Revista Brasileira de Parasitologia Veterinária
Brazilian Journal of Veterinary Parasitology
ISSN 1984-2961 (Electronic)
www.cbpv.org.br/rbpv

Original Article

Parasites of the Shiny Cowbird, *Molothrus bonariensis*, and the Austral Blackbird, *Curaeus curaeus*, (Passeriformes: Icteridae) in Chile

Parasitas do chupim *Molothrus bonariensis* e do pássaro-preto-austral *Curaeus curaeus* (Passeriformes: Icteridae) no Chile

Mabel Mena[1]; José Osvaldo Valdebenito[2]; Lucila Moreno[3]; Danny Fuentes-Castillo[4]; John Mike Kinsella[5]; Sergey Mironov[6]; Carlos Barrientos[7]; Armando Cicchino[8]; Daniel González-Acuña[1]*

[1] Laboratorio de Parásitos y Enfermedades de Fauna Silvestre, Facultad de Ciencias Veterinarias, Universidad de Concepción, Chillán, Chile
[2] Milner Centre for Evolution, University of Bath, Bath, United Kingdom
[3] Facultad de Ciencias Naturales y Oceanográficas, Universidad de Concepción, Concepción, Chile
[4] Laboratório de Patologia Comparada de Animais Selvagens, Departamento de Patologia Experimental e Comparada, Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo – USP, São Paulo, SP, Brasil
[5] Helm West Lab, Missoula, Montana, United States of America
[6] Zoological Institute, Russian Academy of Sciences, Universitetskaya Embankment 1, Saint Petersburg, Russia
[7] Escuela de Medicina Veterinaria, Universidad Santo Tomás, Concepción, Chile
[8] Universidad Nacional de Mar del Plata, Mar del Plata, Argentina

How to cite: Mena M, Valdebenito JO, Moreno L, Fuentes-Castillo D, Kinsella JM, Mironov S, et al. Parasites of the Shiny Cowbird, *Molothrus bonariensis*, and the Austral Blackbird, *Curaeus curaeus* (Passeriformes: Icteridae) in Chile. *Braz J Vet Parasitol* 2020; 29(2): e021819. https://doi.org/10.1590/S1984-29612020022

Abstract

Comparative studies of parasites in sympatric bird species have been generally scarce. Parasitic infection/transmission can be spread in a number of ways that suggests possible direct and indirect, horizontal transmission between avian hosts. In order to determine whether two sympatric icterids from Central and Southern Chile share their parasite fauna (ecto- and endoparasites), we examined parasites of 27 Shiny Cowbirds, *Molothrus bonariensis*, and 28 Austral Blackbirds, *Curaeus curaeus*, including individuals captured in the wild and carcasses. We found that Shiny Cowbirds were infected with the chewing lice *Brueelia bonariensis*, *Philopterus* sp. 1, the feather mites *Amerodectes molothrus*, *Proctophyllodes* spp. (species 1 and 2), and the helminths *Mediorhynchus papillosus*, *Plagiorhynchus* sp., *Dispharynx nasuta* and *Tetrameres paucispina*, while Austral Blackbirds had the chewing lice *Myrsidea* sp., *Philopterus* sp. 2, the feather mites *Proctophyllodes* sp. 3, *Amerodectes* sp., and three helminths: *Anonchotaenia* sp., *Capillaria* sp. and *M. papillosus*. The flea *Dasypsyllus* (*Neornipsyllus*) *cteniopus* was found only on the Austral Blackbird. The only parasite species shared by both icterids was the acanthocephalan *M. papillosus*, possibly due to their feeding on the same intermediate insect hosts. With the exception of *B. bonariensis* and *Philopterus* sp. 1 found on the Shiny Cowbird, all species reported in this study represent new parasite-host associations and new records of parasite diversity in Chile.

Keywords: Parasite diversity, sympatry, Icteridae, Phthiraptera, Acari, roundworm.

Resumo

Estudos comparativos de parasitas em espécies de aves simpátricas são escassos. A infecção/transmissão de parasitas pode acontecer de diversas maneiras, incluindo possível transmissão direta, indireta ou horizontal entre as aves hospedeiras. Com o objetivo de determinar se dois icterídeos simpátricos do centro e sul do Chile compartilham a sua fauna parasitária (ecto- e endoparasitas), foram examinados os parasitas de 27 chupins *Molothrus bonariensis* e 28 pássaros-pretos-austral *Curaeus curaeus*, incluindo indivíduos capturados com rede de neblina e em carcaças. Nos chupins analisados, foram encontrados os piolhos de penas *Brueelia bonariensis*, *Philopterus* sp. 1, os ácaros *Amerodectes molothrus*, *Proctophyllodes* spp. (espécie 1 e 2), e os helmintos *Mediorhynchus papillosus*, *Plagiorhynchus* sp., *Dispharynx nasuta* e *Tetrameres paucispina*. Em contraste, os pássaros-pretos-austral estavam infectados com os piolhos *Myrsidea* sp., *Philopterus* sp. 2, os ácaros *Proctophyllodes* sp. 3,

Received November 27, 2019. Accepted March 24, 2020.
*Corresponding author: Daniel González-Acuña. E-mail: E-mail: danigonz@udec.cl

Amerodectes sp., e os helmintos *Anonchotaenia* sp., *Capillaria* sp. e *M. papillosus*. Adicionalmente, um espécime de pássaro-preto-austral estava parasitado pela pulga *Dasypsyllus* (*Neornipsyllus*) *ctenioptus*. A única espécie de parasita que foi encontrada nas duas espécies de aves foi o acantocéfalo *M. papillosus*, possivelmente devido ao fato de que ambas as aves se alimentam dos insetos que são os hospedeiros intermediários deste parasita. Exceto os registros de *B. bonariensis* e *Philopterus* sp. 1 encontrados no chupim, todas as espécies reportadas neste estudo correspondem à novas associações de parasita/hospedeiro e novos registros para a diversidade parasitológica do Chile.

Palavras-chave: Diversidade de parasitas, simpatria, Icteridae, Phthiraptera, Acari, nematódeos.

Introduction

Parasitism is ubiquitous in nature and although recent advances have revealed important details of some host-parasite associations (e.g. Doña et al., 2019), we are still far from understanding in depth key points of host-parasite dynamics. The relatively vast avian diversity and even richer diversity of gastrointestinal and external parasites make the study of parasite transmission dynamics an obscure subject. For example, transmission of ectoparasites generally happens through direct contact between individuals, either between adult birds (horizontal transmission) or between parents and their offspring (vertical transmission) (Eichler, 1963; Marshall, 1981; Darolova et al., 2001). In the case of gastrointestinal parasites, because they often have complex life cycles and generally need a fecal-oral route to infect, transmission also occurs from ingestion of eggs or other infective stages of the parasite, often within an intermediate host (Atkinson et al., 2008). The Shiny Cowbird, *Molothrus bonariensis* (Gmelin, 1789), and the Austral Blackbird, *Curaeus curaeus* (Molina, 1782), are two locally common icterids that have a similar size, behavior, and diet (Fraga, 2011). Although the Shiny Cowbird and Austral Blackbird are largely distributed in South America and Patagonia, respectively, they are sympatric only in Chile, where they share a large part of their distribution range and are often observed in mixed flocks foraging together (Fraga, 2011; Couve et al., 2016). This close proximity between these two species might suggest interspecific gastrointestinal and ectoparasite exchange. However, to date, the few studies of parasites of Shiny Cowbirds and Austral Blackbirds were centered

Table 1. Checklist of parasites recorded in Shiny Cowbirds and Austral Blackbirds.

Parasites	Host	Origin	Reference
Phthiraptera			
Brueelia bonariensis	Shiny Cowbird	Chile	Cicchino & Castro (1996); This study
Brueelia trinidadensis	Shiny Cowbird	Trinidad and Tobago	Cicchino & Castro (1996)
Brueelia marcoi	Austral Blackbird	Chile; Argentina	Cicchino & Castro (1996)
Philopterus sp. 1	Shiny Cowbird	Chile	This study
Philopterus sp. 2	Austral Blackbird	Chile	This study
Myrsidea sp.	Austral Blackbird	Chile	This study
Myrsidea bonariensis	Shiny Cowbird*	Possibly in Argentina	Clay (1968)
Machaerilaemus laticorpus	Austral Blackbird	Chile	Price et al. (2002)
Acari (feather mites)			
Amerodectes molothrus	Shiny Cowbird	Brazil; Chile	Mironov et al. (2008); This study
Amerodectes sp.	Austral Blackbird	Chile	This study
Proctophyllodes sp. 1	Shiny Cowbird	Chile	This study
Proctophyllodes sp. 2	Shiny Cowbird	Chile	This study
Proctophyllodes sp. 3	Austral Blackbird	Chile	This study
Syringophilopsis bonariensis	Shiny Cowbird	Brazil	Skoracki et al. (2016)
(ticks)			
Ixodes auritulus	Austral Blackbird	Chile	González-Acuña et al. (2004)
Helminths			
Dispharynx nasuta	Shiny Cowbird	Chile	This study
Tetrameres paucispina	Shiny Cowbird	Chile	This study
Mediorhynchus papillosus	Shiny Cowbird; Austral Blackbird	Chile	This study
Plagiorhynchus sp.	Shiny Cowbird	Chile	This study
Capillaria sp.	Austral Blackbird	Chile	This study
Anonchotaenia sp.	Austral Blackbird	Chile	This study
Anonchotaenia longiovata	Austral Blackbird	Not given	Rausch & Morgan (1947)

*Possible erroneous host. See discussion in Clay (1968).

on taxonomical descriptions based on morphological traits of new species instead of the host-parasite dynamics (see Table 1 and references therein).

In the present study, we examined the external and gastrointestinal parasites of sympatric Shiny Cowbirds and Austral Blackbirds in Chile, with the aim to determine whether sharing environment and diet could influence interspecific parasite transmission between these hosts.

Materials and Methods

We examined a total of 27 Shiny Cowbirds and 28 Austral Blackbirds. The first group of birds analyzed corresponded to seven Shiny Cowbirds and 20 Austral Blackbirds captured using mist nets in four localities of Central and Southern Chile (2013-2014): Termas del Flaco (1720 meters above sea level (ma.s.l.); 34°57'S, 70°26'W), Sierras de Bellavista (900-1100 ma.s.l.; 34°48'S, 70°45'W), Parque Inglés (1100-1300 ma.s.l.; 35°28'S, 70°59'W) and Chiloé National Park (sea level; 42°37'S, 74°3'W) (Figure 1). The birds were examined for ectoparasites for no longer than five minutes to avoid an excessive stress. The ectoparasites were removed from feathers with anatomic tweezers and kept in microcentrifuge tubes with 70% ethanol for subsequent identification. The second group examined corresponded to 20 Shiny Cowbirds and eight Austral Blackbirds carcasses (2007-2014), dead after vehicle-collision, poaching or later in rescue centers. The birds were received by the Faculty of Veterinary Science, University of Concepción, Campus Chillán, and each individual was independently stored in a plastic bag and frozen until necropsy, which followed the protocol proposed by Kinsella & Forrester (1972), enabling an efficient

Figure 1. Sampling localities of Shiny Cowbirds and Austral Blackbirds in Central and Southern Chile.

collection of both ectoparasites and gastrointestinal parasites. Lice were mounted in Canada balsam following the protocol described by Palma (1978) and Price et al. (2003). Mites were cleared in Nesbitt's solution (40 g of chloral hydrate, 25 mL of distilled water, and 2.5 mL of hydrochloric acid) for 72 h and were later mounted in Berlese's solution (Walter & Krantz, 2009). Fleas were mounted in Canada balsam following the procedures described by Furman & Catts (1982). All parasites were examined using the standard light microscopy methods, recommended for each parasite type (magnifications 40X-100X). For the identification of Phthiraptera, including sex determination and state of development, were used keys proposed by Nitzsch (1818), Cicchino & Castro (1996) and Price et al. (2003); for feather mites, keys proposed by Gaud & Atyeo (1996), Mironov et al. (2008), Valim & Hernandes (2010), Mironov & Chandler (2017); and for fleas, keys from Hastriter & Schlatter (2006). Endoparasites were processed according to Hendrix & Robinson (2012) and identified with keys proposed by Yamaguti (1961, 1963), Khalil et al. (1994), Van Cleave (1916), Sandground (1928), and Zhang et al. (2004). All collected specimens were stored in the collection of the Laboratory of Zoology, Faculty of Veterinary Science, University of Concepción, under the codes CDCA 140 to 146 for mites, UdeCPhsa 150 to 153 for lice, CDCA 186 to 193 for helminths, and CDCA 50 for the flea.

Results and Discussion

Phthiraptera

On 33.3% of Shiny Cowbirds (9/27), we found two species of chewing lice (Table 2a and Figure 2): *Brueelia bonariensis* Cicchino & Castro, 1996 and *Philopterus* sp. 1. Whereas on Austral Blackbirds, the lice prevalence was lower (Table 2b), with 14.3% of birds (4/28) parasitized with two species (Figure 2): *Myrsidea* sp. and *Philopterus* sp. 2.

In Shiny Cowbirds, the *Brueelia* lice found (Figure 2A, 2B) corresponded to the classic descriptions of this genus in New World Icterids (for details, see Cicchino & Castro, 1996). In particular, the macule on the pulvinar edge of the frontoclipeal suture placed these parasites in the *amazonae* subgroup. Within this group, males of *B. bonariensis* and *B. americana* Cicchino & Castro, 1996 could be very similar, however, it was possible to clearly discriminate from the latter by its head's shape, the II-IV brownish tergites, and lack of the postespiracular setae in the IV tergite

Table 2. Descriptive statistics of parasites of (a) Shiny Cowbirds and (b) Austral Blackbirds in Chile.

Parasites	Prevalence (%)	Mean intensity	Range	Males	Females	Immature
a) Shiny Cowbird						
Phthiraptera						
Brueelia bonariensis	25.9	3.9	0-11	8	11	8
Philopterus sp. 1*	11.1	1.3	0-2	0	1	3
Acari						
*Amerodectes molothrus**	3.8	1	0-1	1	0	0
Proctophyllodes sp. 1*	22.2	4.33	0-12	7	18	1
Proctophyllodes sp. 2*	18.5	1.6	0-2	1	7	0
Helminths						
*Dispharynx nasuta**	5	4	0-4	1	3	0
*Tetrameres paucispina**	5	2	0-2	2	0	0
*Mediorhynchus papillosus**	5	1	0-1	0	1	0
Plagiorhynchus sp.*	5	2	0-2	0	2	0
b) Austral Blackbird						
Phthiraptera						
Myrsidea sp.*	3.6	3	0-3	1	0	2
Philopterus sp. 2*	10.7	1.7	0-2	1	1	2
Acari						
Amerodectes sp.*	53.6	11.7	0-44	60	59	56
Proctophyllodes sp. 3*	7.1	2.5	0-4	1	4	0
Helminths						
Capillaria sp.*	25	3	0-4	2	4	0
Anonchotaenia sp.*	12.5	1	0-1	0	1	0
*Mediorhynchus papillosus**	12.5	2	0-2	0	2	0

*New parasite-host association.

(Cicchino & Castro, 1996). From each bird host, we collected lice that were classified within the *Philopterus*-complex (Figure 2C-E) due to their e.g., preantennal head very narrow, marginal carina with indentation on median side, and terminal segment of female abdomen with paired pseudostyli (more details in Mey, 2004). The lice from this complex are specialized to live on the head of their hosts and are usually found on perching birds (Mey, 2004). Although these lice found shared mutual similarities, they represented two distinctive morphotypes, clearly differing morphologically from one another (see Price et al., 2003), and did not correspond to any known species. In the Austral Blackbird, a louse showed morphological characteristics that suggested a good fit to males of the genus *Myrsidea* (Figure 2F), according to Waterston (1915). Unfortunately, this louse was distinctive enough not to fit any of the nearly 350 described species for *Myrsidea* (Valim et al., 2011; Valim & Weckstein, 2013). Nevertheless, this goes in line with the ideas by the latter authors, suggesting that to date only a small fraction of species in the genus *Myrsidea* have been described.

Acari

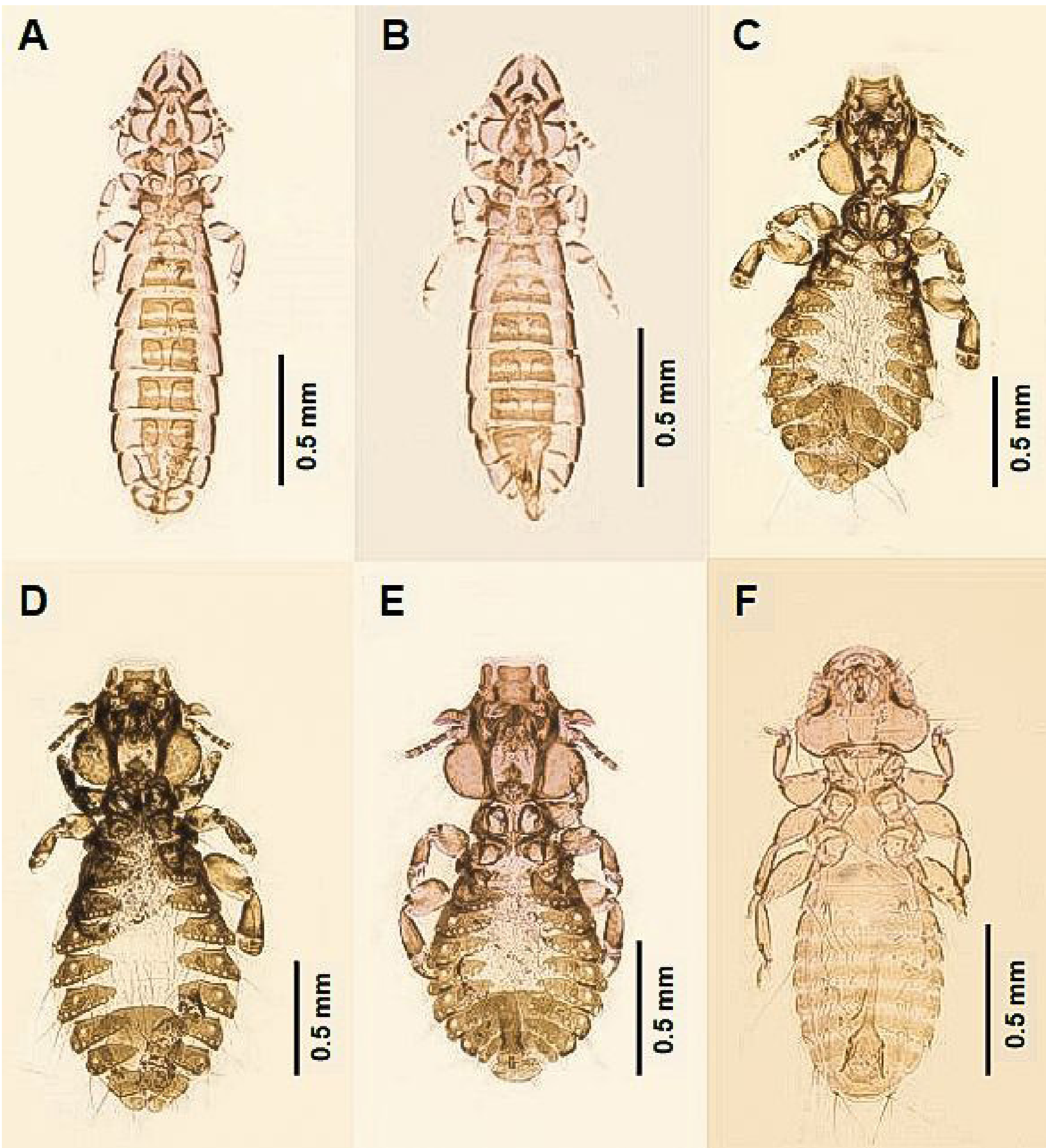

Figure 2. Chewing lice found in Shiny Cowbirds and Austral Blackbirds: *Brueelia bonariensis*, female (A) and male (B); *Philopterus* sp. 1, female (C); *Philopterus* sp. 2, female (D) and male (E); and *Myrsidea* sp., male (F).

Shiny Cowbirds, 37% of individuals (10/27), were infested with three feather mite species of the family Proctophyllodidae (Table 2a and Figure 3): *Amerodectes molothrus* (Mironov, 2008) (Pterodectinae), and two morphotypes of *Proctophyllodes* (hereafter *Proctophyllodes* sp. 1, and *Proctophyllodes* sp. 2) (Proctophyllodinae). On Austral Blackbirds, 53.6% of birds (15/28) had feather mites (Table 2b and Figure 3), belonging to the species *Amerodectes* sp. and *Proctophyllodes* sp. 3. *Amerodectes* mites found on both bird species (Figure 3G-I) met the morphological criteria of the genus (see Valim & Hernandes, 2010). The only female found on the Shiny Cowbird generally corresponds to the description of *A. molothrus*, described from this bird species in Brazil (Mironov et al., 2008), in having similar shape of the dorsal shields, lobar region, and the pattern of ornamentation on the hysteronotal shield. However, in contrast to the original description, our specimen lacks the rudiments of humeral shields and has noticeably shorter terminal appendages that could probably be a manifestation a geographic variability of this mite species widely distributed on *Molothrus* species. Females of the genus *Amerodectes* found on the Austral Blackbird have different shape of the lobal region (with much shorter opisthosomal lobes than

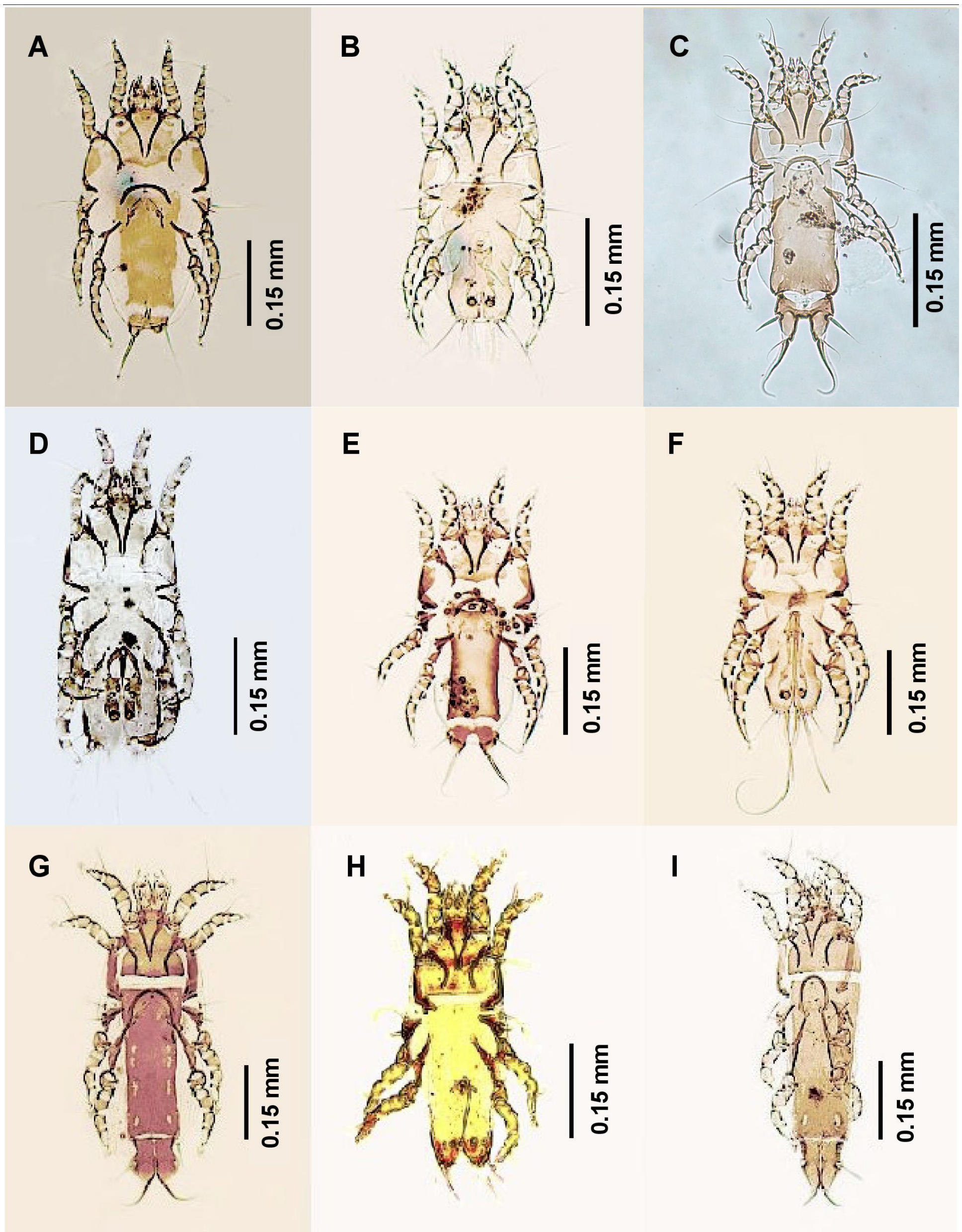

Figure 3. Feather mite species found in Shiny Cowbirds and Austral Blackbirds: *Proctophyllodes* sp. 1, female (A) and male (B); *Proctophyllodes* sp. 2, female (C) and male (D); *Proctophyllodes* sp. 3, female (E) and male (F); *Amerodectes* sp., female (G) and male (H); and *Amerodectes molothrus*, female (I).

in specimen from the Shiny Cowbird), and the hysteronotal shield entirely covered with ornamentation of small lacunae. Males of this mite belong to the species group having long filiform setae *h3,* and by the shape of dorsal shields and the length of the genital apparatus they are most similar to *Amerodectes xanthocephali* Mironov and Overstreet, 2015 described from the Yellow-headed Blackbird *Xanthocephalus xanthocephalus* (Bonaparte, 1826) in Oregon, USA (Mironov & Overstreet, 2015). Males of *Proctophyllodes* sp. 1 (Figure 3B) have the genital apparatus not extending to the level of setae *ps3* and the opisthogastric shield split into two longitudinal pieces that formally allows to refer this mite to the *musicus* species group by Atyeo & Braasch (1966). However, extremely long, narrow and widely separated pieces of the opisthogastric shield and narrow terminal lamellae in males give evidence that this mite could belongs to the *thraupis* species group (phylogenetic clade) (Klimov et al., 2017). *Proctophyllodes* sp. 2, also found on the Shiny Cowbird (Figure 3C, 3D), has an H-shaped opisthogastric shield and wedge-shaped genital sheath with a strongly sclerotized basal ring in males that univocally refers it to the *pinnatus* group (Atyeo & Braasch, 1966). Males of *Proctophyllodes* sp. 3, found in the Austral Blackbird (Figure 3F), have extremely long whip-like genital sheath extending far beyond the posterior end of the body of males. Therefore, following the revision by Atyeo & Braasch (1966), this mite could be formally referred to the *glandarinus* species group. However, taking in attention the structure of the opisthogastric shield represented by a pair of extremely long and thin sclerites bearing setae *g* and *ps3*, and narrow ribbon-like terminal lamellae, this mite definitely belongs to the *thraupis* species group as interpreted by Klimov et al. (2017). Within this group, *Proctophyllodes* sp. 3 is most similar to *Proctophyllodes longiphyllus* Atyeo and Braasch, 1966 associated with the Baltimore Oriole *Icterus galbula* (Linnaeus, 1758) and Hispaniolan Oriole *Icterus dominicensis* (Linnaeus, 1766) in North America.

Siphonaptera

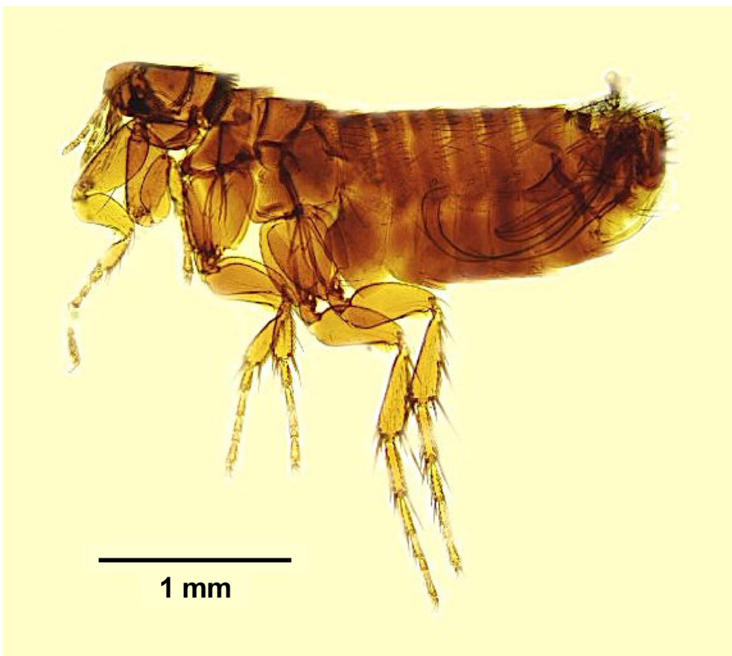

Figure 4. *Dasypsyllus* (*Neornipsyllus*) *cteniopus*, male, found on one Austral Blackbird.

On one Austral Blackbird carcass, we found a male specimen of flea (Figure 4) that, according to Hastriter & Schlatter (2006), was classified as *Dasypsyllus* (*Neornipsyllus*) *cteniopus* Jordan & Rothschild, 1920. This represents a rare finding on host, because fleas often abandon their host once dead. These fleas are commonly found in bird nests (Lewis & Stone, 2001). *Dasypsyllus* species often parasitize passerine birds, however, is not uncommon to find them on hosts of other avian orders, and even on mammals, although the latter hosts have been reported as rare and sporadic (Hastriter & Schlatter, 2006). In Chile, this parasite has been found in nests of the Magellanic Tapaculo *Scytalopus magellanicus* (Gmelin, 1789), Chucao Tapaculo *Scelorchilus rubecula* (Kittlitz, 1830), Thorn-tailed Rayadito *Aphrastura spinicauda* (Gmelin, 1789), Rufous-Collared Sparrow *Zonotrichia capensis* (Müller, 1776), and

House Wren *Troglodytes aedon* (Vieillot, 1809) (Turienzo & Di Iorio, 2013; Beaucournu et al., 2014). We argue that the present record is possibly an accidental finding, because Austral Blackbirds have been reported predating on nests of the Thorn-Tailed Rayadito (Vergara, 2007). Thus, we cannot confirm the present finding as a natural parasite-host association.

Helminths

In 10% of Shiny Cowbirds necropsied (2/20), we found two species of nematodes and two of acanthocephalans: *Dispharynx nasuta* Rudolphi, 1819, and *Tetrameres paucispina* Sandground, 1928, and *Mediorhynchus papillosus* Van Cleave, 1916, and *Plagiorhynchus* sp. (Table 2a). Whereas 50% of Austral Blackbirds (4/8) were parasitized, presenting the helminths *Capillaria* sp. (Nematoda), *Anonchotaenia* sp. (Cestoda), and *M. papillosus* (Acanthocephala) (Table 2b).

The two nematodes found in Shiny Cowbirds agreed with descriptions by Macko et al. (1977) and Zhang et al. (2004) for *D. nasuta*, and of Sandground (1928) for male *T. paucispina*. In the case of acanthocephalans, we identified only gravid females of *M. papillosus*, and two females of one fusiform species, presenting a lacunar system with reticular anastomosis, long cylindrical proboscis, with numerous small hooks at the base, and a terminal genital pore. These features agreed with characteristics of the genus *Plagiorhynchus* (Yamaguti, 1963). In the Austral Blackbird, the *Capillaria* specimens found were males (terminal anus, membranous caudal alae, long and thin spicule with spiny sheath) and females (vulva without a flap or protrusions), but their morphology did not match any previously known species described for related host (Yamaguti, 1961). Only one specimen of cestode was found, a female of *Anonchotaenia* sp. This parasite did not have a rostellum or hooks, had very short proglottids (except for the posterior one), and longitudinal muscles arranged in two distinct layers (Yamaguti, 1959). *Mediorhynchus papillosus* was also present in the Austral Blackbird but at higher prevalence and intensity than in the Shiny Cowbird. As typical for acanthocephalans, *M. papillosus* requires an invertebrate as intermediate host to complete its cycle (Atkinson et al., 2008). Therefore, it is possible to conclude that both birds share at least one invertebrate species in their diets. We did not find *Anonchotaenia longiovata* (Fuhrmann, 1901) in the birds sampled, the only helminth previously reported in the Austral Blackbird (Rausch & Morgan, 1947).

Shared parasite fauna

Host shifts are widespread across parasite taxa (Sieber & Gudelj, 2014). Accordingly, we found that most genera of ectoparasites on Shiny Cowbirds and Austral Blackbirds were shared by these birds. However, the chewing louse genera *Brueelia* and *Myrsidea* were specific to Shiny Cowbirds and Austral Blackbirds, respectively. Although ectoparasites are generally highly species-specific, lice tend to be very mobile, with many accidental reports, e.g. in birds of prey (see discussion on *Heteromenopon macrurum* in Valdebenito et al., 2015). Therefore, it is interesting that these phylogenetically closely related icterid birds (subfamily Agelaiinae) (Remsen et al., 2016) did not share a higher number of ectoparasites. Bush et al. (2019) recently showed that feather lice require a relatively low number of generations to develop adaptations to a new host, suggesting a high plasticity from lice in case of host shifts. However, these are only speculations and we need further studies to prove these ideas on these icterids, since factors that determine success or failure of these events are complex and strongly dependent on, for example, ecological processes (climate, geographical, vectors) and host immune mechanisms (Moens et al., 2016; Sieber & Gudelj, 2014). Gastrointestinal parasites are the most likely to be transmitted between hosts because, contrary to ectoparasites, their life cycle allows indirect transmission. Interestingly, only *M. papillosus* was found in both bird species. Perhaps, only this parasite had the ideal conditions for the transmission to occur, which may include sharing similar diets (to ingest the intermediate host) and physiological conditions to allow its development and further infestation (Holmes, 1987; Hurd, 1990).

The present study contributed to the biodiversity of parasites of Chile, establishing new parasite-host associations. We also showed that, although these birds live in sympatry and share similar behaviors and diets, only one species of gastrointestinal parasite was shared. Parasite-host interactions of icterids of South America are widely understudied. Future studies involving representative samples across the distribution range of both icterids could provide more thorough description on the composition and ecology of their parasite fauna.

Acknowledgements

We thank Carolina Silva, Sofía González and Karen Ardiles for their support during the confection of this study. MM was funded by CONICYT-PCHA/Magíster Nacional/2016-22162322 and JOV was funded by CONICYT, Becas Chile 79090016. The fieldwork conducted during this research work was funded by the FONDECYT, project number 1130948 and 1170972.

References

Atkinson CT, Thomas NJ, Hunter DB. *Parasitic diseases of wild birds*. Ames: Wiley-Blackwell; 2008. http://dx.doi.org/10.1002/9780813804620.

Atyeo WT, Braasch NL. The feather mite genus Proctophyllodes (Sarcoptiformes: proctophyllodidae). *Bull Univ Nebr State Mus* 1966; 5: 1-354.

Beaucournu JC, Moreno L, González-Acuña D. Fleas (Insecta: Siphonaptera) of Chile: a review. *Zootaxa* 2014; 3900(2): 151-203. http://dx.doi.org/10.11646/zootaxa.3900.2.1. PMid:25543732.

Bush SE, Villa SM, Altuna JC, Johnson KP, Shapiro MD, Clayton DH. Host defense triggers rapid adaptive radiation in experimentally evolving parasites. *Evol Lett* 2019; 3(2): 120-128. http://dx.doi.org/10.1002/evl3.104. PMid:31007943.

Cicchino A, Castro DC. Revisión preliminar de las especies del género *Brueelia* Kéler, 1936 (Phthiraptera, Philopteridae) parásitas de Icterinae (Aves, Passeriformes, Fringillidae). *Graellsia* 1996; 52(0): 3-30. http://dx.doi.org/10.3989/graellsia.1996.v52.i0.373.

Clay T. Contributions towards a revision of *Myrsidea* Waterston, III. (Menoponidae: mallophaga). *Bull Br Mus Nat Hist* 1968; 21(4): 203-243.

Couve E, Vidal CF, Ruiz TJ. *Aves de Chile, sus Islas Oceánicas y Península Antártica*. Punta Arenas: FS Editorial; 2016.

Darolova A, Hoi H, Kristofik J, Hoi C. Horizontal and vertical ectoparasite transmission of three species of Malophaga, and individual variation in european bee-eaters (*Merops apiaster*). *J Parasitol* 2001; 87(2): 256-262. http://dx.doi.org/10.1645/0022-3395(2001)087[0256:HAVETO]2.0.CO;2. PMid:11318553.

Doña J, Proctor H, Serrano D, Johnson KP, Oploo AO, Huguet-Tapia JC, et al. Feather mites play a role in cleaning host feathers: new insights from DNA metabarcoding and microscopy. *Mol Ecol* 2019; 28(2): 203-218. http://dx.doi.org/10.1111/mec.14581. PMid:29726053.

Eichler W. *Dr. H. G. Bronns Klassen und Ordnungen des Tierreichs. Bd 5, III. Abteilung, 7. Buch, b) Phthiraptera, Mallophaga*. Leipzig: Akademische Verlagsgesellschaft; 1963. 290 p.

Fraga R. Family Icteridae (New World Blackbirds). In: Del Hoyo J, Elliott A, Christie DA, editors. *Handbook of the birds of the world alive*. Barcelona: Lynx Edicions; 2011. p. 684-807. (vol. 16).

Furman DP, Catts EP. *Manual of medical entomology*. 4th ed. New York: Cambridge University Press; 1982.

Gaud J, Atyeo WT. *Feather mites of the world (Acarina, Astigmata): the supraspecific taxa, part I*. Belgium: Musée Royal De L'Africque Central; 1996.

González-Acuña D, Venzal JM, Guglielmone AA. Nuevos hospedadores y localidades de *Ixodes sigelos* e *Ixodes auritulus* (Acari: Ixodidae) en Chile. *Gayana* 2004; 68(1): 108-111. http://dx.doi.org/10.4067/S0717-65382004000100012.

Hastriter MW, Schlatter RP. Revision of the fleas in the subgenus *Dasypsyllus* (*Neornipsyllus*) (Siphonaptera: ceratophyllidae). *Ann Carnegie Mus* 2006; 75(4): 247-257. http://dx.doi.org/10.2992/0097-4463(2006)75[247:ROTFIT]2.0.CO;2.

Hendrix C, Robinson E. *Diagnostic parasitology for veterinary technicians*. 4th ed. St. Louis: Elsevier; 2012.

Holmes PH. Pathophysiology of parasitic infections. *Parasitology* 1987;94(S1 Suppl): S29-S51. http://dx.doi.org/10.1017/S0031182000085814. PMid:3295690.

Hurd H. Physiological and behavioural interactions between parasites and invertebrate hosts. *Adv Parasitol* 1990; 29: 271-318. http://dx.doi.org/10.1016/S0065-308X(08)60108-6. PMid:2181829.

Khalil LF, Jones A, Bray RA. *Keys to the cestode parasites of vertebrates*. Wallingford: CAB International; 1994.

Kinsella JM, Forrester DJ. Helminths of the Florida duck, *Anas platyrhynchos fulvigula. Proc Helminthol Soc Wash* 1972; 39(2): 173-176.

Klimov PB, Mironov SV, O'Connor BM. Convergent and unidirectional evolution of extremely long aedeagi in the largest feather mite genus, *Proctophyllodes* (Acari: Proctophyllodidae): evidence from comparative molecular and morphological phylogenetics. *Mol Phylogenet Evol* 2017; 114: 212-224. http://dx.doi.org/10.1016/j.ympev.2017.06.008. PMid:28642015.

Lewis RE, Stone E. *Psittopsylla mexicana*, a new genus and species of bird flea from Chihuahua, Mexico (Siphonaptera: Ceratophyllidae: Ceratophyllinae). *J NY Entomol Soc* 2001; 109(3-4): 360-366. http://dx.doi.org/10.1664/0028-7199(2001)109[0360:PMANGA]2.0.CO;2.

Macko JK, Birova V, Hovorka J. On the variability of *Dispharynx nasuta* (Rudolphi, 1819) in Cuba. *Helminthologia* 1977; 15: 881-903.

Marshall AG. *The ecology of ectoparasitic insects*. London: Academic Press; 1981.

Mey E. Zur taxonomie, Verbreitung und parasitophyletischer Evidenz des *Philopterus*-Komplexes (Insecta, Phthiraptera, Ischnocera). *Ornithol Anz* 2004; 43: 149-203.

Mironov S, Literak I, Capek M. New feather mites of the subfamily Pterodectinae (Acari: Astigmata: Proctophyllodidae) from passerines (Aves: Passeriformes) in Mato Grosso do Sul, Brazil. *Zootaxa* 2008; 1947(1): 1-38. http://dx.doi.org/10.11646/zootaxa.1947.1.1.

Mironov SV, Chandler CR. New feather mites of the genus *Amerodectes* Valim and Hernandes (Acariformes: Proctophyllodidae) from passerines (Aves: Passeriformes) in Georgia, USA. *Zootaxa* 2017; 4344(2): 201-245. http://dx.doi.org/10.11646/zootaxa.4344.2.1. PMid:29245629.

Mironov SV, Overstreet RM. A new species of the feather mite genus *Amerodectes* Valim et Hernandes, 2010 (Acariformes: Proctophyllodidae) from *Xanthocephalus xanthocephalus* (Passeriformes: Icteridae) in Oregon. *Acarina* 2015; 23(1): 74-80.

Moens MA, Valkiūnas G, Paca A, Bonaccorso E, Aguirre N, Pérez-Tris J. Parasite specialization in a unique habitat: hummingbirds as reservoirs of generalist blood parasites of Andean birds. *J Anim Ecol* 2016; 85(5): 1234-1245. http://dx.doi.org/10.1111/1365-2656.12550. PMid:27177277.

Nitzsch CL. Die Familien und Gattungen der Thierinsekten (insecta epizoica); als Prodromus einer Naturgeschichte derselben. *Magazin der Entomologie* 1818; 3: 261-316.

Palma RL. Slide mounting of lice: a detailed description of the Canada balsam technique. *N Z Entomol* 1978; 6(4): 432-436. http://dx.doi.org/10.1080/00779962.1978.9722313.

Price RD, Hellenthal RA, Dalgleish RC. A review of *Machaerilaemus* (Phthiraptera: Amblycera: Menoponidae) from the Passeriformes (Aves), with the description of five new species. *Am Midl Nat* 2002; 148(1): 61-74. http://dx.doi.org/10.1674/0003-0031(2002)148[0061:AROMPA]2.0.CO;2.

Price RD, Hellenthal RA, Palma RL, Johnson KP, Clayton DH. *The chewing lice: world checklist and biological overview*. Illinois: Illinois Natural History Survey; 2003. (Special Publication; vol. 24).

Rausch R, Morgan BB. The genus *Anonchotaenia* (Cestoda: Dilepididae) from North American birds, with the description of a new species. *Trans Am Microsc Soc* 1947; 66(2): 203-211. http://dx.doi.org/10.2307/3223251. PMid:20266405.

Remsen JV Jr, Powell AF, Schodde R, Barker FK, Lanyon SM. A revised classification of the Icteridae (Aves) based on DNA sequence data. *Zootaxa* 2016; 4093(2): 285-292. http://dx.doi.org/10.11646/zootaxa.4093.2.9. PMid:27394496.

Sandground JH. A New Nematode parasite, *Tetrameres paucispina*, from a South American bird, *Amblyramphus holocericeus. J Parasitol* 1928; 14(4): 265-268. http://dx.doi.org/10.2307/3271385.

Sieber M, Gudelj I. Do-or-die life cycles and diverse post-infection resistance mechanisms limit the evolution of parasite host ranges. *Ecol Lett* 2014; 17(4): 491-498. http://dx.doi.org/10.1111/ele.12249. PMid:24495077.

Skoracki M, Mironov SV, Hernandes FA, Valim MP. Syringophilid quill mites (Acari: Syringophilidae) parasitizing passerines (Aves: Passeriformes) in Brazil. *Int J Acarol* 2016; 42(5): 252-257. http://dx.doi.org/10.1080/01647954.2016.1179673.

Turienzo P, Di Iorio O. Insectos en nidos de aves de la Argentina: *Asthenes dorbignyi* (Reichenbach, 1853) [Aves: Furnariidae]. *Idesia* 2013; 31(4): 87-94. http://dx.doi.org/10.4067/S0718-34292013000400012.

Valdebenito JO, Moreno L, Landaeta-Aqueveque C, Kinsella JM, Mironov S, Cicchino A, et al. Gastrointestinal and external parasites of *Enicognathus ferrugineus* and *Enicognathus leptorhynchus* (Aves, Psittacidae) in Chile. *Rev Bras Parasitol Vet* 2015; 24(4): 422-431. http://dx.doi.org/10.1590/S1984-29612015074. PMid:26648008.

Valim MP, Hernandes FA. A systematic review of feather mites of the *Pterodectes* generic complex (Acari: Proctophyllodidae: Pterodectinae) with redescriptions of species described by Vladimir Cerny. *Acarina* 2010; 18(1): 3-35.

Valim MP, Price RD, Johnson KP. New host records and descriptions of five new species of *Myrsidea* Waterston, 1915 (Phthiraptera: Menoponidae) from passerines (Aves: Passeriformes). *Zootaxa* 2011; 3097(1): 1-19. http://dx.doi.org/10.11646/zootaxa.3097.1.1.

Valim MP, Weckstein JD. A drop in the bucket of the megadiverse chewing louse genus *Myrsidea* (Phthiraptera, Amblycera, Menoponidae): ten new species from Amazonian Brazil. *Folia Parasitol (Praha)* 2013; 60(5): 377-400. http://dx.doi.org/10.14411/fp.2013.040. PMid:24471279.

Van Cleave HJ. Acanthocephala of the genera *Centrorhynchus* and *Mediorhynchus* (new genus) from North American birds. *Trans Am Microsc Soc* 1916; 35(4): 221-232. http://dx.doi.org/10.2307/3221908.

Vergara PM. Effects of nest box size on the nesting and renesting pattern of *Aphrastura spinicauda* and *Troglodytes aedon. Ecol Austral* 2007; 17: 133-141.

Walter DE, Krantz GW. Collection, rearing, and preparing specimens. In: Krantz GW, Walter DE,editors. *A manual of acarology*. 3rd ed. Lubbock: Texas Tech University Press; 2009. p. 83-96.

Waterston J. On two new species of Mallophaga (Menoponidae): *menacanthus balfouri* n. sp. and *Myrsidea victrix* n. sp. from Colombia. *Entomol Mon Mag* 1915; 51(3): 12-16. http://dx.doi.org/10.5962/bhl.part.7786.

Yamaguti S. *Systema Helminthum, vol. II: the cestodes of vertebrates*. New York: Interscience Publishers; 1959.

Yamaguti S. *Systema Helminthum, vol. III: the nematodes of vertebrates, part I*. New York: Interscience Publishers; 1961.

Yamaguti S. *Systema Helminthum, vol. V: Acanthocephala*. New York: Interscience Publishers; 1963.

Zhang L, Brooks DR, Causey D. Two species of *Synhimantus* (*Dispharynx*) (Nematoda: Acuarioidea: Acuariidae), in passerine birds from the Área de Conservación Guanacaste, Costa Rica. *J Parasitol* 2004; 90(5): 1133-1138. http://dx.doi.org/10.1645/GE-3253. PMid:15562615.