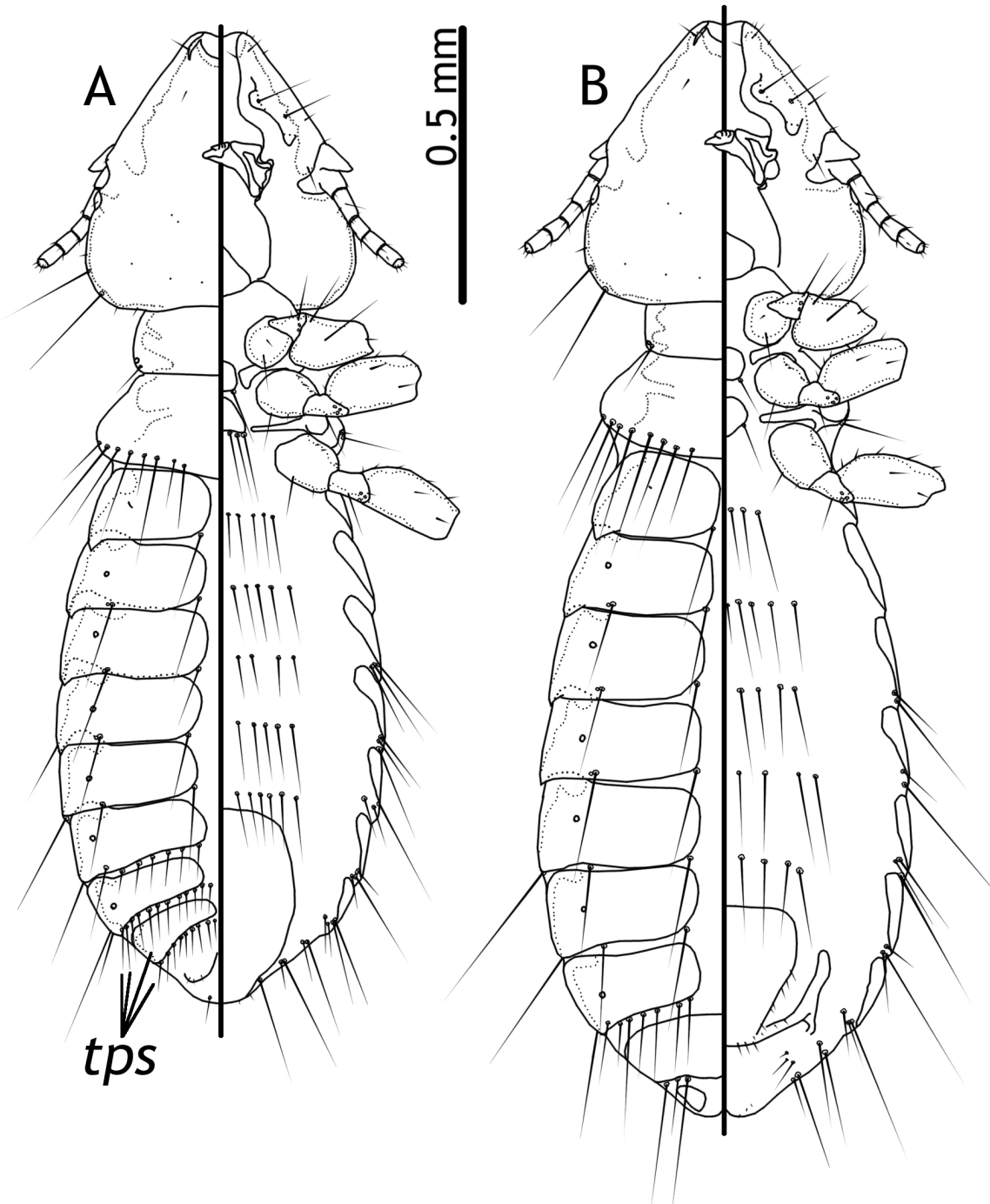


Figure 1. *Motmotnirmus danielalfonsoi* n. sp. ex Turquoise-browed Motmot (*Eumomota superciliosa*). A. Male habitus, dorsal and ventral views. B. Female habitus, dorsal and ventral views. Anatomical structure: tps = tergal posterior setae.

long, slender *vulval oblique setae* follow lateral margins of the subgenital plate on each side, with distal 1-3 *vulval oblique setae* located median to *vulval submarginal setae*. Measurements (n = 6): total length = 1.96-2.16 mm; head length = 0.50-0.55 mm; head width = 0.49-0.53 mm; prothoracic width = 0.30-0.38 mm; pterothoracic width = 0.43-0.50 mm; abdominal width = 0.61-0.68 mm.

***Motmotnirmus guatemalensis* (Dagleish 1971)**

Brueelia guatemalensis Dagleish 1971: 140.

Motmotnirmus guatemalensis (Dagleish 1971); Mey & Barker 2014: 98.

Type host. *Campephilus guatemalensis* (Hartlaub, 1844)
– Pale-billed Woodpecker (English) or carpintero pico

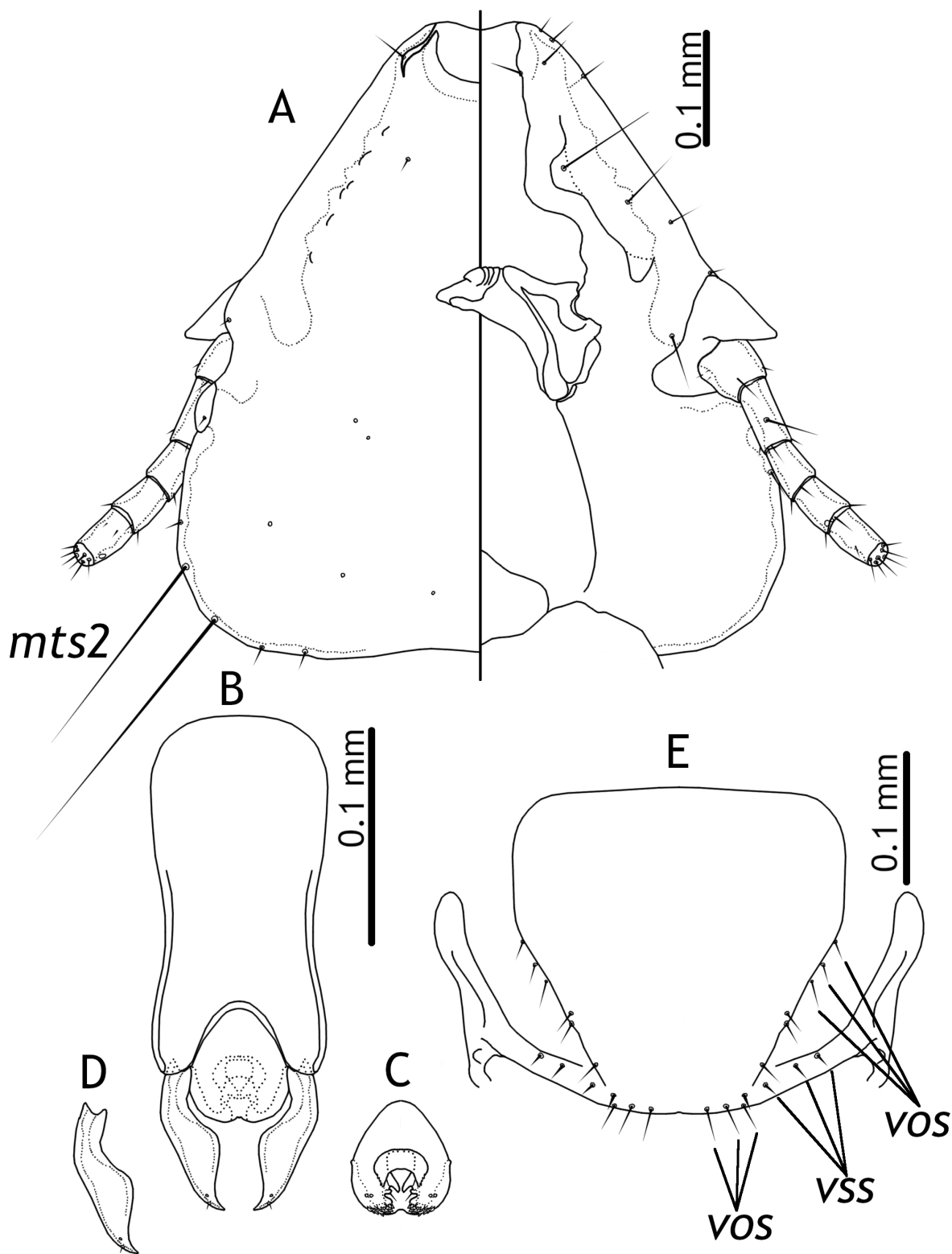


Figure 2. *Motmotnirmus danielalfonsoi* n. sp., ex Turquoise-browed Motmot (*Eumomota superciliosa*). A. Male head, dorsal and ventral views. B. Male genitalia, dorsal view. C. Male mesosome, ventral view. D. Male paramere, dorsal view. E. Female subgenital plate and vulval margin, ventral view. Anatomical structures: *mts2* = marginal temporal seta 2; *vos* = vulval oblique setae; *vss* = vulval submarginal setae. Note that the vulval oblique setae form two separate sets in this species.

plateado (Spanish).

New host. *Momotus lessonii* Lesson, 1842 – Lesson's Motmot (English) or momoto diademado (Spanish).

Type material. Holotype ♂, Santa Clara, Chiriquí Province, Panama, 15 Feb. 1956, G. Hartman, Brit. Mus. 1956-449 (NHML). **Allotype** ♀, same data as holotype (NHML). Additional material examined (non-types). Ex *Momotus coeruliceps lessonii*: 23♂, 34♀, Panama, R. Meinertzhagen, 13468 (NHML) [one slide also contains an unidentified *Picicola* female].

Remarks. *Motmotnirmus guatemalensis* is the only species in the genus known from a woodpecker. Mey & Barker (2014) suspected that the host record of *Mot. guatemalensis* is likely the result of straggling, and they questioned the validity this species. These authors suggested that it may be a synonym of *Motmotnirmus marginellus* (Nitzsch [in Giebel] 1874). They based this synonymization on the female genitalia of *Mot. guatemalensis*, which are like those of *Mot. marginellus*. However, several non-genital characters contradict this synonymization. Males of *Mot. marginellus* do not have *tergal posterior setae* on tergopleurite VI, and female *Mot. marginellus* do not have *tergal posterior setae* on tergopleurite VII. Conversely, *Mot. guatemalensis* have *tergal posterior setae* on both these segments. In the specimens we have examined, there are no other significant differences between the type series of *Mot. guatemalensis* and the series from *Mom. c. lessonii*, indicating that the two sets of specimens are conspecific.

Supposing that the type locality of *Mot. guatemalensis* is correct, the natural host of this species is most likely a species that occurs in western Panama. Three motmot species occur in or near Chiriquí Province: Broad-billed Motmot (*Electron platyrhynchum minus*), Tody

Motmot (*Hylomanes momotula obscurus*) and Lesson's Motmot (Vallely & Dyer 2018, Clements *et al.* 2019). Up to now, no louse specimens have been reported from the first two host species. However, as specimens of *Motmotnirmus* from *Mom. lessonii* are indistinguishable from the type specimens of *Mot. guatemalensis*, we suggest that this may be a natural host of *Mot. guatemalensis*. More collections of lice from Central American motmots and woodpeckers are necessary to establish whether this louse species occurs naturally on other hosts.

Key to the species of *Motmotnirmus*

Based on current knowledge, females of *Motmotnirmus humphreyi* (Oniki & Emerson 1982) and *Mot. marginellus* cannot be reliably separated. The status of *Motmotnirmus xilitla* is not clear (see Oniki & Emerson 1982, Gustafsson & Bush 2017).

1. Lateral margins of pre-antennal head straight, pre-antennal nodi slender (Fig. 2A) ... *Motmotnirmus danielalfonsoi* new species.
 - Lateral margins of pre-antennal head convex, pre-antennal nodi wide ... 2.
2. Row of *tergal posterior setae* on tergopleurite VI (male) or tergopleurite VII (female) ... *Motmotnirmus guatemalensis* (Dalglish 1971).
 - No *tergal posterior setae* on tergopleurite VI (male) or tergopleurite VII (female) ... 3.
3. Pre-antennal nodi with distinctly narrowed anterior "neck" ... *Motmotnirmus xilitla* (Carriker 1954).
 - Pre-antennal nodi with broad anterior section ... 4.
4. Male proximal mesosome with bilobed anterior margin

Table 1. Checklist of the louse species of the genus *Motmotnirmus* Mey & Barker 2014 and their avian hosts.

Louse	Host
<i>Motmotnirmus danielalfonsoi</i> Gustafsson & Bush, new species	Turquoise-browed Motmot, momoto cejazul (<i>Eumomota superciliosa</i>)
<i>Motmotnirmus guatemalensis</i> (Dalglish 1971)	Pale-billed Woodpecker, carpintero pico plateado (<i>Campephilus guatemalensis</i>) ^a Lesson's Motmot, momoto diademado (<i>Momotus lessonii</i>)
<i>Motmotnirmus humphreyi</i> (Oniki & Emerson 1982)	Rufous-capped Motmot, momoto yeruvá oriental (<i>Baryphthengus ruficapillus</i>)
<i>Motmotnirmus marginellus</i> (Nitzsch [in Giebel] 1866)	Andean Motmot, momoto serrano (<i>Momotus aequatorialis chlorolaemus</i>) Amazonian Motmot, momoto común (<i>Momotus momota momota</i> , <i>Momotus momota natteri</i>) Amazonia Motmot (<i>Momotus momota natteri</i>) Whooping Motmot, momoto rojizo (<i>Momotus subrufescens subrufescens</i> , <i>Momotus subrufescens spatha</i>)
<i>Motmotnirmus xilitla</i> (Carriker 1954) ^b	Blue-capped Motmot, momoto capiazul (<i>Momotus coeruliceps</i>)

^a The records from *C. guatemalensis* are presumably based on stragglers, contaminations, or misattributions, but that needs verification.

^b It is unclear whether *Mot. xilitla* can be reliably separated from *Mot. marginellus*.

.... *Motmotnirmus humphreyi* (Oniki & Emerson 1982).
 - Mesosome with rounded anterior margin ... *Motmotnirmus marginellus* (Nitzsch [in Giebel] 1866).

DISCUSSION

With the description of *Motmotnirmus danielalfonsoi*, we now know lice in this genus are present on three of the six genera of motmots (Table 1). To date, there are no descriptions of any species of *Motmotnirmus* from the host of the genera *Hylomanes*, *Electron*, or *Aspatha*. Species of *Motmotnirmus* from different host genera are remarkably homogeneous morphologically, suggesting that the genus has radiated recently. However, three of the five known species of *Motmotnirmus* occur on host species of the *Momotus* genus, which are also morphologically homogeneous (Stiles 2009). The morphological similarity and close relationship between these motmot host species may indicate that selective pressures do not differ significantly between host species, which may restrain morphological variation in the lice. Alternatively, the perceived lack of morphological diversity within the genus *Motmotnirmus* may be an artifact of sampling bias. As more species and individuals of motmots are available for lice sampling, a clearer picture of the morphological variation within *Motmotnirmus* may emerge.

Several morphological characters separate *Motmotnirmus* from all other lice in the *Brueelia*-complex. Among these characters are the lack of sternal plates, the shape of the dorsal pre-antennal suture, the structure and chaetotaxy of the female subgenital plate, the abdominal chaetotaxy of both sexes, and that *marginal temporal seta 2* is a macroseta (Gustafsson & Bush 2017). There are no other genera of lice that are morphologically similar. Valim & Cicchino (2015) once considered *Bobdalgleishia* from jacamars a close relative of these lice, but this hypothesis was later rejected in a morphological revision by Gustafsson & Bush (2017). Genetic data suggest that the closest relatives of *Motmotnirmus* are present in Old World bee-eaters and some Madagascan endemic cuckoos (Bush *et al.* 2016).

In a curious parallel, the only other ischnoceran lice genus known from motmots is *Clayiella*. This genus is limited to motmots and the distantly related Madagascan endemic Cuckoo-roller (*Leptosomus discolor*; Mey 2004). *Clayiella* is morphologically closest to *Vinceopteris* from Asian trogons (Gustafsson *et al.* 2019). These relationships are peculiar. While bee-eaters are widely distributed across the Old World, Neotropical motmots, Madagascan endemics, and Asian trogons do not have overlapping ranges. Moreover, these host groups are not closely related (*e.g.*, Prum *et al.* 2015). Neither strict co-evolution between hosts and lice nor extensive switch-

ing of lice between distantly related but geographically overlapping hosts are sufficient to explain the host associations of *Motmotnirmus*, *Clayiella* and their relatives.

Motmots, cuckoo rollers, and trogons are all known from fossil deposits well outside their current ranges, suggesting that the prehistoric distribution of these taxa may have been radically different (*e.g.*, Olson 1976, Becker 1986, Kristoffersen 2002, Mayr 2005, 2009, Mourer-Chauviré 2006, Weidig 2006). Moreover, the ischnoceran louse fauna of many Neotropical bird groups is poorly known. For instance, few or no lice are known from jacamars, todies, puffbirds, barbets, and many groups of cuckoos and suboscine passerines. Conceivably, undiscovered close relatives of *Motmotnirmus* and *Clayiella* may occur in these host groups. Large-scale surveys of lice from Neotropical birds are rare (*e.g.*, Clayton *et al.* 1992, Soto-Patiño *et al.* 2018), and checklists are published for only a few Latin American countries (Sánchez-Montes *et al.* 2018, González-Acuña & Palma 2021, Guzmán-Torres & Cano-Santana 2021, Minaya *et al.* 2021). Clearly, much research on Neotropical chewing lice remains to be done before we can get an overview of the diversity and relationships of lice in this part of the world.

IN HONOR OF DANIEL

The kind of large-scale, long-term devotion to the chewing louse fauna of a region shown by Daniel González-Acuña, whose publications on lice of Chile span 20 years, is rare in South America, surpassed only by M.A. Carriker, Jr. (active 1903-1966), Lindolpho R. Guimarães (active 1935-1985), and Armando C. Cicchino (active 1977-present). Therefore, it was with great sadness we received the news of the untimely death of Dr. González-Acuña, and we hope to honor his contributions to our knowledge of Neotropical lice with the dedication of a new species to his memory.

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Appendix 1. Definition of some technical terms used in this description.

Abdomen (abdominal): the last, and largest, part of the body, inside which both the stomach and the genitalia are found.

Allotype: traditionally used term for specimen considered typical of the species, but of a different sex than the holotype.

Basal apodeme: the largest part of the male genitalia, positioned anterior to the other parts and, in *Motmotnirmus*, articulating with them distally.

Carina: internal thickenings of the exoskeleton that run along the margins of the body, most prominently along the circumference of the head.

Chaetotaxy: a description of the general length and size, placement, and number of setae on the louse's head or body.

Endophallus: the often-tube-like organ that delivers the sperm during copulation.

Frons: the most anterior part of the head.

Gonopore: the opening in the male genitalia from which the endophallus emerges.

Holotype: the specimen designated to be the link between the theoretical world of humans and the natural world in taxonomy. Essentially, the holotype establishes that at the time of description, at least one specimen existed that possessed the combination of characters described. Holotypes are also important when establishing whether two species (or other taxa) are conspecific.

Macrosetae: very long setae.

Mesosome: part of the male genitalia, typically formed by the fusion of many genitalic plates and associated with the gonopore.

Nodus (nodi): internal thickening of the exoskeleton that is wider, more rounded, and more limited in extent than a carina.

Paratype(s): specimen(s) considered conspecific with the holotype at the time of description. If the holotype is lost or destroyed, these specimens should be used to replace it by designating a "lectotype".

Pre-spiracular ridges: internal thickenings of the tergopleurites just in front of the spiracle openings.

Prothorax (prothoracic): the first body part behind the head, where the first leg pair is situated.

Pterothorax (pterothoracic): the second body part behind the head, where the second and third leg pairs are situated.

Seta (plural: setae): hair- or spike-like bristles on the head and body of the louse, often useful for species identification. Some may be modified to sense organs (*e.g.*, on the antennae).

Setal rows: A row of setae.

Spiracle openings: small openings on the surface of the louse's body (most prominently on the abdomen) which are connected to the spiracle system, which distributes oxygen to all parts of the louse's body.

Subgenital plate: hardened plate on the lower (ventral) side of the abdomen just below the male genitalia, or just in front of the female genital opening.

Tergopleurites: hardened plates on the upper (dorsal) side of the abdomen.