

Renata Pereira Beco

**Evolução dos sinais acústicos e visuais nos
thamnofilídeos da Tribo Formicivorini (Aves,
Thamnophilidae)**

**Evolution of acoustic and visual signals in the
antwrens of the tribe Formicivorini (Aves,
Thamnophilidae)**

São Paulo

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Orientador: Prof. Dr. Luís Fábio
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Índice

General Introduction.....	1
Literature cited.....	8
Capítulo Único.....	14
Resumo.....	15
Palavras-chave.....	16
Single Chapter.....	17
Abstract.....	18
Keywords.....	19
Introduction.....	20
Methods.....	22
Results.....	31
Discussion.....	38
Conclusion.....	42
Literature cited.....	43
General Discussion and Conclusions.....	50
Resumo.....	52
Abstract.....	54
Appendix A. Supplementary Figures.....	56
Appendix B. Supplementary Tables.....	83

General Introduction

Animal Communication and sensory signals

Animal communication transmits information using different types of sensory signals (e.g. visual, auditory, olfactory and contact). These signals have different communication purposes such as courtship, territorial defense, maintaining groups together and minimizing predation. However, the efficacy of the signal transmission from an emitter to a receiver is subject to habitat pressures (Endler, 1992; Endler, 1993).

According to the Sensory Drive Hypothesis (SDH), habitat physical conditions can “drive” the evolution of sensory signals in particular directions (Endler, 1992). In birds, the SDH has been tested in acoustic and visual signals for a variety of groups. Regarding acoustic signals, some studies showed that song structure is related to sound transmission capacity in different habitats. Whereas some studies found a relationship between habitat and song frequency traits (e.g. Morton, 1975; Slabbekoorn and Smith, 2002; Seddon, 2005; Kirschel *et al.*, 2009; Mason and Burns, 2015), in other studies habitat was correlated only with temporal components of song structure (e.g. Badyaev and Leaf, 1997; Derryberry *et al.*, 2018). With respect to visual signals, some plumage aspects such as color, brightness, and pattern seem to vary according to light conditions of the environment in order to provide maximum contrast against the background (e.g. Marchetti, 1993; Endler and Thery, 1996; McNaught and Owens, 2002; Gomez and Théry, 2004; Shultz and Burns 2013; Shultz and Burns 2017). Closed habitat birds have brighter and more complex color patterns than birds from open habitat (Marchetti, 1993). In the forests, canopy birds have brighter coloration and more diverse color patterns than understory birds (Gomez and Théry, 2004; Shultz and Burns 2017).

In addition to habitat effects, other factors such as energetic limits, predation and parasitism risk can limit the investment in more than one type of sensory signal (Endler, 1993; Partan and Marler, 1999; Partan and Marler, 2005). Due to this high cost, it was proposed the existence of an evolutionary trade-off between the different types of sensory signals in organisms (Darwin, 1871), termed Transfer (Gilliard, 1956) (TH) or Trade-off hypothesis (Repentigny *et al.*, 2000). Few studies have tested the TH in birds and they showed diverse results. Two studies found a trade-off between song complexity and plumage elaboration in cardueline finches (Badyaev and Weckworth, 2002) and in new world warblers (Laverde-R., 2017), whereas four studies did not find any trade-off between these signals in trogons (Ornelas *et al.*, 2009), tanagers (Mason *et al.*, 2014), estrildid finches (Gomes *et al.*, 2017) and old-world orioles (Matysioková *et al.*, 2017). Four other studies found a positive correlation between these signals in North American wood warblers (Shutler and Weatherhead, 1990), 123 species of North American oscines (Repentigny *et al.*, 2000), Asian barbets (Gonzalez-Voyer *et al.*, 2013) and 1023 species of songbirds (Webb *et al.*, 2016). These conflicting results might result from methodological differences or because this hypothesis is simply not held in all groups. Furthermore, only a few studies tested the TH considering the habitat conditions as a covariate (Gonzalez-Voyer *et al.*, 2013; Mason *et al.*, 2014; Laverde-R., 2017; Gomes *et al.*, 2017). Therefore, the fundamental research goal of the proposed research was to assess the existence of a trade-off between acoustic and visual signals (TH), while simultaneously considering potential effects of habitat conditions (SDH) in a diverse group of Neotropical birds.

Family Thamnophilidae

The Thamnophilidae is a large family of insectivorous passerine birds which contains about 230 species and is supported by recent molecular studies (Irestedt *et al.*, 2004; Moyle *et al.*, 2009; Bravo *et al.*, 2012; Bravo *et al.*, 2014). They are diurnal birds that exhibit great morphological, ecological, and behavioral diversity. The family members are commonly known as antbirds due to a common foraging behavior of following swarms of army-ants in order to prey arthropods flushed by these ants (Willis and Oniki, 1978). The family distribution is Neotropical and the vast majority inhabits lowland and foothill humid forests (Zimmer and Isler, 2016). The greatest diversity is found in the Amazon Basin, where 40-45 species may occur syntopically in various places in Bolivia, Peru, Brazil and Colombia (e.g. Terborgh *et al.*, 1990). However, the species diversity falls off with increasing elevation in mountain regions, with none occurring above 3000 m. Most of the species are arboreal, occupying all forest strata, i.e. from the ground to the canopy (Zimmer and Isler, 2016).

Antbird songs are relatively simple and usually consist of series of simple notes delivered in a stereotyped pattern, referred to as loudsong by Willis (Willis 1967; Zimmer and Isler 2016). Despite their simplicity, loudsong composition exhibits a great variety of ways in which notes are shaped and combined. Loudsongs are vocalized in different contexts, but usually they seem to be used in maintaining pairs together, and in territorial defense. Most of the thamnophilid species have males and females with similar patterned loudsongs. Both sexes can have near identical loudsongs, just varying in the pitch. Females of some species have higher-pitched loudsongs than males, whereas other females have loudsong in the same pitch as the male, or at a lower pitch (Zimmer and Isler 2016). Moreover, all vocalizations in the Thamnophilidae family are assumed to be innate or genetically determined and independent of learning or cultural evolution

(Touchton *et al.*, 2014). Thus, they have an important role in the maintenance of species integrity and are of extreme importance for diagnosing species (Isler *et al.*, 1998).

The thamnophilid plumages does not have great color variation, but most have attractive patterns in black and white or rufous, buff or brown tones. Many species also have spotted and streaked patterns that can cover all body or just specific regions like throat, belly, crown, nape and back (Figure 1). Sexual dimorphism is pronounced in almost all family. Whereas males usually have combinations of grey, black and white; females often have brown, rufous and buff tones (Zimmer and Isler, 2016).

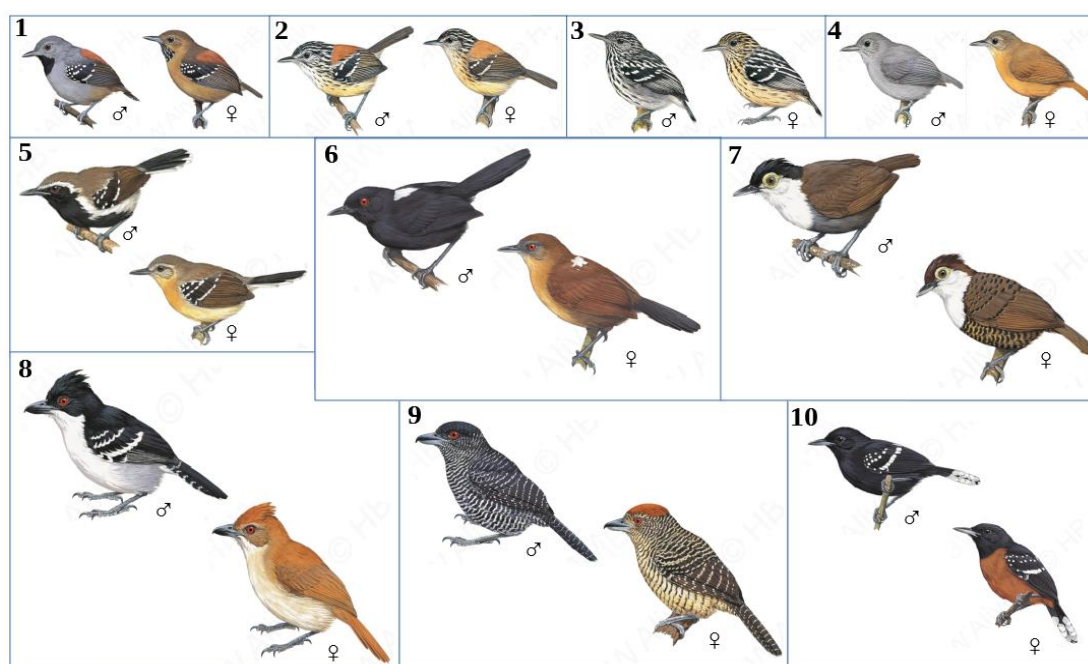


Figure 1. Some antbird species showing the plumage and sexual dimorphism diversity in the family. 1. *Epinecrophylla ornata*, 2. *Terenura maculata*, 3. *Myrmotherula cherriei*, 4. *Myrmotherula grisea*, 5. *Formicivora grisea*, 6. *Pyriglena leuconota*, 7. *Rhegmatorhina hoffmannsi*, 8. *Taraba major*, 9. *Cymbilaimus lineatus*, 10. *Microrhopias quixensis*. Images were extracted from the *Handbook of the Birds of the World Alive*. Lynx Edicions, Barcelona.

Although their diet is basically composed of arthropods, antbirds exhibit a wide variety of foraging behaviors. Many antbird species participate in mixed-species foraging flocks. These flocks are formed of different species that unite and move together during foraging in the tropical forests in order to enhance foraging and decrease chances of predation (Powell, 1979). These flocks are formed by several closely related species and occur throughout the year (Powell, 1979; Munn, 1985). Another common behavior is observed in the dead-leaf users. Many thamnophilids species specialize in foraging dead leaves that falls from the canopy and are trapped by vines and other vegetation most in the understory, creating an arboreal leaf litter, which provides hiding places for many arthropods (Remsen and Parker, 1984). Lastly, the most noted foraging behavior present in the family consists of following army-ants. A number of antbirds have specialized in following swarms raiders in order to prey many arthropods that are trapped or flushed by these carnivorous ants (Willis and Oniki, 1978). All described foraging behaviors when present in a species can be obligatory or occasional.

Tribe Formicivorini

The family is subdivided in three subfamilies: Eucrepomidae, Myrmornithinae, and Thamnophilinae (Bravo *et al.*, 2012). The latter contains most of the species in the family and is organized in five tribes: Microrhopiini, Formicivorini, Thamnophilini, Pyriglenini e Pithyini (Moyle *et al.*, 2009). One of the strongly supported groups in the family by recent molecular studies is the tribe Formicivorini, which contains 36 species, commonly known as antwrens (Bravo *et al.*, 2012; Bravo *et al.*, 2014, Remsen *et al.*, 2018). They are small birds that inhabit a wide diversity of habitats and exhibit contrasting patterns of foraging behavior, acoustic, and visual signals. They are primarily distributed in lowland

forests and different species are associated with different habitats (e.g. flooded forests, white sand forests) and foraging strata (e.g. understory, canopy). Foraging behavior is also variable, some species engage in obligate or facultative mixed-species flocking behavior, whereas others forage solitary or in small family groups (Bravo *et al.*, 2014; Zimmer and Isler, 2016).

Acoustic and visual signals are variable in the group. Their songs show little to no sexual dimorphism and they are composed by a series of single notes that ranges in number of notes, duration, intensity, frequency, and composition. Song and note structure can vary geographically in some species. Regarding plumage, antwrens are sexually dimorphic. They exhibit small color variation, but have high variation in plumage patterns, ranging from plain colors to spots and streaks around their body regions (e.g. throat, wings, dorsal and ventral region) (Zimmer and Isler, 2016). Some species have white or pale gray flanks that contrasts with dark body feathers. Another pattern present in a few antwrens is a bright white interscapular patch in the center of the back. The species with these different patterns of flanks and interscapular usually display it, suggesting an important role in communication.

It is expected that the interaction between ecology and behavior influences the structure of acoustic and sensory signals. For instance, because mixed-species flocking behavior depends on inter and intraspecific communication among group members (Powell, 1979), it could be predicted that species engaging in this behavior exhibit more structured sensory signals.

Therefore, the combination of a variation in acoustic and visual signals, occupied habitats and mixed-species flocking behavior make the tribe Formicivorini an ideal group to test the TH, and a possible influence

of habitat (SDH) and mixed-species flocking behavior in the structure of these signals.

Justification

The tribe Formicivorini is an ideal group for this study because it has a great diversity in habitat preferences, foraging behavior and inter/intraspecific interaction levels that can generate a variety of communication possibilities. However, the way these traits may be influencing the visual and acoustic communication in the evolutionary context of the group is still unknown. Therefore, this study aimed at unravelling how habitat (SDH) and foraging behavior can influence the structure of acoustic and visual signals, and elucidate whether there is an evolutionary trade-off between these sensory signals (TH). Besides contributing to our understanding of the evolution of acoustic and visual signals in the Formicivorini, it will also shed light on the TH while accounting for possible effects posed by habitat (SDH) and behavioral traits.

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Capítulo Único

Evolução correlacionada dos sinais acústicos e visuais está associada com ecologia e comportamento nas choquinhas e formigueiros (Thamnophilidae)

Renata Beco, Luís Fábio Silveira e Gustavo A. Bravo

Resumo

A comunicação animal transmite informações usando diferentes tipos de sinais sensoriais que possuem propósitos específicos (e.g. cortejo, defesa territorial, manutenção de grupos unidos e minimização da predação) e estão suscetíveis a pressões do habitat (Hipótese de Condução Sensorial - HCS). Em aves, alguns estudos de sinais acústicos e visuais demonstraram que a estrutura do canto está associada com a capacidade de transmissão do som em diferentes habitats e alguns aspectos de plumagem (e.g. coloração, brilho e padrão) parecem variar de acordo com as condições de iluminação do ambiente. Além dos efeitos de habitat, outros fatores como limitação energética, risco de predação e de parasitismo podem limitar o investimento em mais de um tipo de sinal sensorial. Devido a esse alto custo, foi proposta a existência de uma demanda conflitante (*trade-off*) evolutiva entre os diferentes tipos de sinais sensoriais denominada Hipótese de Transferência (HT) ou de “*Trade-off*”. Os poucos estudos que testaram a HT em aves apresentaram resultados contrastantes, sendo corroborada apenas em dois trabalhos. Além disso, há uma baixa quantidade de trabalhos que consideraram as condições de habitat como covariáveis. Assim, nós avaliamos a HT entre os sinais acústicos e visuais, considerando simultaneamente os efeitos potenciais das condições de habitat (HCS) em um diverso grupo de aves subóscines neotropicais, comumente conhecidas como papa-formigas (Thamnophilidae). Especificamente, nós integramos a filogenia em escala genômica da tribo Formicivorini (36 espécies) com dados vocais, de plumagem, ecológicos e comportamentais utilizando uma abordagem comparativa filogenética para testar simultaneamente a HT, a HCS e também considerando a influência do comportamento de formação de bandos mistos na diversidade da estrutura dos sinais acústicos e visuais. Enquanto que demandas conflitantes significativas entre algumas medidas

de plumagem e de canto foram encontradas em ambos os sexos (e.g. luminância dorsal contra declive de frequência) corroborando a HT, uma tendência oposta não significativa foi encontrada entre o dimorfismo sexual de plumagem e canto. Todas essas relações são influenciadas por condições de habitat e comportamento como covariáveis, corroborando a HCS e a influência do comportamento de bandos mistos na evolução da estrutura dos sinais acústicos e visuais.

Palavras-chave: Hipótese de condução sensorial, hipótese de transferência, Formicivorini, plumagem, canto.

Single Chapter

Correlated evolution of acoustic and visual signals is associated with ecological and behavioral traits in antwrens (Thamnophilidae)

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Abstract

Animal communication transmits information using different sensory signals that have particular purposes (e.g. courtship, territorial defense, maintaining groups together and minimizing predation) and are susceptible to habitat pressures (Sensory Drive Hypothesis - SDH). In birds, some studies on acoustic and visual signals showed that song structure is associated with sound transmission capacity in different habitats and some plumage features (e.g. color, brightness and pattern) seem to vary according to light conditions of the environment. In addition to habitat effects, other factors such as energetic limits, predation, and parasitism risk can limit the investment in more than one type of sensory signal. Due to this high cost, it was proposed the existence of an evolutionary trade-off between the different types of sensory signals termed Transfer (TH) or Trade-off hypothesis. Few studies that have tested the TH in birds showed contrasting results, being corroborated only in two studies. Also, there is a low in the number of studies that have considered habitat conditions as covariates (SDH). Here, we assess the TH between acoustic and visual signals, while simultaneously considering potential effects of habitat conditions (SDH) in a diverse group of Neotropical suboscine birds, commonly known as antbirds (Thamnophilidae). Specifically, we integrated a genome-scale phylogeny of the tribe Formicivorini (36 species) with vocal, plumage, ecological, and behavioral data within a phylogenetic comparative framework to simultaneously test the TH and SDH while assessing the influence of mixed-species flocking foraging behavior on the structural diversity of acoustic and visual signals. Whereas in both sexes we found significant trade-offs between some plumage and vocal traits (e.g. dorsal luminance versus frequency slope), providing support for the TH, we found a non-significant opposite trend between plumage and vocal sexual dimorphism. All these relationships are

influenced by habitat conditions and behavioral traits as covariates, corroborating the SDH and mixed-species flocking behavior influence in the evolution of visual and acoustic signals.

Keywords: Sensory drive hypothesis, transfer hypothesis, Formicivorini, plumage, song.

Introduction

Sensory signals, such as avian acoustic and visual traits, are used to transmit information with different communication purposes (e.g. courtship, territorial defense, maintaining groups together and minimizing predation) and are susceptible to habitat pressures (Endler, 1992; Endler, 1993). According to the Sensory Drive Hypothesis (SDH), habitat physical conditions can “drive” the evolution of sensory signals in particular directions (Endler, 1992). For instance, some studies have shown that song structure is associated to sound transmission capacity in different habitats (e.g. Morton, 1975; Badyaev and Leaf, 1997; Slabbekoorn and Smith, 2002; Seddon, 2005; Kirschel *et al.*, 2009; Mason and Burns, 2015; Derryberry *et al.*, 2018), some plumage features such as color, brightness, and pattern seem to vary according to light conditions of the environment to provide maximum contrast against the background (e.g. Marchetti, 1993; Endler and Thery, 1996; McNaught and Owens, 2002; Gomez and Théry, 2004; Shultz and Burns 2013; Shultz and Burns 2017).

In addition to habitat effects, other factors such as energetic limits, predation and parasitism risk can limit the investment in more than one type of sensory signal (Endler, 1993; Partan and Marler, 1999; Partan and Marler, 2005). Due to this high cost, it was proposed the existence of an evolutionary trade-off between the different types of sensory signals in organisms (Darwin, 1871), termed Transfer (Gilliard, 1956; TH) or Trade-off hypothesis (Repentigny *et al.*, 2000). Few studies have tested the TH in birds and they showed diverse results. Just two studies found a trade-off between song complexity and plumage elaboration in cardueline finches (Badyaev and Weckworth, 2002) and in new world warblers (Laverde-R., 2017), whereas four studies did not find any trade-off between these signals in trogons (Ornelas *et al.*, 2009), tanagers (Mason *et al.*, 2014), estrildid finches (Gomes *et al.*, 2017) and old world orioles (Matysioková *et al.*,

2017), and four other studies found a positive correlation between these signals in North American wood warblers (Shutler and Weatherhead, 1990), 123 species of North American oscines (Repentigny *et al.*, 2000), Asian barbets (Gonzalez-Voyer *et al.*, 2013) and 1023 species of songbirds (Webb *et al.*, 2016). These conflicting results might be explained by methodological differences or because this hypothesis is simply not held in all groups. Furthermore, only a few studies tested the TH considering the habitat conditions as a covariate (Gonzalez-Voyer *et al.*, 2013; Mason *et al.*, 2014; Laverde-R., 2017; Gomes *et al.*, 2017). Therefore, the fundamental research goal of the proposed research was to assess the existence of a trade-off between acoustic and visual signals (TH), while simultaneously considering potential effects of habitat conditions (SDH) in a diverse group of Neotropical birds.

The Thamnophilidae is a large family of insectivorous passerine birds that exhibit high phenotypic, ecological, and behavioral diversity (Zimmer and Isler, 2016). One of the strongly supported groups in the family by recent molecular studies is the tribe Formicivorini, which contains 36 species, commonly known as antwrens (Irestedt *et al.*, 2004; Moyle *et al.*, 2009; Bravo *et al.*, 2012; Bravo *et al.*, 2014, Remsen *et al.*, 2018). They are small birds that inhabit a wide diversity of habitats and exhibit contrasting patterns of foraging behavior, acoustic, and visual signals. They are primarily distributed in lowland forests and different species are associated with different habitats (e.g. flooded forests, white sand forests) and microhabitats (e.g. understory, canopy). Foraging behavior is also variable, some species engage in obligate or facultative mixed-species flocking behavior, whereas others forage solitarily or in small family groups (Bravo *et al.*, 2014; Zimmer and Isler, 2016). Acoustic and visual signals are variable in the group. Their songs show little to no sexual dimorphism and they tend to be composed by a series of single notes

that vary in number of notes, duration, intensity, frequency, and composition. Regarding plumage, antwrens are sexually dimorphic. They exhibit small color variation, but have high variation in plumage patterns, ranging from plain colors to spots and streaks around their body regions (e.g. throat, wings, dorsal and ventral region) (Zimmer and Isler, 2016). It might be expected that the interaction between ecology and behavior influences the structure of acoustic and sensory signals. For instance, because mixed-species flocking behavior depends on inter and intraspecific communication among group members (Powell, 1979), it could be predicted that species engaging in this behavior exhibit more structured sensory signals.

Here, we integrate a genome-scale phylogeny of the tribe Formicivorini with vocal, plumage, ecological, and behavioral data within a phylogenetic comparative framework to simultaneously test the TH and SDH while assessing the influence of mixed-species flocking foraging behavior on the structural diversity of acoustic and visual signals. Given the contrasting patterns of both vocal and plumage variation and the varying levels of mixed-species flocking behavior in this group of antwrens, we anticipate a negative correlation between acoustic and visual signals (TH) with an influence of habitat effects (SDH) and mixed-species flocking behavior in the structure of these signals.

Methods

Phylogenetic hypothesis

We used a molecular phylogeny of the Formicivorini (Bravo *et al.* unpublished data) that contains all species currently recognized in the tribe (Renssen *et al.*, 2018), except for the critically endangered *Terenura sicki*, and that was built using 2,400 loci from 53 of the 74 named subspecies-level taxa.

Vocal data and analyses

We collected a total of 267 audio recordings (194 males and 73 females), corresponding to 64 male and 38 female taxa, respectively (Appendix B; Table S4). The selected recordings represent a series of simple notes delivered in a stereotyped pattern (i.e., loudsongs sensu Willis 1967) for both sexes and were obtained from the Macaulay Library (<https://www.macaulaylibrary.org>), Xeno-canto (<https://www.xeno-canto.org>), Fonoteca Neotropical Jacques Vielliard (<https://www2.ib.unicamp.br/fnjv>), Isler and Whitney (2002) and private audio collections. Loudsongs were analyzed using Raven Pro 1.5 software and following standardized protocols (Isler *et al.*, 1998; Seddon, 2005; Mason *et al.*, 2014). Spectrograms, oscillogram and power spectra of each recording were generated and used to extract the following measurements: song duration, number of notes (note count), note types, note rate, note diversity, low frequency, high frequency, peak frequency, song bandwidth and frequency slope. Oscillograms were used to determine the song duration. Spectrograms were visually inspected to assert the number of notes and note types. Power spectra were used to obtain frequency-based measurements using a Hann window with 512 samples, 3 dB filter bandwidth of 124 Hz and DFT size of 512 samples. An example of an extracted sonogram and spectrogram are available in figure S1 (Appendix A) and descriptions of each vocal trait are available in table S1 (Appendix B). We measured at least two loudsongs per recording and three male and three female different individuals per taxon when available.

To obtain a proxy for vocal sexual dimorphism, we calculated the euclidean distance of all song measurements of males and females for each taxon between sexes. The euclidean distance was calculated using the `dist` function of stats package in R (R Core Team, 2018).

Lastly, we conducted a Phylogenetic Principal Component Analysis (pPCA) with all song measurements of each sex in order to reduce multivariate dataset to an uncorrelated set of variables that explain the distribution of data in males and females, while correcting for phylogenetic non-independence (Revell, 2009). The pPCA was implemented in phytools R package (Revell, 2013) using the lambda model. Before performing the pPCA, we applied a log transformation in all song measurements. The first (pPC1) and the second (pPC2) male song pPCA accounted for 43% and 34% of the total data distribution and had a high lambda value ($\lambda=0.77$), indicating a strong phylogenetic signal (Table 1). In females, song pPC1 and pPC2 explained 45% and 29% of the data distribution (Table 2) and the lambda value was lower ($\lambda=0.20$). We used song pPC1 and pPC2 scores values for each taxon as components of song variation.

Table 1. Load values for the first and second pPCA of song traits in males. The first and the second pPCA axis of song ($\lambda=0.77$) explain 43% and 34% of the data distribution. Load values greater or equal to 0.50 are bolded.

Song character	PC1	PC2
Note count	0.38	-0.90
Note types	0.52	0.04
Low frequency	-0.45	0.17
High frequency	0.23	0.13
Song duration	-0.74	-0.49
Peak frequency	0.09	0.20
Note diversity	-0.08	0.93
Note rate	0.90	-0.35
Song bandwidth	0.46	0.04
Frequency slope	0.84	0.46

Table 2. Load values for the first and second pPCA of song traits in females. The first and the second pPCA axis of song ($\lambda=0.20$) explain 45% and 29% of the data distribution. Load values greater or equal to 0.50 are bolded.

Song character	PC1	PC2
Note count	-0.95	-0.24
Note types	-0.20	-0.24
Low frequency	0.44	0.29
High frequency	0.19	-0.04
Song duration	-0.65	0.66
Peak frequency	0.36	-0.09
Note diversity	0.89	0.12
Note rate	-0.43	-0.86
Song bandwidth	-0.04	-0.27
Frequency slope	0.57	-0.74

Plumage data and analyses

Plumage coloration and pattern data were obtained directly from standardized photos of museum specimens housed at major ornithological collections. We photographed a total of 606 specimens (319 males; 287 females) representing 73 taxa for males and 70 for females (4.23 specimens per taxa for each sex) (Appendix B; Table S5). We gathered data from nine different topographical body regions: head (i.e. crown and nape), throat, breast, belly, back, cheek, flanks, wing coverts and tail (Appendix A; Figure S2). Breast and belly were select as unique region called “belly” due to the difficulty of delimiting these regions separately. Photos were taken in RAW format in the presence of a standard 18% grey card (GC-3 3-in-1 Digital Grey Card; JJC Photography Equipment Co., Ltd) and measuring tape to standardize color and size proportions in all images (Stevens *et al.*, 2007). These standardized photos were calibrated and had plumage data using the software ImageJ with the *Image calibration and analysis toolbox* plugin (Troschianko and Stevens, 2015). Plumage data

consist of standardized directive RGB reflectance values, luminance, contrast and pattern measurements based on Fast Fourier bandpass filtering. The standardized directive RGB reflectance values correspond to the Red, Green and Blue color channels, which are based on the camera color system. The images are in 16-bit, so the RGB reflectance values range from zero to 65535 and it is relative to the 18% grey standard card. The luminance is calculated from the sum of RGB values and corresponds to an intensity of luminosity (i.e. darker plumages have low luminance values and brighter plumages have high luminance values) (Endler, 2012). Topographical body regions known to commonly have spots and streaks (i.e., throat, belly, wing coverts, head and back) had their contrast and pattern measured using two different tools. The contrast was measured using the *Adaptive thresholding tool* in ImageJ software, which automatically selects and measures light (maculation) and dark (background) area values on the selected regions of interest. The calculated proportion of the maculation and background luminance values represents the contrast measurement, being that low values represent a higher contrast and higher values represents a low contrast. The pattern analysis is based on Fast Fourier bandpass filtering and consists in filtering each image at multiple spatial frequency scales and quantifying the “energy” in each scale, measured as the standard deviation of the filtered pixels values. This form of analysis is also called granularity analysis and is based on the mechanism of neuro-physiological image processing in vertebrates and invertebrates (Godfrey *et al.*, 1987; Stoddard and Stevens, 2010). These analyses were performed using the green channel which is recommended in birds when the images are not converted into the avian visual model (Spottiswoode and Stevens, 2010). The measurements obtained in the pattern analysis are the maximum frequency (the spatial frequency with the highest energy), the maximum energy (the energy at the maximum

frequency) and summed energy (the energy summed across all spatial frequencies).

We examined the distribution of each plumage variable to decide which ones explain better the plumage variation in the group. First, we summarized the body regions in dorsal (mean of crown, nape and back), ventral (mean of throat, breast, belly and flanks) and wing coverts. Then, we calculated the euclidean distance between the selected plumage measurements (i.e. luminance, contrast, maximum energy and summed energy of dorsal, ventral and wing coverts regions) of males and females of each taxon in order to obtain the plumage sexual dimorphism. The RGB measurements were not considered because they had similar values among them in both sexes (Appendix A; Figures S3-S8), suggesting a low color variation across the group and thus not being good indexes of plumage elaboration.

Lastly, we performed the pPCA with the selected plumage measurements in males and females as described previously for the vocal traits. All selected plumage traits were also log-transformed. The plumage male pPC1 and pPC2 accounted for 55% and 15% of the total data distribution, respectively, and had a high lambda value ($\lambda=0.89$) (Table 3). In females, plumage pPC1 and pPC2 explained 35% and 33% of the total data distribution. Lambda also had a high value ($\lambda=0.86$) (Table 4). Plumage pPC1 and pPC2 scores values for each taxon were used as components of plumage variation in males and females.

Table 3. Load values for the first and second pPCA of plumage traits in males. The first and the second pPCA axis ($\lambda=0.89$) explain 55% and 15% of the data distribution. Load values greater or equal to 0.50 are bolded.

Plumage character	PC1	PC2
MaxPower dorsal	-0.69	-0.58
SumPower dorsal	-0.68	-0.57
Luminance dorsal	-0.68	-0.52
Contrast dorsal	0.17	0.31
MaxPower ventral	-0.96	0.25
SumPower ventral	-0.96	0.24
Luminance ventral	-0.32	0.32
Contrast ventral	0.39	0.24
MaxPower wing coverts	-0.34	-0.53
SumPower wing coverts	-0.33	-0.51
Luminance wing coverts	-0.59	-0.49
Contrast wing coverts	0.17	0.41

Table 4. Load values for the first and second pPCA of plumage traits in females. The first and the second pPCA axis ($\lambda=0.86$) explain 35% and 33% of the data distribution. Load values greater or equal to 0.50 are bolded.

Plumage character	PC1	PC2
MaxPower dorsal	-0.01	0.92
SumPower dorsal	-0.06	0.93
Luminance dorsal	0.06	0.90
Contrast dorsal	0.24	-0.34
MaxPower ventral	-0.28	0.16
SumPower ventral	-0.30	0.20
Luminance ventral	-0.18	0.14
Contrast ventral	0.02	0.07
MaxPower wing coverts	-0.91	0.29
SumPower wing coverts	-0.90	0.28
Luminance wing coverts	-0.40	0.60
Contrast wing coverts	0.77	0.51

Ecological and behavioral data

Habitat, forest strata, and mixed-species flocking behavioral data were taken from the literature (e.g. Munn, 1985; Ridgely and Tudor, 1994; Whitney, 1994; Whitney and Pacheco, 1997; Zimmer and Isler, 2016; See detailed description in Bravo *et al.*, 2014) and from our knowledge of the group. Habitat exposure was classified as exposed and unexposed, according to how birds in different habitats are subject to direct sunlight, precipitation, and wind (e.g., birds in canopy and non-forested environments are more exposed than birds in the forest understory). Forest strata was categorized as understory, midstory and canopy. The classification of mixed-species flocking behavior was divided in three categories: no formation, occasional to common and obligate mixed-species flocking formation following Bravo *et al.* (2014).

Comparative analyses

We conducted Phylogenetic Generalized Least Squares (PGLS) analysis, which is a phylogenetic comparative method that allows testing the association and interaction among all collected variables simultaneously under different evolutionary models. Therefore, it was possible to test TH and SDH as well as assessing a possible influence of mixed-species flocking behavior on the structural diversity of acoustic and visual signals. PGLS analyses were performed in R (R Core Team, 2018) using the packages Ape (Paradis *et al.*, 2004), nlme (Pinheiro *et al.*, 2013), and Geiger (Harmon *et al.*, 2008).

We tested the correlation between plumage and song traits under two different evolutionary models: Brownian motion (BM), which represents a stochastic process, without selection; and Ornstein-Uhlenbeck (OU), which represents selection towards an adaptive optimum. The following eight models were tested:

1. A base model with no covariates;
2. Habitat exposure as a covariate;
3. Foraging strata as a covariate;
4. Mixed-species flocking behavior as a covariate;
5. Habitat exposure + Foraging strata as covariates;
6. Habitat exposure + Mixed-species flocking behavior as covariates;
7. Foraging strata + Mixed-species flocking behavior as covariates;
8. Habitat exposure + Foraging strata + Mixed-species flocking behavior as covariates.

All models were tested under BM and OU adding up to a total of 16 models. First, we tested the correlation between plumage and vocal sexual dimorphism under the 16 models. After, we tested the correlation between plumage and song pPCAs scores in males and females. Lastly, due to possible bias involved in the use of pPCA scores (Uyeda *et al.*, 2015) and the difficulty in choosing the best representative plumage and song measurements, we also tested the correlation between the plumage and song traits that had load values of pPC1 and pPC2 axes greater or equal to 0.50 in each sex (Tables 1, 2, 3 and 4). The best-fit models for each pair of plumage and song traits were chosen based on the Akaike information criterion (AIC). The model with the lowest AIC value was considered the best model and any model with the ΔAIC less or equal two were considered a competing model. Also, we calculated the Akaike weights to assess their relative likelihood.

Results

Relationship between sexual dimorphism in plumage and song

We found a positive correlation between plumage and vocal sexual dimorphism that was not significant (Table 5 and Figure S9). The best model was with no covariates, while the competing models were with mixed-species flocking behavior, habitat exposure + mixed-species flocking behavior, and habitat exposure, all under BM (Table 5 and Figure S9). According to Akaike weights values, the first two models are more informative to explain the association between sexual dimorphism in plumage and song (Table 5).

Relationship between plumage and song components of variation in males

When testing the relationship between plumage and song components of variation (i.e. plumage and song pPC1 and PC2 scores), we found positive correlations that were significant in two cases: 1. Between plumage pPC1 and song pPC2 and 2. Between plumage pPC1 + pPC2 and song pPC2 (Table 6). The significant correlations were under BM and their best models had habitat exposure, foraging strata and mixed-species flocking behavior as covariates in both cases.

Relationship between the selected plumage and song traits in males

Whereas all correlations between plumage and song components of variation were positive, we had both positive and negative correlations when testing the relationship between selected plumage and song traits (i.e. characters that had load values of pPC1 and pPC2 axes greater or equal to 0.50).

We found a significant negative correlation of dorsal luminance versus note types and frequency slope (Figure 1 and Table S2). The best and competing models were under OU in both cases, being the first with

foraging strata plus mixed-species flocking behavior as covariates and the other with different combinations of habitat exposure, foraging strata and mixed-species flocking behavior (Figures S10-S11).

Significant positive correlations were found between dorsal luminance and song duration, dorsal maximum energy and song duration, ventral maximum and summed energy versus note rate (Figure 1 and Table S2). While the first two had the best models under BM with habitat exposure and mixed-species flocking behavior as covariates, the last two had their best significant models under OU with all ecological and behavioral traits as covariates (Figures S12-S15).

Relationship between plumage and song components of variation in females

In females, we found both positive and negative correlations between plumage and song components of variation. While a significant negative correlation was found between plumage pPC2 and song pPC1, a significant positive correlation was found between plumage pPC1 + pPC2 and song pPC1 (Table 7). These significant correlations were under OU and had their best models associated with habitat exposure and mixed-species flocking behavior.

Relationship between plumage and song traits in females

We also found both positive and negative correlations when testing the relationship between the selected plumage and song traits. Significant negative correlations were found between dorsal luminance and frequency slope, wing contrast, dorsal maximum and summed energy versus frequency slope and note diversity (Figure 2 and Table S3). The best models were under OU in mostly cases and had at least one of the

ecological traits and mixed-species flocking behavior as covariates (Figures S16, S17, S19, S20, S22, S23 and S24).

We found significant positive correlations of dorsal summed energy and wing contrast versus note count (Figure 2 and Table S3). All the best models with significant positive correlations were under OU, being the first associated with habitat exposure and mixed-species flocking behavior and the last with different combinations of all ecological traits and mixed-species flocking behavior (Figures S18 and S21).

Table 5. PGLS results of the relationship between plumage and vocal sexual dimorphism. The first row corresponds to the best model and the others correspond to the competing models ($\Delta AIC \leq 2$). β is the effect size of each correlation and SE is its standard error. HAB = Habitat exposure, FOR = Foraging strata and MSF = Mixed-species flocking behavior.

Plumage character	Song character	Model	Evolutionary model	ΔAIC	ω_i	$\beta \pm SE$	P
SD plumage	SD song	base	BM	0	0.30	0.19 ± 0.22	0.38
SD plumage	SD song	MSF	BM	0.89	0.19	0.20 ± 0.21	0.36
SD plumage	SD song	HAB + MSF	BM	1.81	0.12	0.24 ± 0.22	0.28
SD plumage	SD song	HAB	BM	1.99	0.11	0.20 ± 0.22	0.39

Table 6. PGLS results of the relationship between male plumage and song PC1 and PC2. The first row of each relationship corresponds to the best model and the others correspond to the competing models ($\Delta AIC \leq 2$). β is the effect size of each correlation and SE is its standard error. An asterisk indicates when the relationship is significant (P value ≤ 0.05). HAB = Habitat exposure, FOR = Foraging strata and MSF = Mixed-species flocking behavior.

Plumage character	Song character	Model	Evolutionary model	ΔAIC	ω_i	$\beta \pm SE$	P
plumage PC1	song PC1	MSF	BM	0	0.24	0.09 ± 0.18	0.62
plumage PC1	song PC1	HAB + MSF	BM	0.58	0.18	0.06 ± 0.18	0.76
plumage PC1	song PC1	HAB + FOR + MSF	BM	0.90	0.16	0.08 ± 0.18	0.67
plumage PC1	song PC1	FOR + MSF	BM	0.99	0.15	0.09 ± 0.18	0.62
plumage PC2	song PC2	MSF	BM	0	0.31	0.07 ± 0.08	0.44
plumage PC2	song PC2	HAB + MSF	BM	1.33	0.16	0.07 ± 0.08	0.42
plumage PC2	song PC2	base	BM	1.41	0.15	0.07 ± 0.09	0.40
plumage PC2	song PC2	FOR	BM	1.50	0.14	0.08 ± 0.09	0.34
plumage PC1	song PC2	HAB + FOR + MSF	BM	0	0.27	0.37 ± 0.17	0.03*
plumage PC1	song PC2	FOR + MSF	BM	0.77	0.19	0.36 ± 0.17	0.04*
plumage PC1	song PC2	MSF	BM	0.86	0.18	0.33 ± 0.17	0.06
plumage PC1	song PC2	HAB + MSF	BM	0.87	0.18	0.34 ± 0.17	0.05*
plumage PC2	song PC1	MSF	BM	0	0.28	0.12 ± 0.09	0.17
plumage PC2	song PC1	base	BM	0.63	0.21	0.14 ± 0.08	0.10
plumage PC2	song PC1	FOR	BM	1.55	0.13	0.13 ± 0.08	0.15
plumage PC2	song PC1	HAB + MSF	BM	1.68	0.12	0.11 ± 0.09	0.21
plumage PC2	song PC1	HAB	BM	1.84	0.11	0.15 ± 0.08	0.09
plumage PC1 + PC2	song PC1	HAB + FOR + MSF	BM	0	0.51	0.12 ± 0.18	0.49

plumage			HAB + FOR				
PC1 + PC2	song PC2	+ MSF	BM	0	0.51	0.43 ± 0.17	0.02*
plumage							
PC1 + PC2	song PC1	FOR + MSF	BM	1.99	0.19	0.15 ± 0.18	0.43
plumage							
PC1 + PC2	song PC2	FOR + MSF	BM	1.99	0.19	0.41 ± 0.18	0.03*

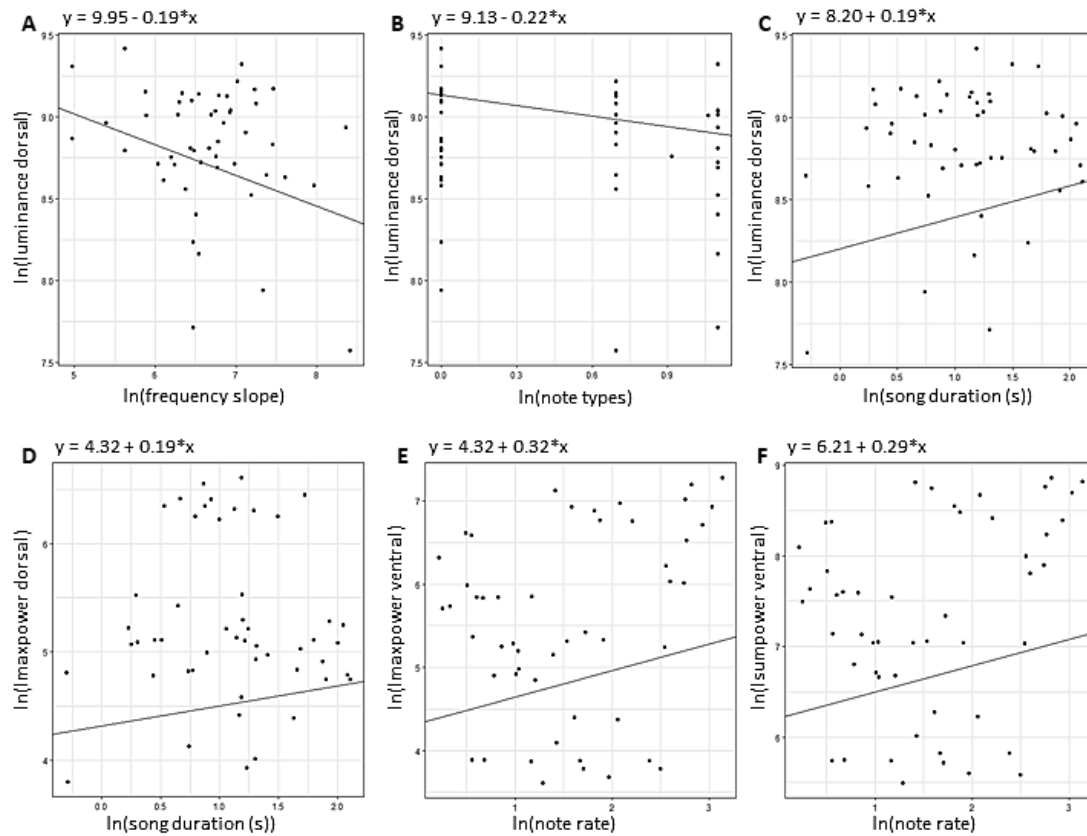


Figure 1. Scatterplots illustrating the obtained significant correlations between plumage and song traits in males antwrens. **A**, **B** and **C** is representing the relationship between dorsal luminance versus frequency slope, note types and song duration, respectively. **D** is representing a positive correlation between dorsal maximum energy and song duration. **E** and **F** are representing positive correlations of ventral maximum energy and ventral summed energy versus note rate, respectively. All variables had a log transformation (\ln).

Table 7. PGLS results of the relationship between female plumage and song PC1 and PC2. The first row of each relationship corresponds to the best model and the others correspond to the competing models ($\Delta AIC \leq 2$). β is the effect size of each correlation and SE is its standard error. An asterisk indicates when the relationship is significant (P value ≤ 0.05). HAB = Habitat exposure, FOR = Foraging strata and MSF = Mixed-species flocking behavior.

Plumage character	Song character	Model	Evolutionary model	ΔAIC	ω_i	$\beta \pm SE$	P
plumage PC1	song PC1	base	BM	0	0.51	0.19 ± 0.12	0.13
plumage PC1	song PC1	HAB	BM	1.86	0.20	0.20 ± 0.13	0.13
plumage PC2	song PC2	MSF	OU	0.00	0.42	0.14 ± 0.14	0.31
plumage PC2	song PC2	HAB + MSF	OU	1.11	0.24	0.17 ± 0.14	0.22
plumage PC2	song PC2	HAB + FOR + MSF	OU	1.94	0.16	0.14 ± 0.14	0.32
plumage PC1	song PC2	base	BM	0	0.52	-0.03 ± 0.14	0.83
plumage PC1	song PC2	HAB	BM	1.99	0.19	-0.03 ± 0.15	0.84
plumage PC2	song PC1	FOR + MSF	OU	0.00	0.41	-0.15 ± 0.08	0.07
plumage PC2	song PC1	HAB + MSF	OU	0.39	0.34	-0.18 ± 0.08	0.04*
plumage PC2	song PC1	HAB + FOR + MSF	OU	1.84	0.16	-0.16 ± 0.08	0.08
plumage PC1 + PC2	song PC1	MSF	OU	0	0.38	0.33 ± 0.14	0.02*
plumage PC1 + PC2	song PC2	MSF	OU	0	0.38	0.23 ± 0.21	0.28
plumage PC1 + PC2	song PC1	HAB + MSF	OU	1.66	0.16	0.32 ± 0.14	0.03*
plumage PC1 + PC2	song PC2	HAB + MSF	OU	1.66	0.16	0.27 ± 0.22	0.24

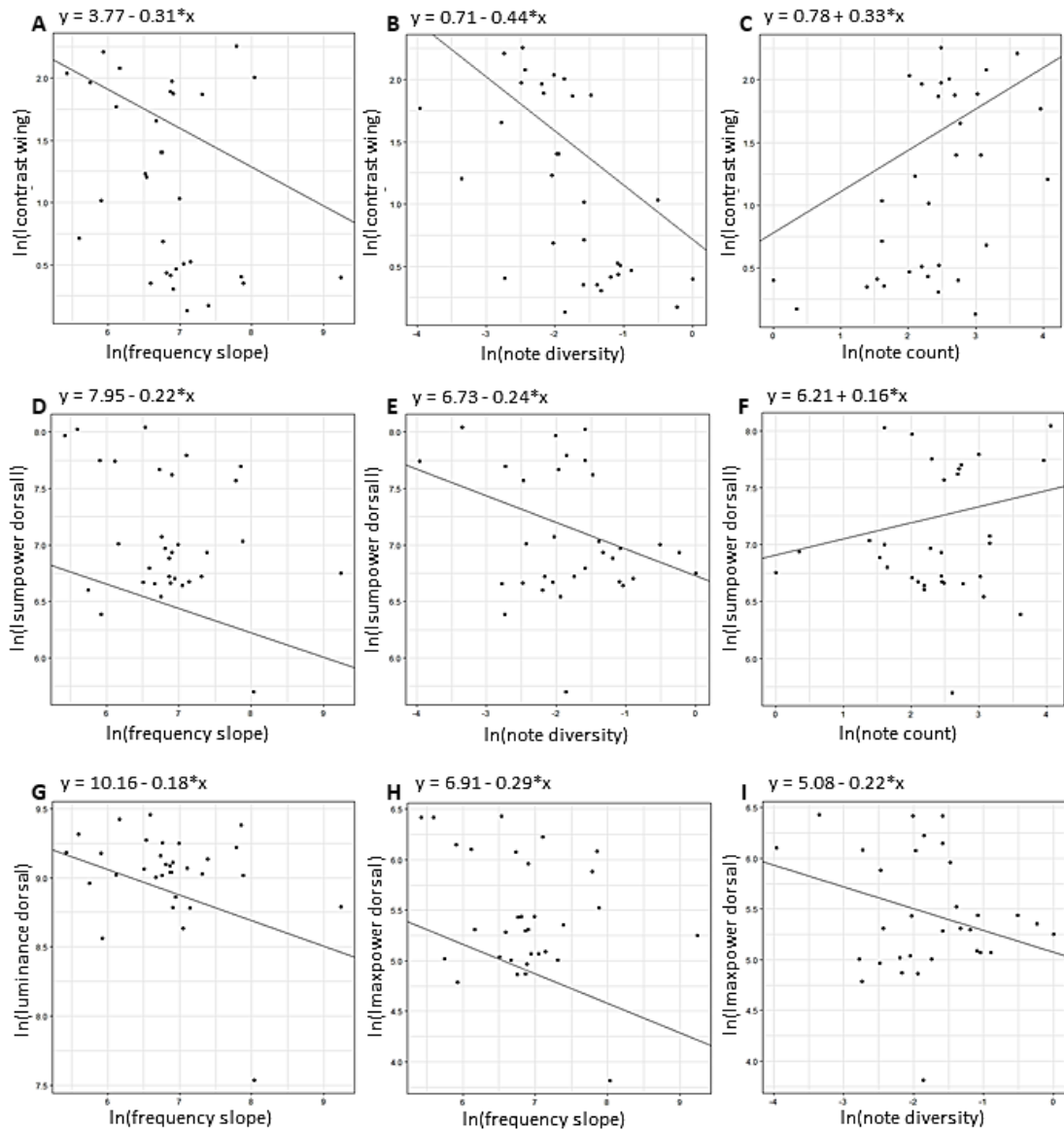


Figure 2. Scatterplots illustrating the obtained significant correlations between plumage and song traits in females antwrens. **A**, **B** and **C** is representing the relationship between wing contrast versus frequency slope, note diversity and note count, respectively. **D**, **E** and **F** is representing the relationship between dorsal summed energy versus frequency slope, note diversity and note count, respectively. **G** is representing a negative correlation between dorsal luminance and frequency slope. **H** and **I** are representing negative correlations between dorsal maximum energy versus frequency slope and note diversity, respectively. All variables had a log transformation (\ln).

Discussion

The Transfer Hypothesis is not supported for sexual dimorphism in plumage and vocal traits

We found a positive correlation between plumage and vocal sexual dimorphism, thus contradicting the TH. Also, this relationship was under an absence of selection pressures (i.e. BM model). Although this correlation was not significant, the observed pattern evidences a trend that the greater the plumage dimorphism, the greater the vocal dimorphism. This trend can suggest a redundancy on the sensory signals communication system (redundant signal hypothesis; Moller and Pomiankowski, 1993) or a multimodal communication system in which each sensory signal (i.e. vocal and visual) communicate different information in the taxa with high sexual dimorphism (multiple message hypothesis; Moller and Pomiankowski, 1993). Antwrens with low levels of sexual dimorphism may have evolved other communication traits that were not addressed in this study, but can still be part of the acoustic and visual signals spectra, such as the different types of calls, the duet formation between males and females and the many types of stereotyped body motion displayed (e.g. Whitney, 1994; Whitney and Pacheco, 1997; Zimmer and Isler, 2016).

Whereas only four studies testing the TH took plumage sexual dimorphism in account (Shutler and Weatherhead, 1990; Repentigny *et al.*, 2000; Ornelas *et al.*, 2009, Webb *et al.*, 2018), none used vocal sexual dimorphism or tested the correlation between them. This can be partially explained by the lack of available female recordings in audio collections, an underrepresentation that have been alerted by Odom and Benedict (2018). Whereas we obtained plumage data for almost all antwrens taxa (73 for males and 70 for females), the obtained vocal data was lower for males and almost the half for females (64 male and 38 female taxa). Thus, despite the difficulties in obtaining female vocal data, we were able to test

the relationship between sexual dimorphism in plumage and song traits. The obtained positive correlation pattern evidence that the TH may be not held in all groups and that its corroboration depends on which traits are being assessed (as shown in the following discussion sections).

Mixed evidence for TH between plumage and vocal components of variation

When testing the relationship between plumage and song components of variation, we found positive correlations in males and both positive and negative correlations in females, being significant only in some cases. We tested the correlations between plumage and song pPC1 and pPC2 scores values as a form of summarizing these traits, while correcting for phylogenetic non-independence. However, according to Uyeda *et al.* (2015), we need to take caution with the use of pPCA scores in comparative studies, because they can bias inferences to particular evolutionary patterns. Also, their simulations and empirical analyses suggested that pPCA scores can be more distorted when correlation among traits are not so strong (e.g. first PC explaining less than 75% of the total data variation). In our data, plumage and song pPC1 do not explain more than 35% and 45% in females, and 55% and 43% in males data distribution, indicating a weak correlation in our vocal and visual traits.

Thus, the significant correlations obtained between plumage and song components of variation should be interpreted with caution due to the possible biases involved and should also be compared with the obtained correlations between the selected plumage and vocal traits.

Transfer hypothesis seems to be corroborated between some selected plumage and vocal traits

We found both positive and negative correlations between all selected plumage and song traits in males and females, being significant only in some cases. The existence of both positive and negative relationships might obscure our interpretation of the support for the TH in the Formicivorini. However, these significant correlations occur only with certain song traits. Whereas the relationships between all selected plumage traits and note types, note diversity, and frequency slope were mostly negative, the relationships between plumage and note count, note rate and song duration in both sexes were mostly positive (Appendix B; Tables S2 and S3). Although song duration has been considered a proxy for song complexity in birds (e.g. Badyaev and Weckworth, 2002; Gonzalez-Voyer *et al.*, 2013; Mason *et al.*, 2014), it does not seem to describe accurately song complexity in Formicivorini. Antwrens have a considerable diversity in song duration, note count and note rate, but these measurements alone do not depict song complexity in the group. For instance, taxa that have longer songs tend emit just one note type several times, whereas taxa with shorter songs tend to produce less notes but of different types. Therefore, the measurements that better explain song complexity are note type and note diversity, song traits that are significantly negatively correlated with dorsal luminance in males and with wing contrast, dorsal maximum and summed energy in females, respectively. Frequency slope, the only frequency-based trait that was selected to test PGLS analyses, showed significant negative correlations with dorsal luminance in both sexes and with wing contrast, dorsal maximum and summed energy in females, thus also corroborating the TH. Therefore, we conclude that the TH seems to be corroborated in both sexes under a context of importance of the antwrens

song complexity, having a force of selection toward adaptive peaks (i.e. OU model) in males and in almost all correlations in females.

Ecological and behavioral traits are associated with plumage and vocal structure

Habitat (i.e., SDH) and mixed-species flocking behavior influence the structural variation in visual and acoustic signals. At least one of the ecological traits (i.e. habitat exposure or foraging strata) and mixed-species flocking behavior was a covariate in the best and competing models, but they usually did not alter much the effect size of plumage and song traits relationship when compared with the base model. It is difficult to determine which ecological trait combined or not combined with mixed-species flocking behavior were the best model in each significant relationship because we had a lot of competing models in mostly cases ($\Delta AIC \leq 2$) with Akaike weights very similar, indicating that these models were equally informative. Furthermore, we were not able to determine more precisely how these covariates limits the plumage and song traits. However, the ecological traits associations found when testing the TH also appeared in three other studies that considered habitat conditions as covariates (Gonzalez-Voyer *et al.*, 2013; Laverde-R., 2017; Gomes *et al.*, 2017), while only one study did not find significant interactions with habitat type (Mason *et al.*, 2014); thus, supporting the SDH. Also, the mixed-species flocking behavior association obtained in the present study support its influence on visual and acoustic signals structure.

Conclusion

Despite mixed evidences for some plumage and song traits relationships, the TH is corroborated in both sexes when we consider the variation of antwrens song complexity. Male antwrens with brighter dorsal regions tend to have a lower number of note types per song and a lower frequency range per song duration (i.e. frequency slope). Females with a brighter dorsal region also tend to have a lower frequency range per song duration. Furthermore, dorsal regions with a more complex pattern and more contrasted wing coverts are associated with a lower frequency range per song duration and a lower note diversity in females.

The TH was not supported only between plumage and song sexual dimorphism, in which a non-significant positive was found. The observed pattern suggests a redundancy or multimodal communication in antwrens with high sexual dimorphism and suggests the existence of other forms of communication in low sexually dimorphic antwrens that were not assessed in this study.

Whereas the observed significant trade-offs between some plumage and song traits have a force of selection toward adaptive peaks in males and in almost all cases in females, the positive correlation between plumage and song sexual dimorphism was under an absence of selection pressures. However, regardless of the best fitted evolutionary models, all these relationships are influenced by at least one ecological trait (i.e. habitat exposure or foraging strata) or with mixed-species flocking behavior as covariates, corroborating the SDH and the mixed-species flocking behavior influence on visual and acoustic signals structure.

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General discussion and Conclusions

In the present study, we integrated a genome-scale phylogeny of the tribe Formicivorini with vocal, plumage, ecological, and behavioral data following a phylogenetic comparative framework in order to comprehend the evolution of acoustic and visual signals in the diverse Formicivorini clade.

We found significant trade-offs between some acoustic and visual signals (TH) in both sexes. In males, antwrens with a brighter dorsal region have a lower number of note types in a song and a lower frequency range per song duration. While in females, antwrens with a brighter dorsal region have a lower frequency range per song duration and those with a more complex patterned dorsal region and wing coverts more contrasted have a lower frequency range per song duration and a lower note diversity. These significant trade-offs are under a force of selection towards an adaptive optimum in males and in almost all cases in females.

When we tested the relationship between sexual dimorphism in plumage and song traits, we found an opposite trend. A non-significant positive correlation was found, thus refuting the TH and evidencing a trend that the greater the plumage dimorphism, the greater the vocal dimorphism. The observed pattern was under an absence of selection forces and suggests a redundancy on the sensory signals system communication or a multimodal communication system in which each sensory signal communicate different information in the antwrens taxa with high sexual dimorphism, while the antwrens with low sexual dimorphism may have evolved other ways to recognize each other that were not assessed in this study (e.g. calls, duets, stereotyped body motion displays).

All these described relationships (either the trade-offs between some plumage and vocal traits or the positive correlation between sexual dimorphism in plumage and song traits) are influenced by at least one ecological trait (i.e. habitat exposure or foraging strata) or with mixed-species flocking behavior as covariates, corroborating the SDH and mixed-species flocking behavior influence on visual and acoustic signals structure. Although we have not been able to determine more precisely how these covariates limits these plumage and song traits, they seem to have an important role in shaping the acoustic and visual signals structure evolution.

The present study had an important role in comprehending how the plumage and song evolved in the tribe Formicivorini and which traits are influencing the observed pattern. Also, it shed light on the poorly studied TH that have mixed evidences in the literature, it accounted for the habitat effects on both acoustic and visual signals and a possible influence of foraging behavior. We suggest that further studies investigating the TH should consider habitats effects and other possible important behavioral traits as covariates in their study models. Also, a family level study with all antbirds incorporating other possible important habitat and behavior traits is recommended to access if the observed patterns are maintained in a larger scale.

Resumo

A comunicação animal transmite informações usando diferentes tipos de sinais sensoriais que possuem propósitos específicos (e.g. cortejo, defesa territorial, manutenção de grupos unidos e minimização da predação) e estão suscetíveis a pressões do habitat (Hipótese de Condução Sensorial - HCS). Em aves, alguns estudos de sinais acústicos e visuais demonstraram que a estrutura do canto está associada com a capacidade de transmissão do som em diferentes habitats e alguns aspectos de plumagem (e.g. coloração, brilho e padrão) parecem variar de acordo com as condições de iluminação do ambiente. Além dos efeitos de habitat, outros fatores como limitação energética, risco de predação e de parasitismo podem limitar o investimento em mais de um tipo de sinal sensorial. Devido a esse alto custo, foi proposta a existência de uma demanda conflitante (*trade-off*) evolutiva entre os diferentes tipos de sinais sensoriais denominada Hipótese de Transferência (HT) ou de “*Trade-off*”. Os poucos estudos que testaram a HT em aves apresentaram resultados contrastantes, sendo corroborada apenas em dois trabalhos. Além disso, há uma baixa quantidade de trabalhos que consideraram as condições de habitat como covariáveis. Assim, nós avaliamos a HT entre os sinais acústicos e visuais, considerando simultaneamente os efeitos potenciais das condições de habitat (HCS) em um diverso grupo de aves subóscines neotropicais, comumente conhecidas como papa-formigas (Thamnophilidae). Especificamente, nós integramos a filogenia em escala genômica da tribo Formicivorini (36 espécies) com dados vocais, de plumagem, ecológicos e comportamentais utilizando uma abordagem comparativa filogenética para testar simultaneamente a HT, a HCS e também considerando a influência do comportamento de formação de

bandos mistos na diversidade da estrutura dos sinais acústicos e visuais. Enquanto que demandas conflitantes significativas entre algumas medidas de plumagem e de canto foram encontradas em ambos os sexos (e.g. luminância dorsal contra declive de frequência) corroborando a HT, uma tendência oposta não significativa foi encontrada entre o dimorfismo sexual de plumagem e canto. Todas essas relações são influenciadas por condições de habitat e comportamento como covariáveis, corroborando a HCS e a influência do comportamento de bandos mistos na evolução da estrutura dos sinais acústicos e visuais.

Abstract

Animal communication transmits information using different sensory signals that have particular purposes (e.g. courtship, territorial defense, maintaining groups together and minimizing predation) and are susceptible to habitat pressures (Sensory Drive Hypothesis - SDH). In birds, some studies on acoustic and visual signals showed that song structure is associated with sound transmission capacity in different habitats and some plumage features (e.g. color, brightness and pattern) seem to vary according to light conditions of the environment. In addition to habitat effects, other factors such as energetic limits, predation, and parasitism risk can limit the investment in more than one type of sensory signal. Due to this high cost, it was proposed the existence of an evolutionary trade-off between the different types of sensory signals termed Transfer (TH) or Trade-off hypothesis. Few studies that have tested the TH in birds showed contrasting results, being corroborated only in two studies. Also, there is a low in the number of studies that have considered habitat conditions as covariates (SDH). Here, we assess the TH between acoustic and visual signals, while simultaneously considering potential effects of habitat conditions (SDH) in a diverse group of Neotropical suboscine birds, commonly known as antbirds (Thamnophilidae). Specifically, we integrated a genome-scale phylogeny of the tribe Formicivorini (36 species) with vocal, plumage, ecological, and behavioral data within a phylogenetic comparative framework to simultaneously test the TH and SDH while assessing the influence of mixed-species flocking foraging behavior on the structural diversity of acoustic and visual signals. Whereas in both sexes we found significant trade-offs between some plumage and vocal traits (e.g. dorsal luminance versus frequency slope),

providing support for the TH, we found a non-significant opposite trend between plumage and vocal sexual dimorphism. All these relationships are influenced by habitat conditions and behavioral traits as covariates, corroborating the SDH and mixed-species flocking behavior influence in the evolution of visual and acoustic signals.

Appendix A. Supplementary Figures

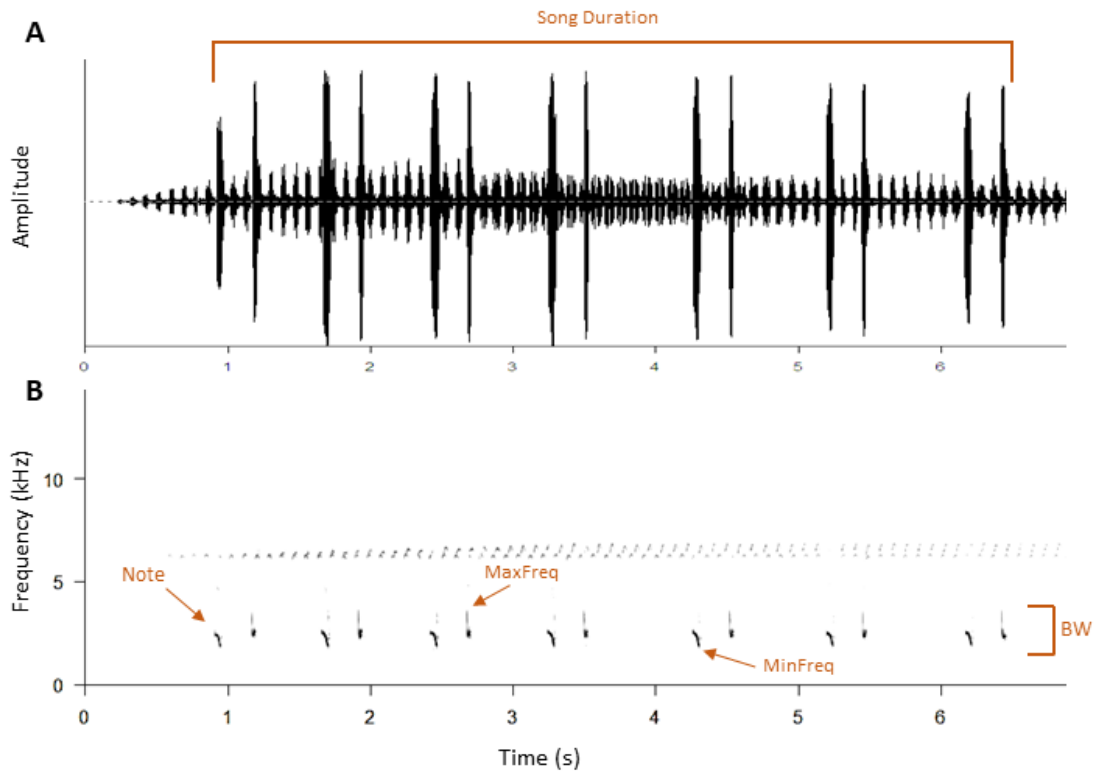


Figure S1. An example of an oscillogram (A) and a spectrogram (B) of a *Stymphalornis acutirostris* male individual. The x axis is representing time (s) in both plots, whereas the y axis is representing amplitude in the oscillogram and frequency in the spectrogram. The former was used only to determine the song duration. The spectrogram was used to determine the number of notes and note types. Here, we also indicated some of the frequency-based measurements used: MaxFreq is high frequency, MinFreq is low frequency, and BW is song bandwidth.

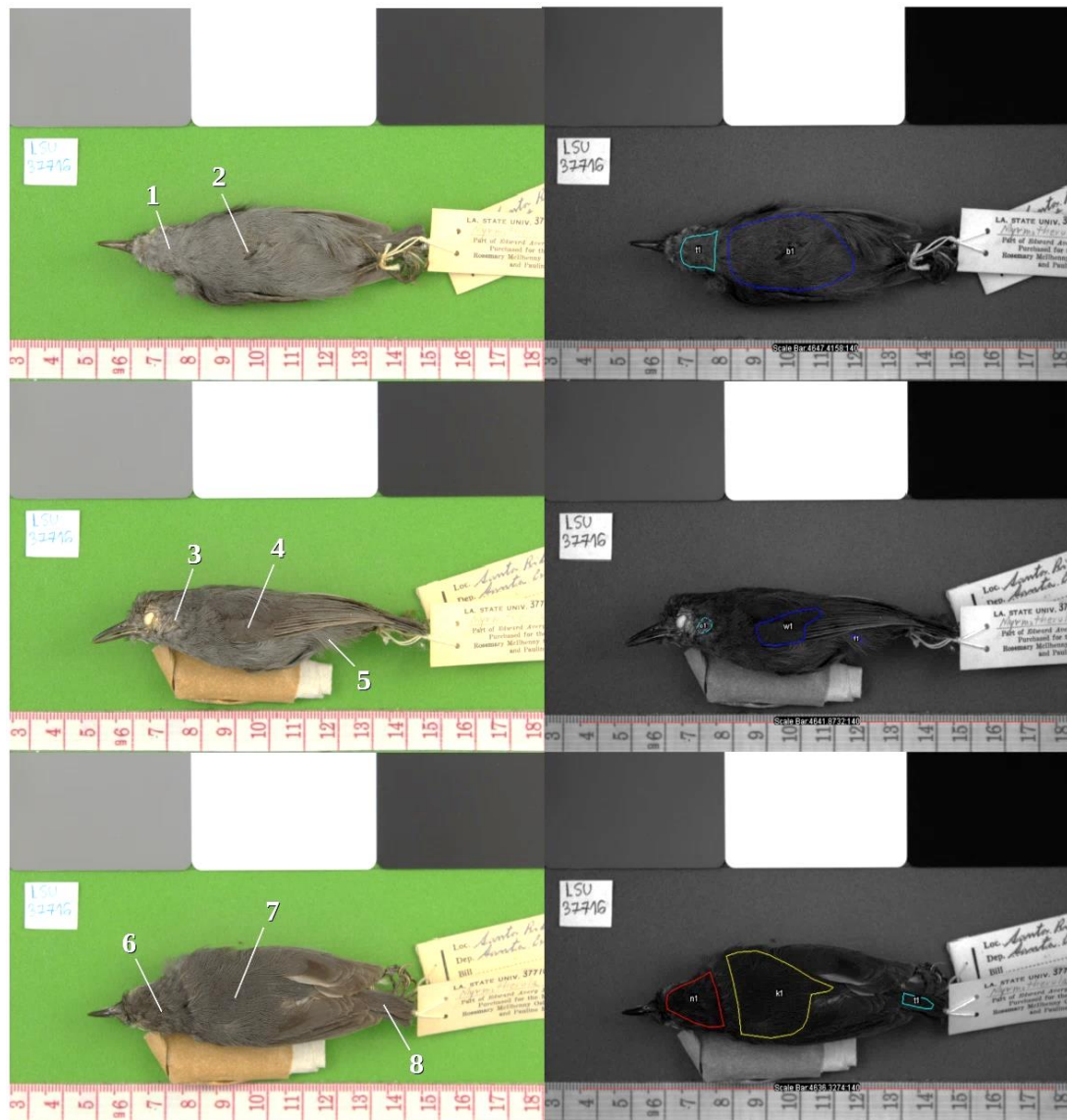


Figure S2. In the left, an example of a photographed museum specimen. In the right, the same photographed specimen with each plumage region selected in the ImageJ software. 1: throat, 2: belly, 3: cheek, 4: wing coverts, 5: flanks, 6: head, 7: back, 8: tail.

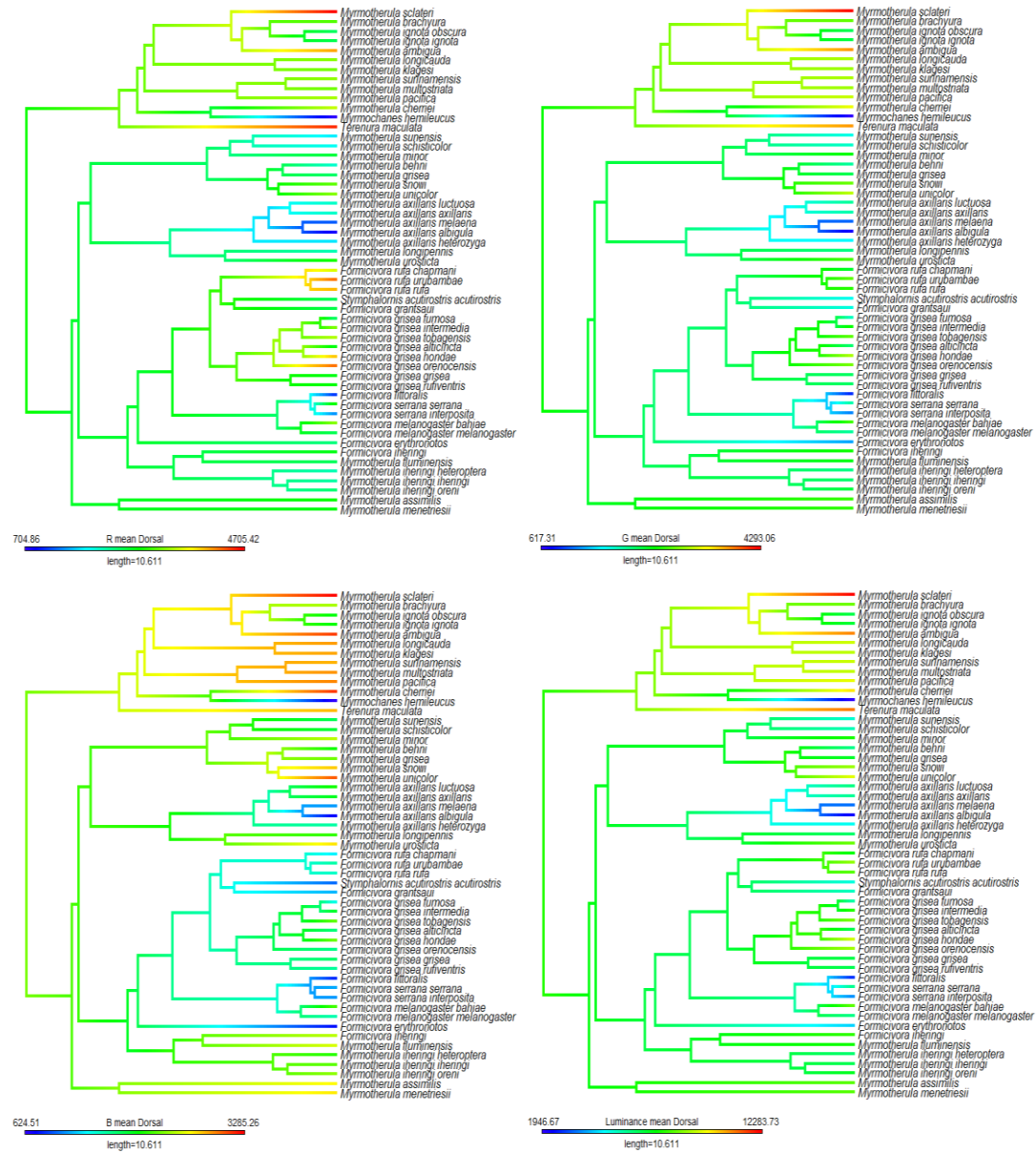


Figure S3. Ancestral state reconstructions of Red, Green, Blue channels and Luminance of the dorsal region in males.

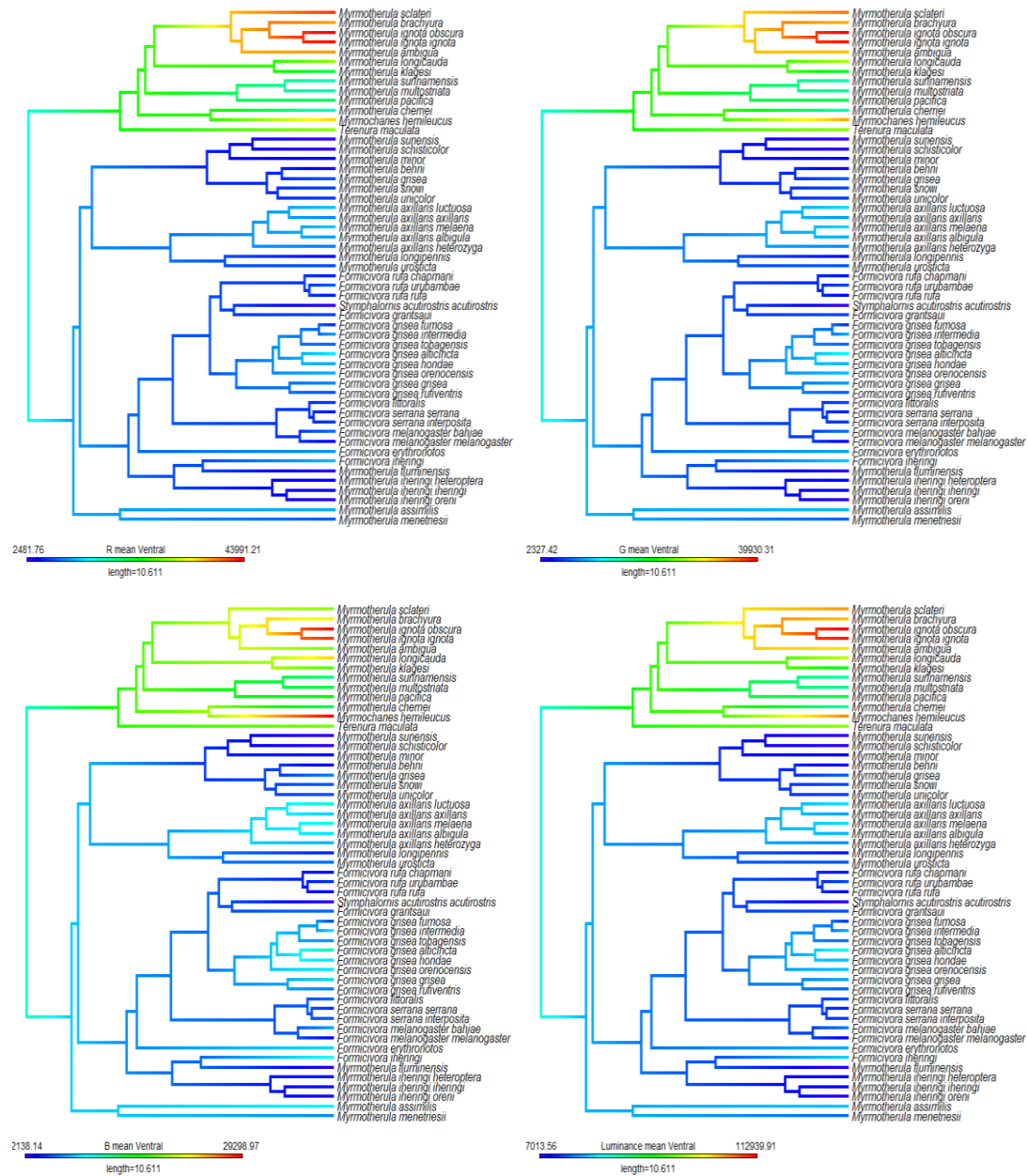


Figure S4. Ancestral state reconstructions of Red, Green, Blue channels and Luminance of the ventral region in males.

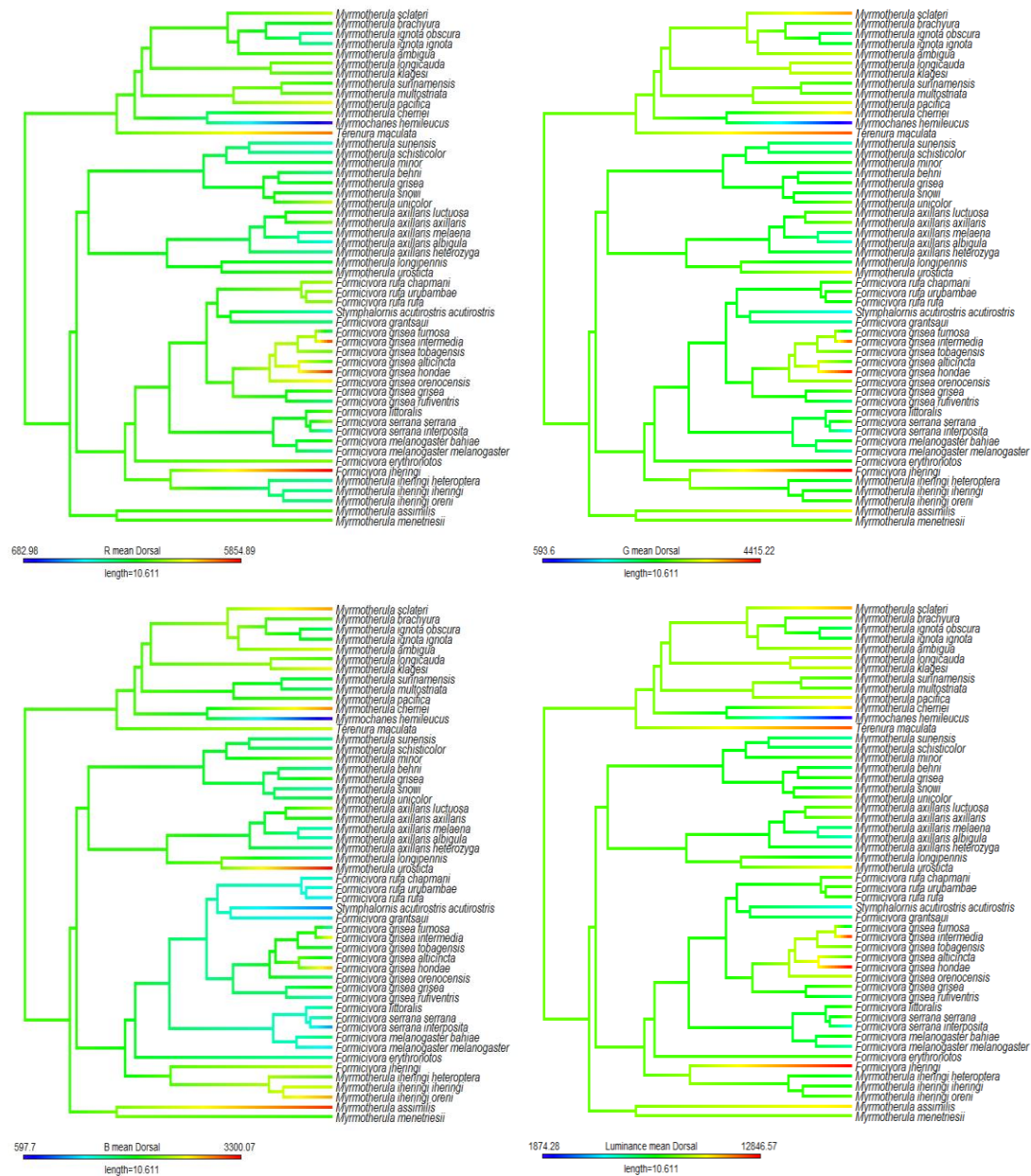


Figure S6. Ancestral state reconstructions of Red, Green, Blue channels and Luminance of the dorsal region in females.

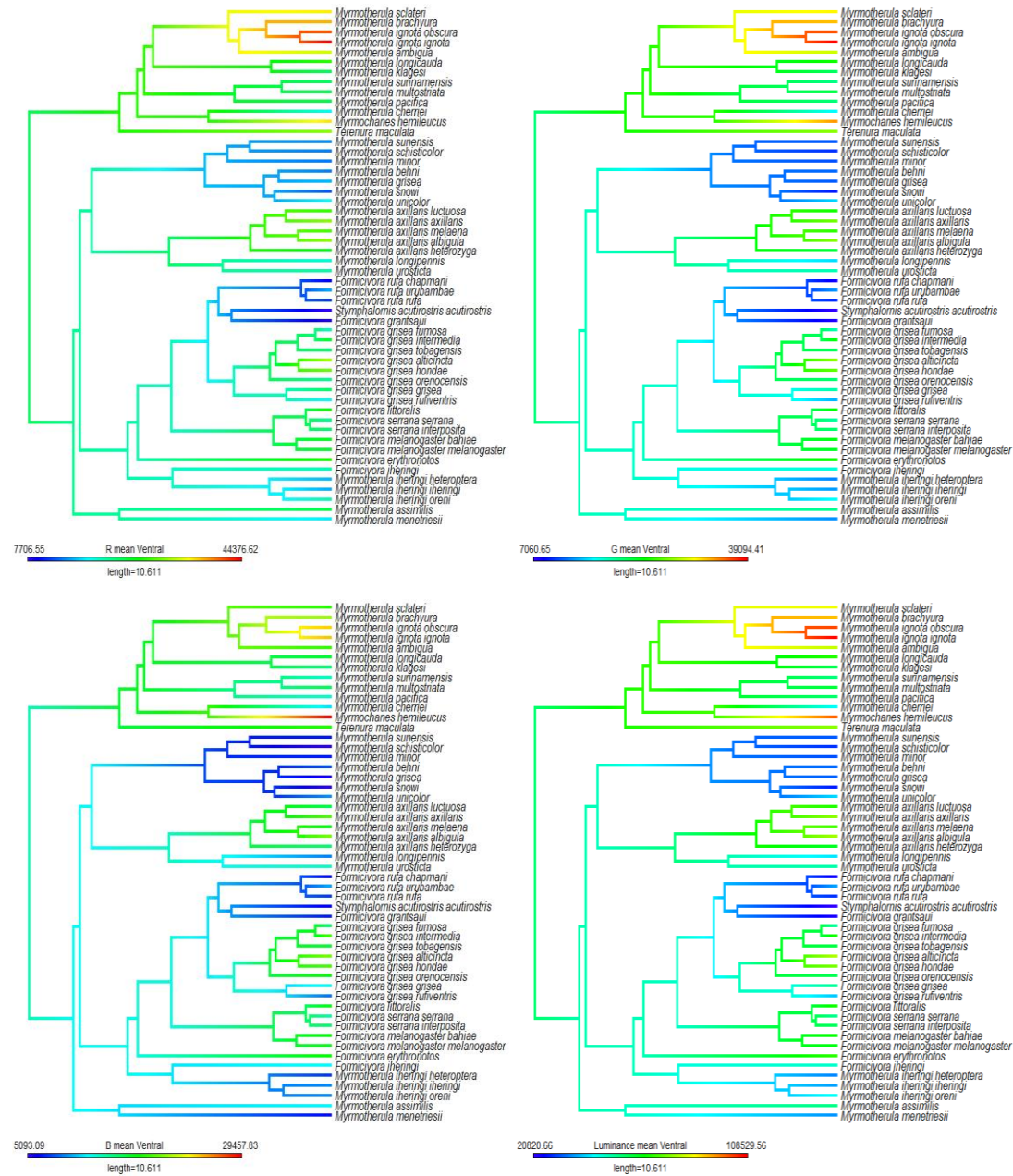


Figure S7. Ancestral state reconstructions of Red, Green, Blue channels and Luminance of the ventral region in females.

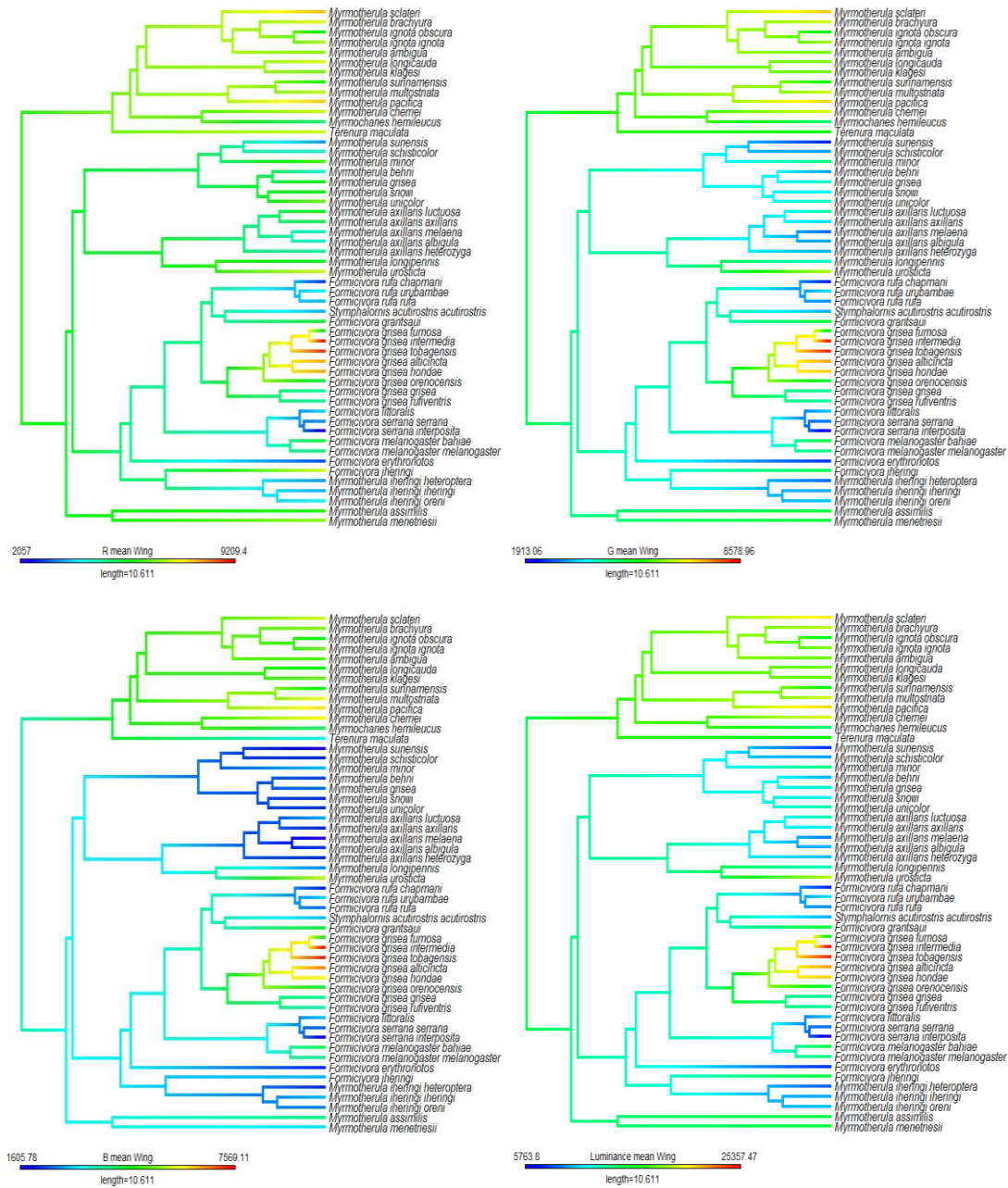


Figure S8. Ancestral state reconstructions of Red, Green, Blue channels and Luminance of the wing coverts region in females.

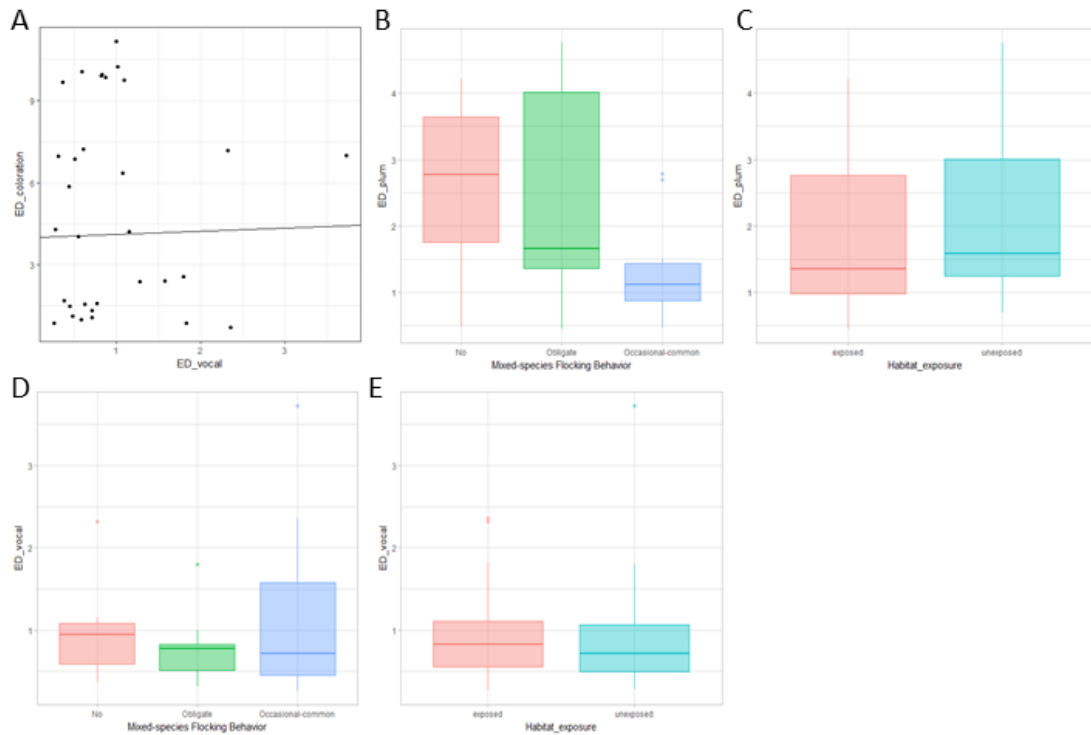


Figure S9. A. Scatterplot illustrating a non-significant positive correlation between plumage and vocal sexual dimorphism. B and C have boxplots representing the relationship between plumage sexual dimorphism versus mixed-species flocking behavior and habitat exposure, respectively. D and E have boxplots representing the relationship between vocal sexual dimorphism versus mixed-species flocking behavior and habitat exposure, respectively.

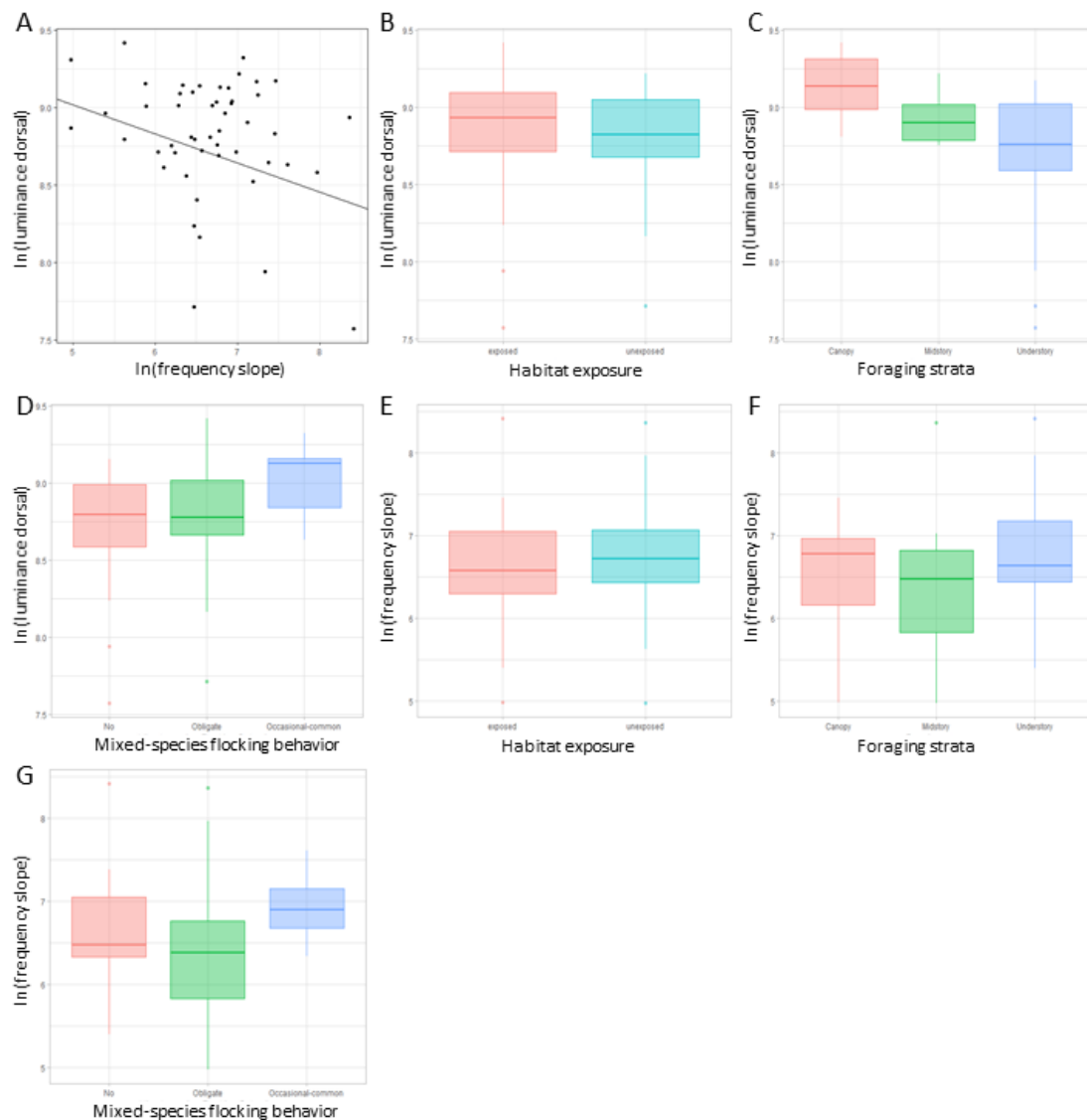


Figure S10. A. Scatterplot illustrating the significant correlation between dorsal luminance versus frequency slope in males. B, C and D have boxplots representing the relationship between dorsal luminance versus habitat exposure, foraging strata and mixed-species flocking behavior, respectively. E, F and G have boxplots representing the relationship between frequency slope versus habitat exposure, foraging strata and mixed-species flocking behavior, respectively.

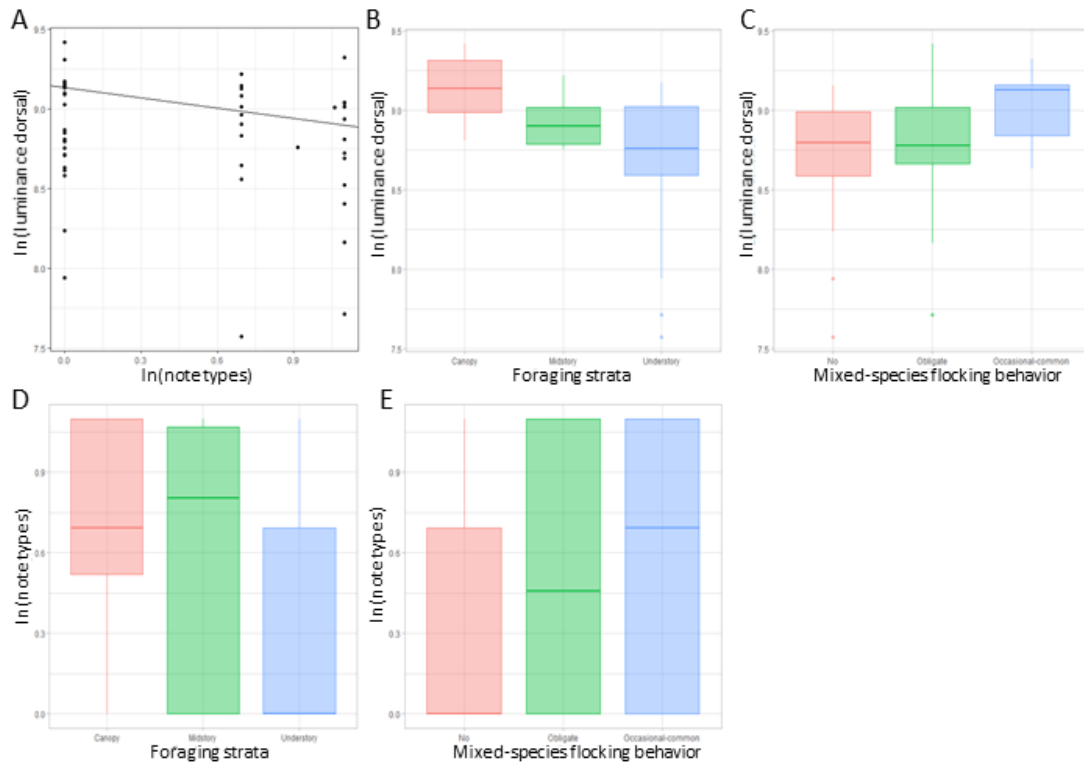


Figure S11. A. Scatterplot illustrating the significant correlation between dorsal luminance versus note type. B and C have boxplots representing the relationship between dorsal luminance versus foraging strata and mixed-species flocking behavior, respectively. D and E have boxplots representing the relationship between note type versus foraging strata and mixed-species flocking behavior, respectively.

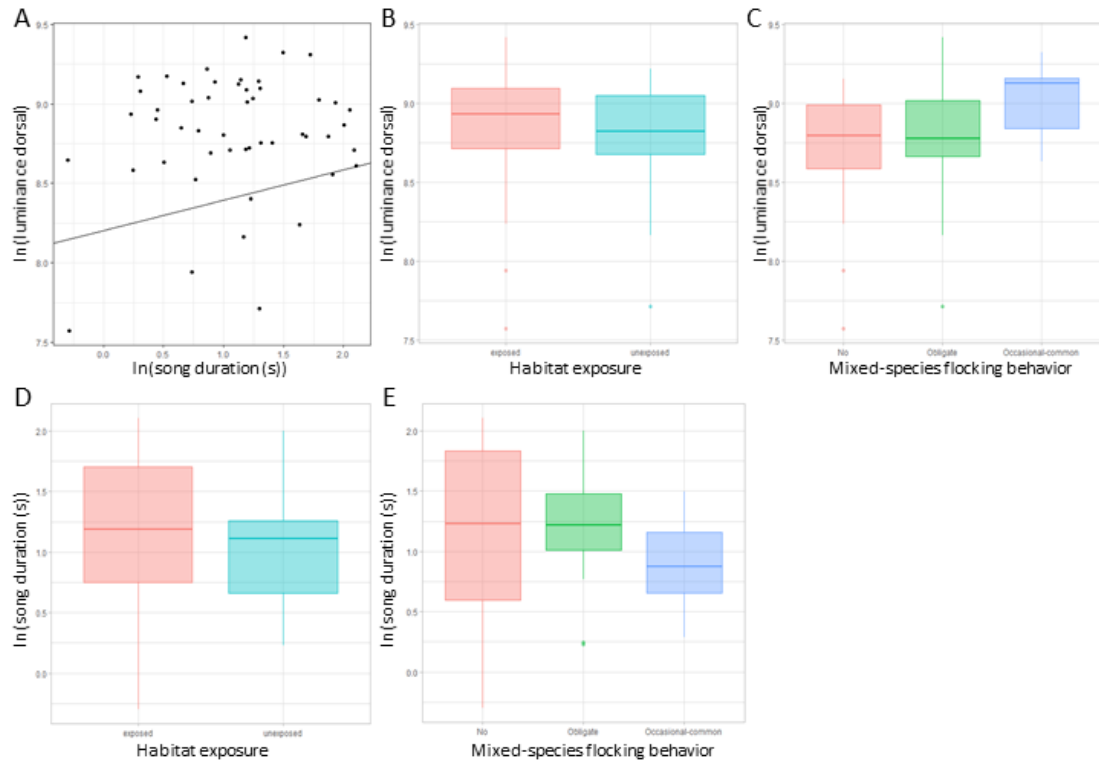


Figure S12. A. Scatterplot illustrating the significant correlation between dorsal luminance versus song duration in males. B and C have boxplots representing the relationship between dorsal luminance versus habitat exposure and mixed-species flocking behavior, respectively. D and E have boxplots representing the relationship between song duration versus habitat exposure and mixed-species flocking behavior, respectively.

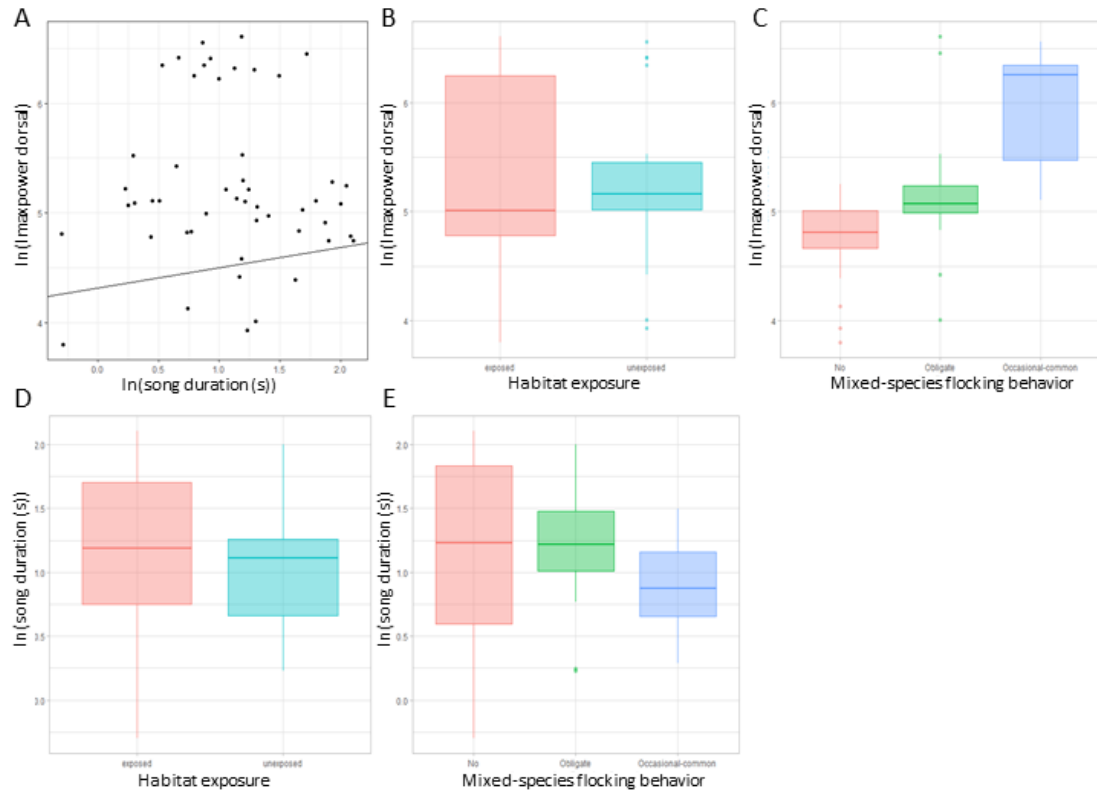


Figure S13. A. Scatterplot illustrating the significant correlation between dorsal maximum energy versus song duration in males. B and C have boxplots representing the relationship between dorsal maximum energy versus habitat exposure and mixed-species flocking behavior, respectively. D and E have boxplots representing the relationship between song duration versus habitat exposure and mixed-species flocking behavior, respectively.

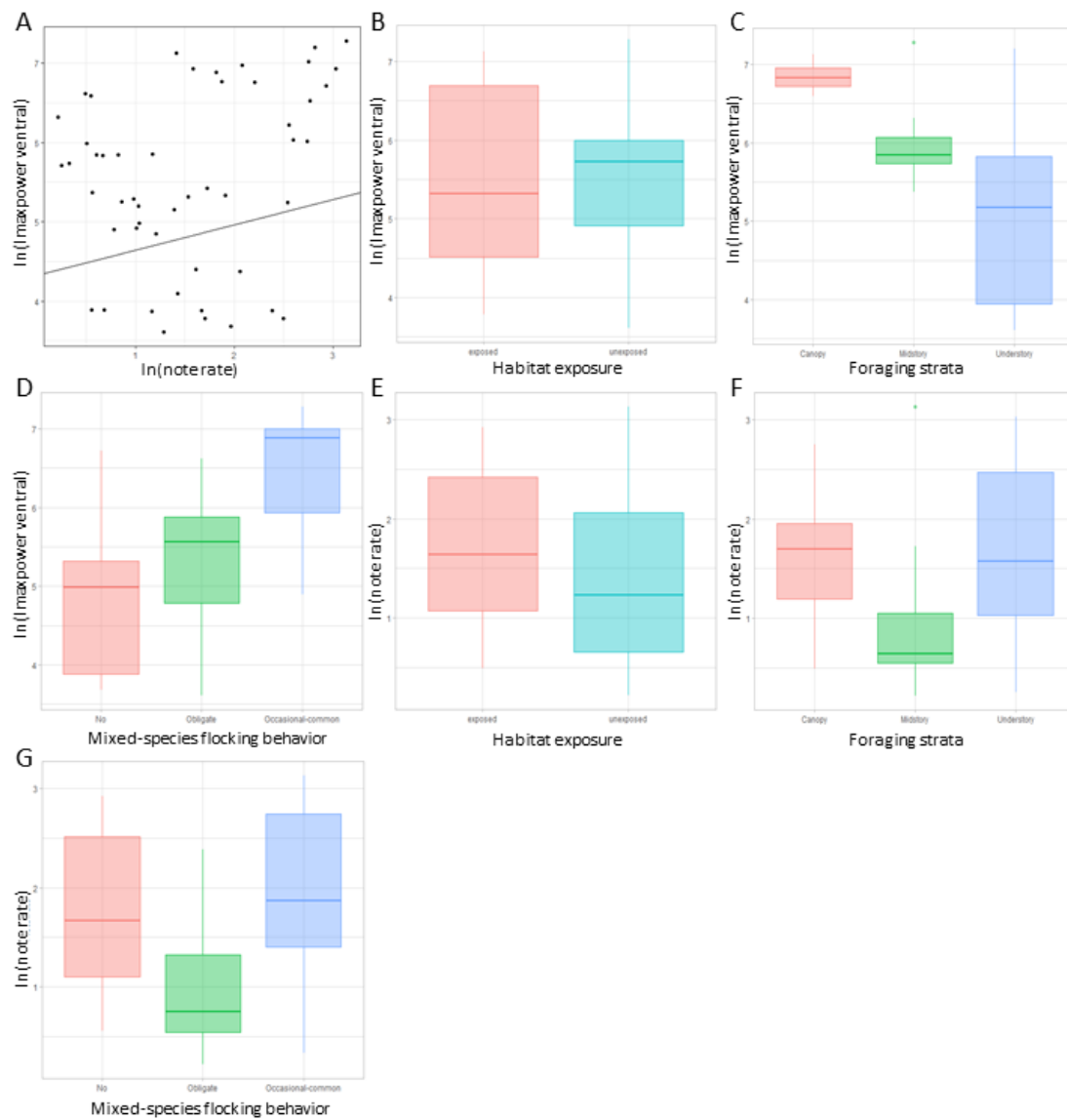


Figure S14. A. Scatterplot illustrating the significant correlation between ventral maximum energy versus note rate in males. B, C and D have boxplots representing the relationship between ventral maximum energy versus habitat exposure, foraging strata and mixed-species flocking behavior, respectively. E, F and G have boxplots representing the relationship between note rate versus habitat exposure, foraging strata and mixed-species flocking behavior, respectively.

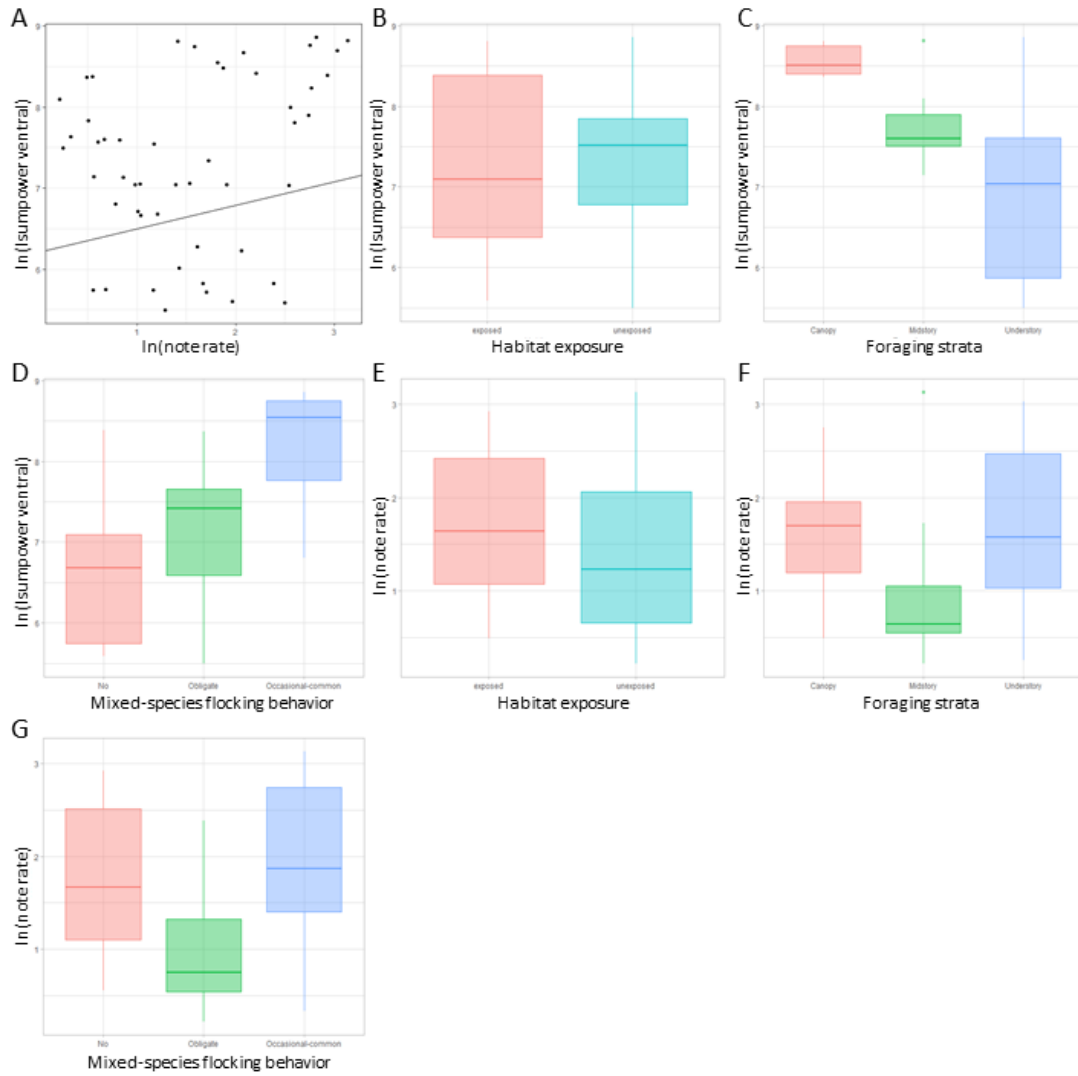


Figure S15. A. Scatterplot illustrating the significant correlation between ventral summed energy versus note rate in males. B, C and D have boxplots representing the relationship between ventral summed energy versus habitat exposure, foraging strata and mixed-species flocking behavior, respectively. E, F and G have boxplots representing the relationship between note rate versus habitat exposure, foraging strata and mixed-species flocking behavior, respectively.

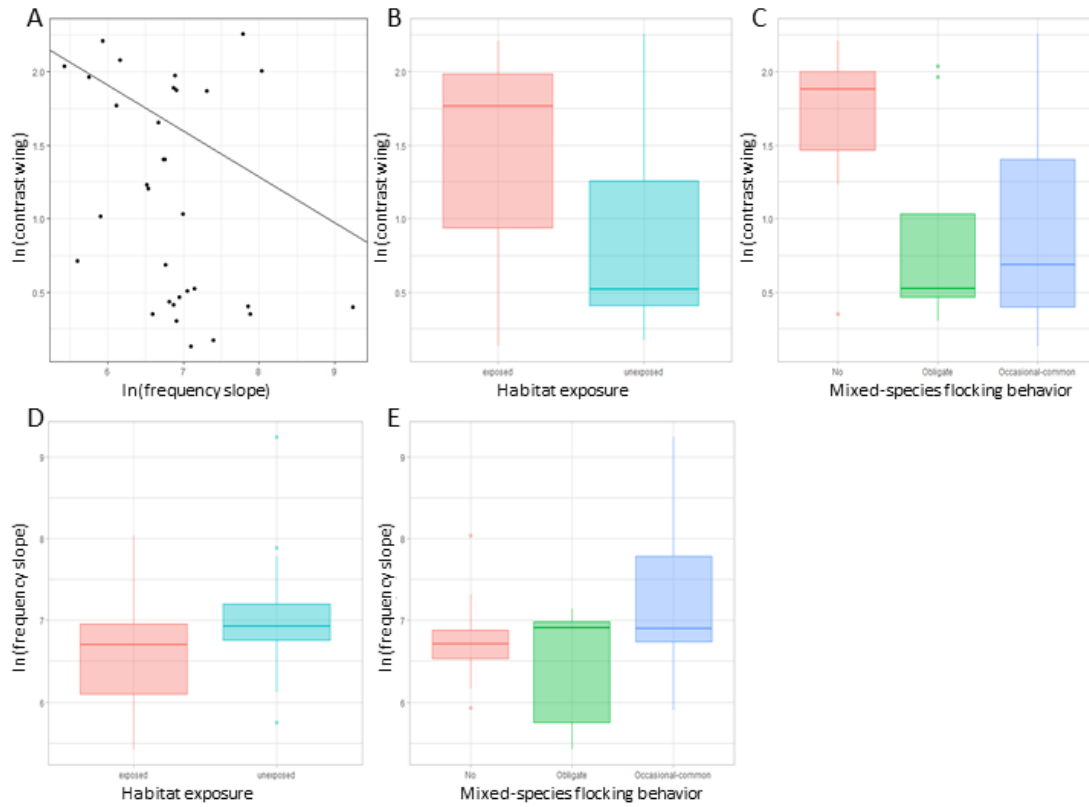


Figure S16. A. Scatterplot illustrating the significant correlation between wing contrast versus frequency slope in females. B and C have boxplots representing the relationship between wing contrast versus habitat exposure and mixed-species flocking behavior, respectively. D and E have boxplots representing the relationship between frequency slope versus habitat exposure and mixed-species flocking behavior, respectively.

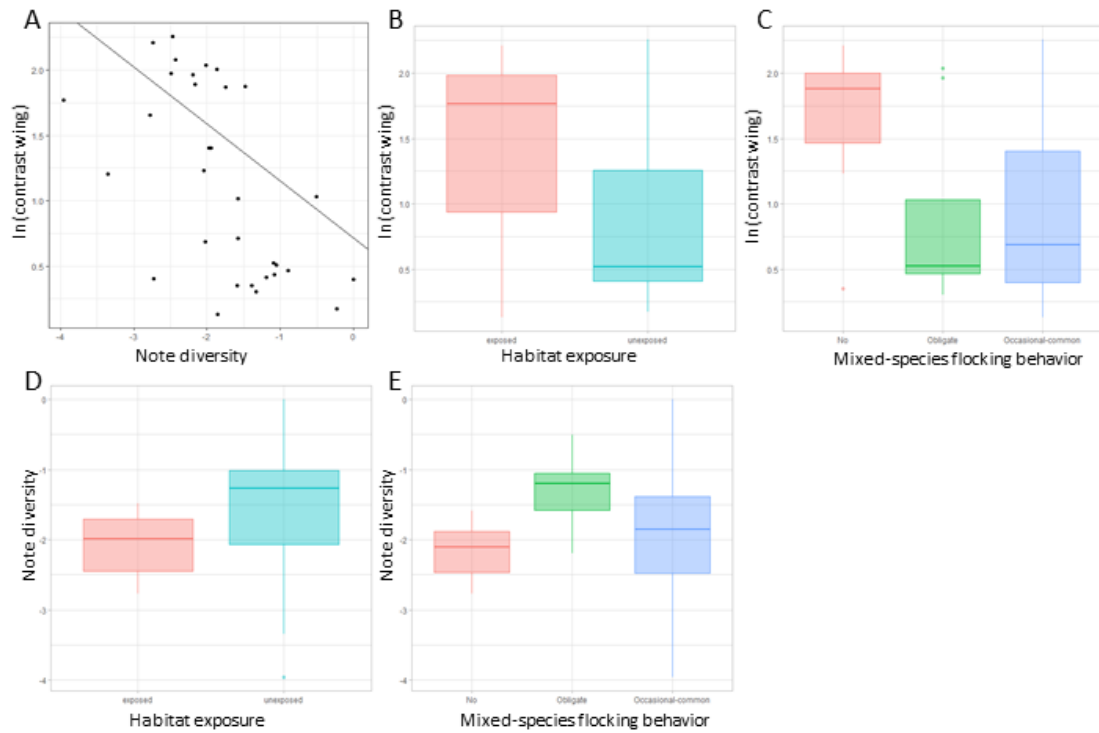


Figure S17. A. Scatterplot illustrating the significant correlation between wing contrast versus note diversity in females. B and C have boxplots representing the relationship between wing contrast versus habitat exposure and mixed-species flocking behavior, respectively. D and E have boxplots representing the relationship between note diversity versus habitat exposure and mixed-species flocking behavior, respectively.

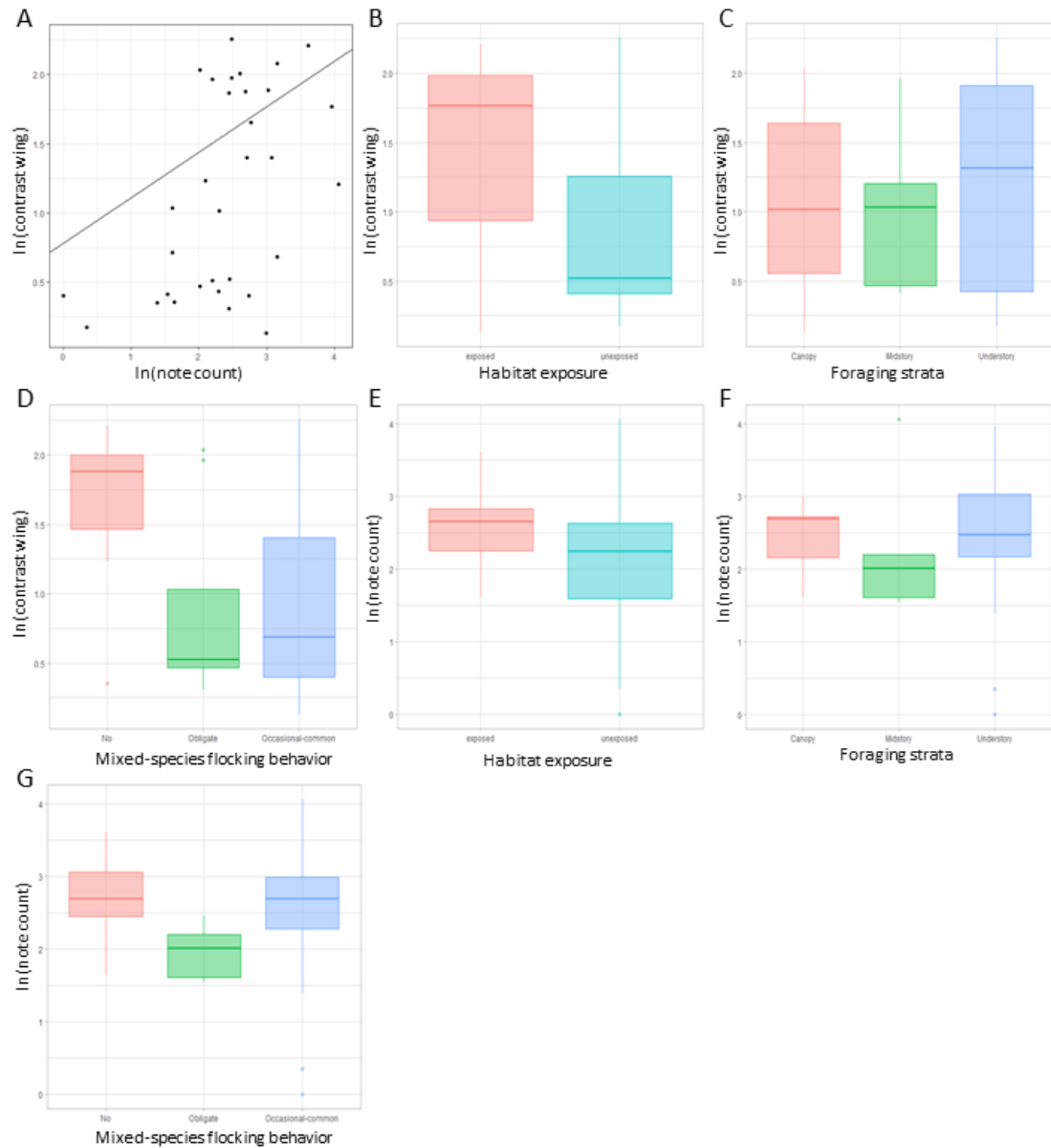


Figure S18. A. Scatterplot illustrating the significant correlation between wing contrast versus note count in females. B, C and D have boxplots representing the relationship between wing contrast versus habitat exposure, foraging strata and mixed-species flocking behavior, respectively. E, F and G have boxplots representing the relationship between note count versus habitat, foraging strata and mixed-species flocking behavior, respectively.

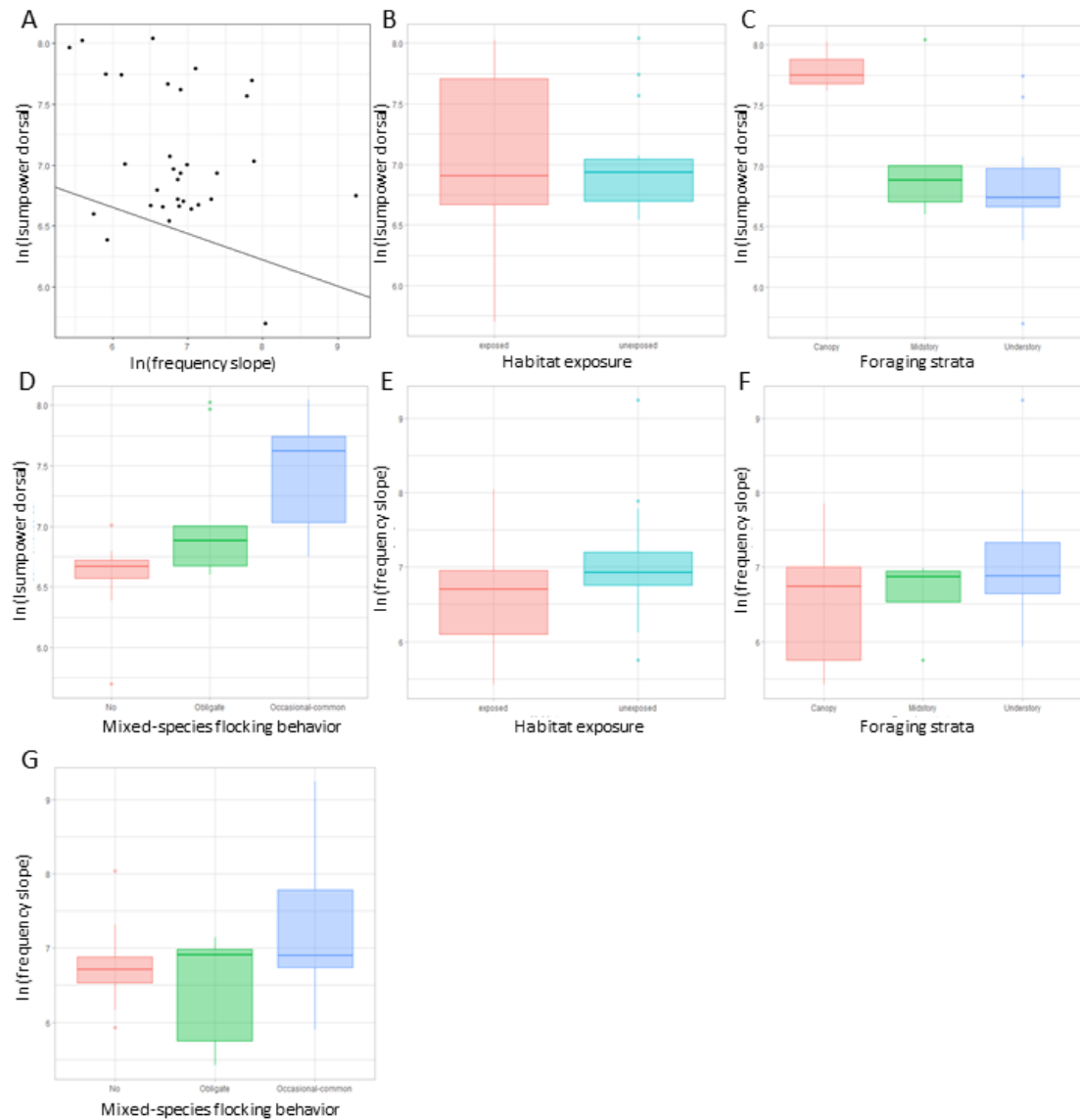


Figure S19. A. Scatterplot illustrating the significant correlation between dorsal summed energy versus frequency slope in females. B, C and D have boxplots representing the relationship between dorsal summed energy versus habitat exposure, foraging strata and mixed-species flocking behavior, respectively. E, F and G have boxplots representing the relationship between frequency slope versus habitat exposure, foraging strata and mixed-species flocking behavior, respectively.

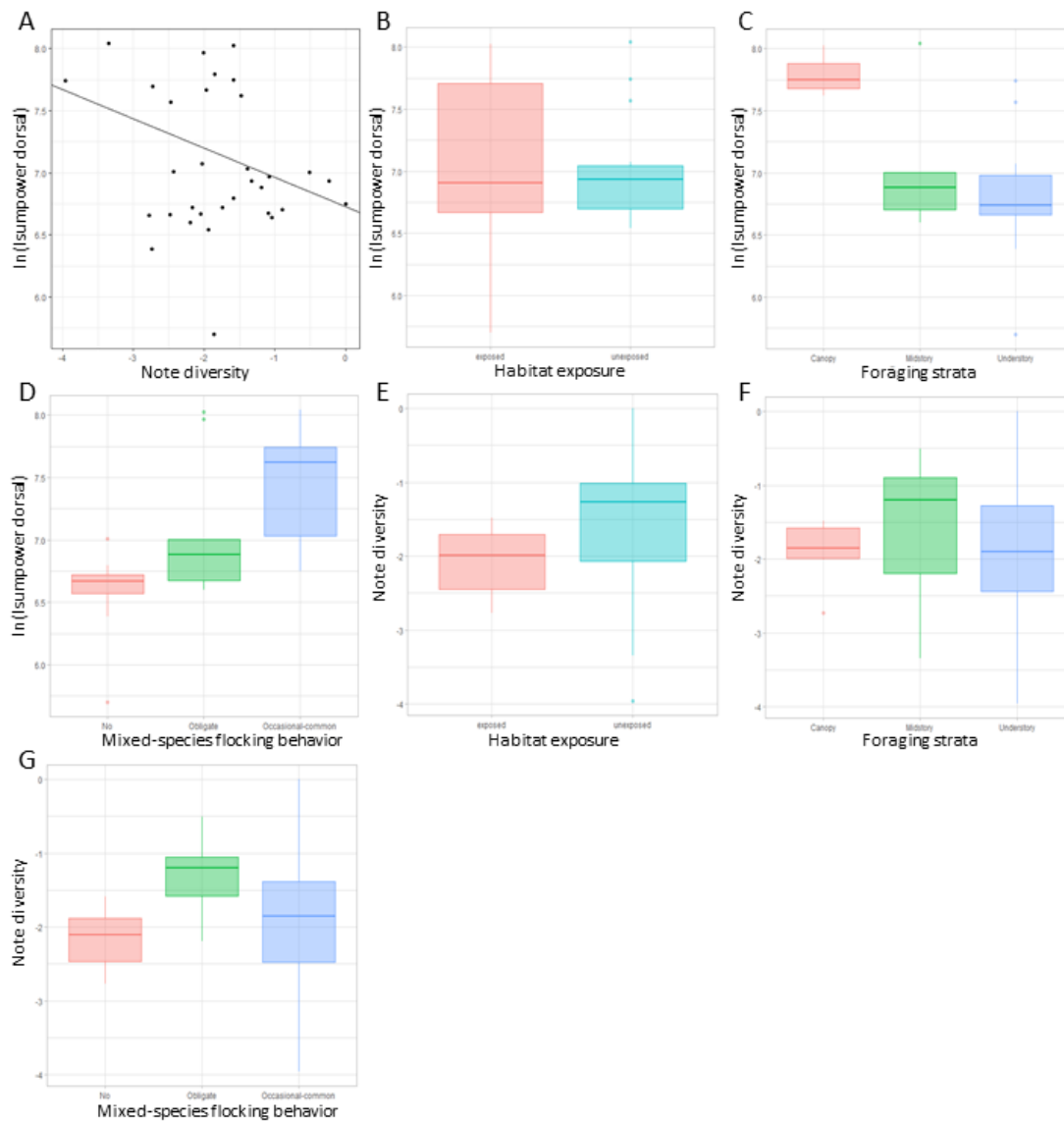


Figure S20. A. Scatterplot illustrating the significant correlation between dorsal summed energy versus note diversity in females. B, C and D have boxplots representing the relationship between dorsal summed energy versus habitat exposure, foraging strata and mixed-species flocking behavior, respectively. E, F and G have boxplots representing the relationship between note diversity versus habitat, foraging strata and mixed-species flocking behavior, respectively.

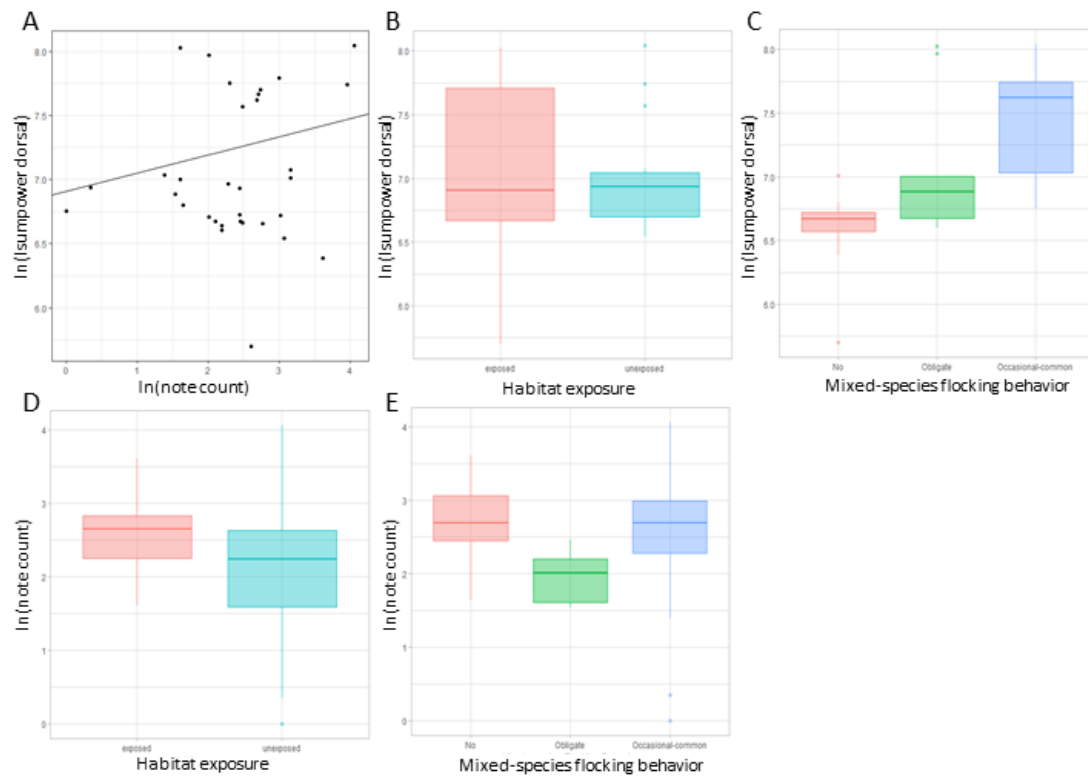


Figure S21. A. Scatterplot illustrating the significant correlation between dorsal summed energy versus note count in females. B and C have boxplots representing the relationship between dorsal summed energy versus habitat exposure and mixed-species flocking behavior, respectively. D and E have boxplots representing the relationship between note count versus habitat exposure and mixed-species flocking behavior, respectively.

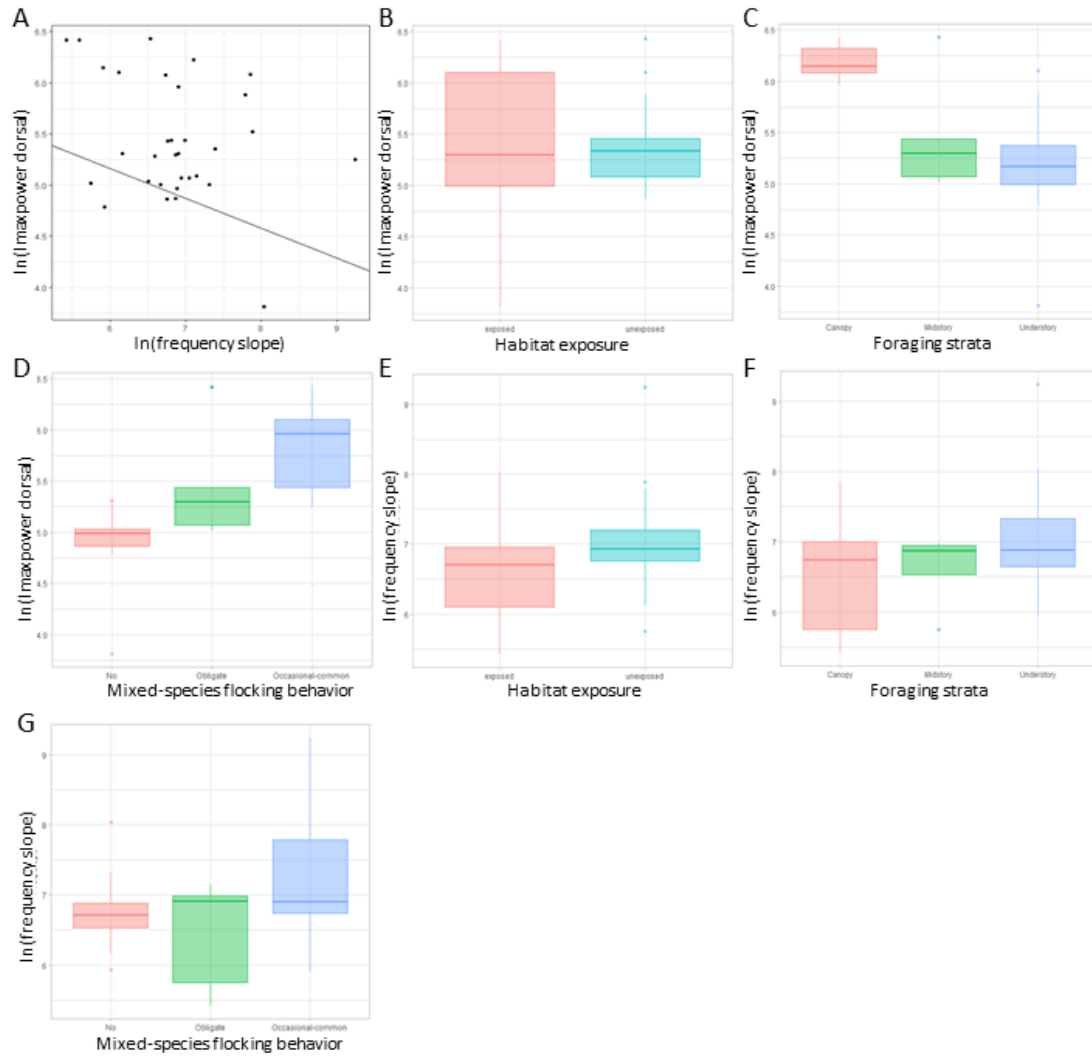


Figure S22. A. Scatterplot illustrating the significant correlation between dorsal maximum energy versus frequency slope in females. B, C and D have boxplots representing the relationship between dorsal maximum energy versus habitat exposure, foraging strata and mixed-species flocking behavior, respectively. E, F and G have boxplots representing the relationship between frequency slope versus habitat exposure, foraging strata and mixed-species flocking behavior, respectively.

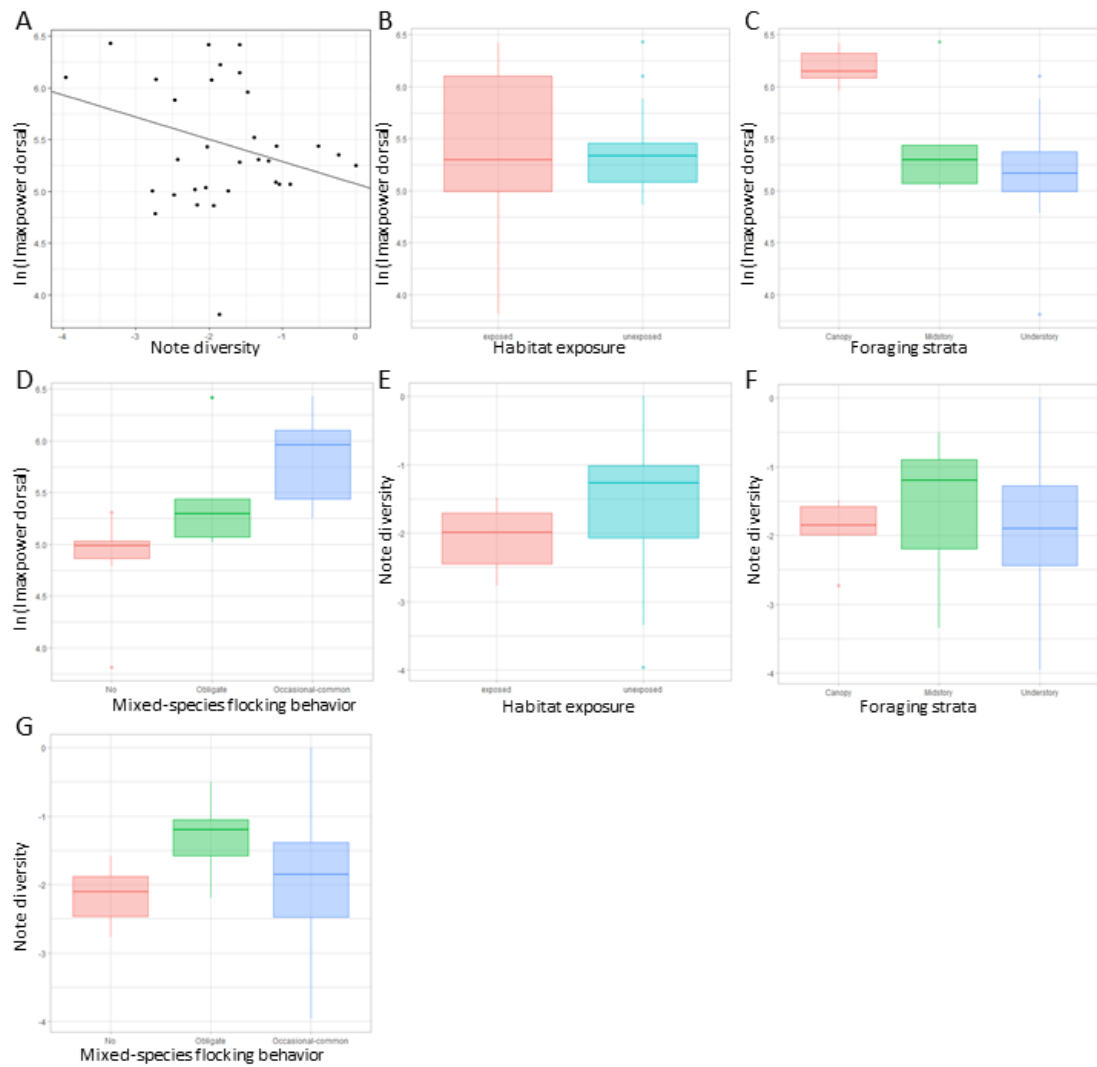


Figure S23. A. Scatterplot illustrating the significant correlation between dorsal maximum energy versus note diversity in females. B, C and D have boxplots representing the relationship between dorsal maximum energy versus habitat exposure, foraging strata and mixed-species flocking behavior, respectively. E, F and G have boxplots representing the relationship between note diversity versus habitat exposure, foraging strata and mixed-species flocking behavior, respectively.

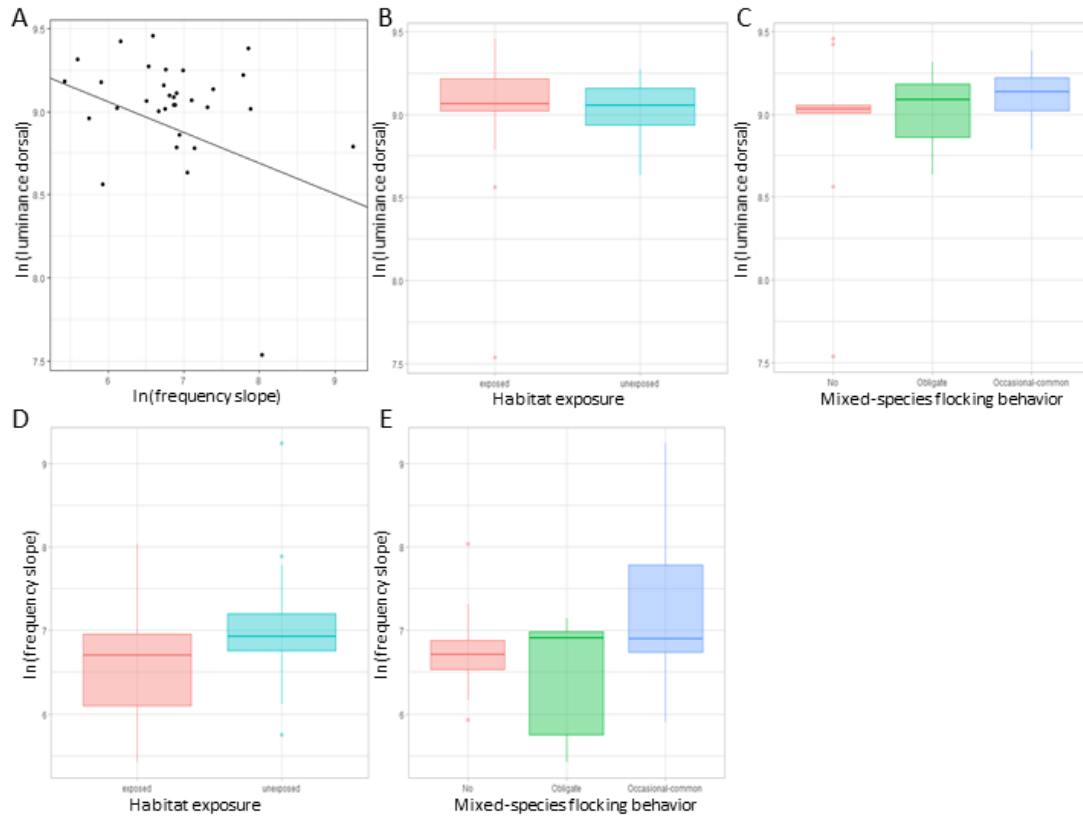


Figure S24. A. Scatterplot illustrating the significant correlation between dorsal luminance versus frequency slope in females. B and C have boxplots representing the relationship between dorsal luminance versus habitat exposure and mixed-species flocking behavior, respectively. D and E have boxplots representing the relationship between frequency slope versus habitat exposure and mixed-species flocking behavior, respectively.

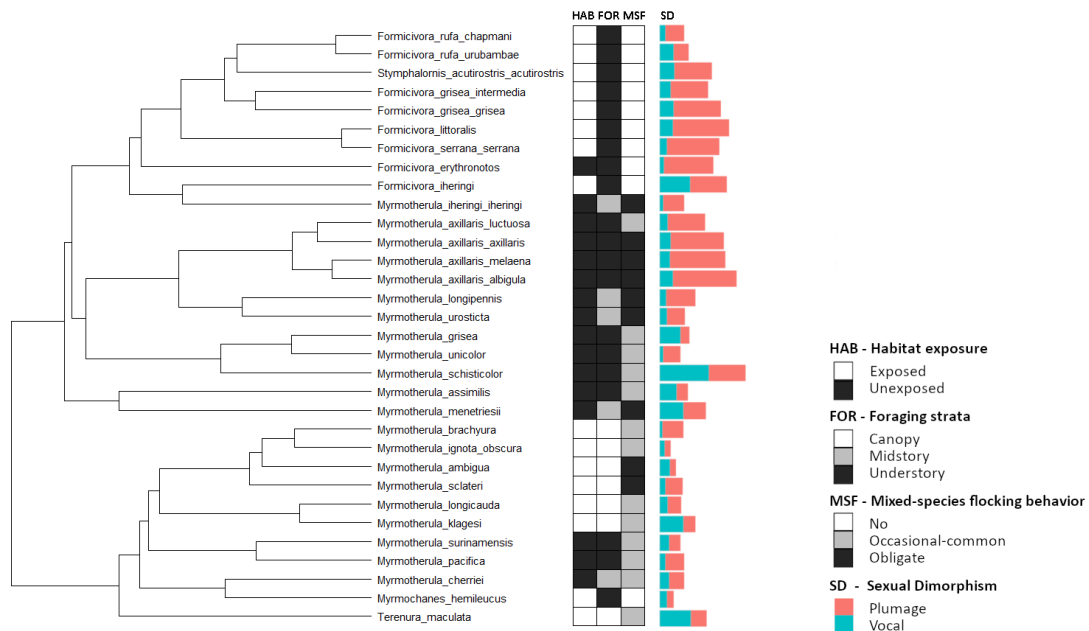


Figure S25. Formicivorini phylogeny with the mapping of ecological, behavioral, plumage and vocal sexual dimorphism traits of each taxa. Habitat exposure, foraging strata and mixed-species flocking behavior are represented in a heatmap. Plumage and vocal sexual dimorphism are represented in a barplot.

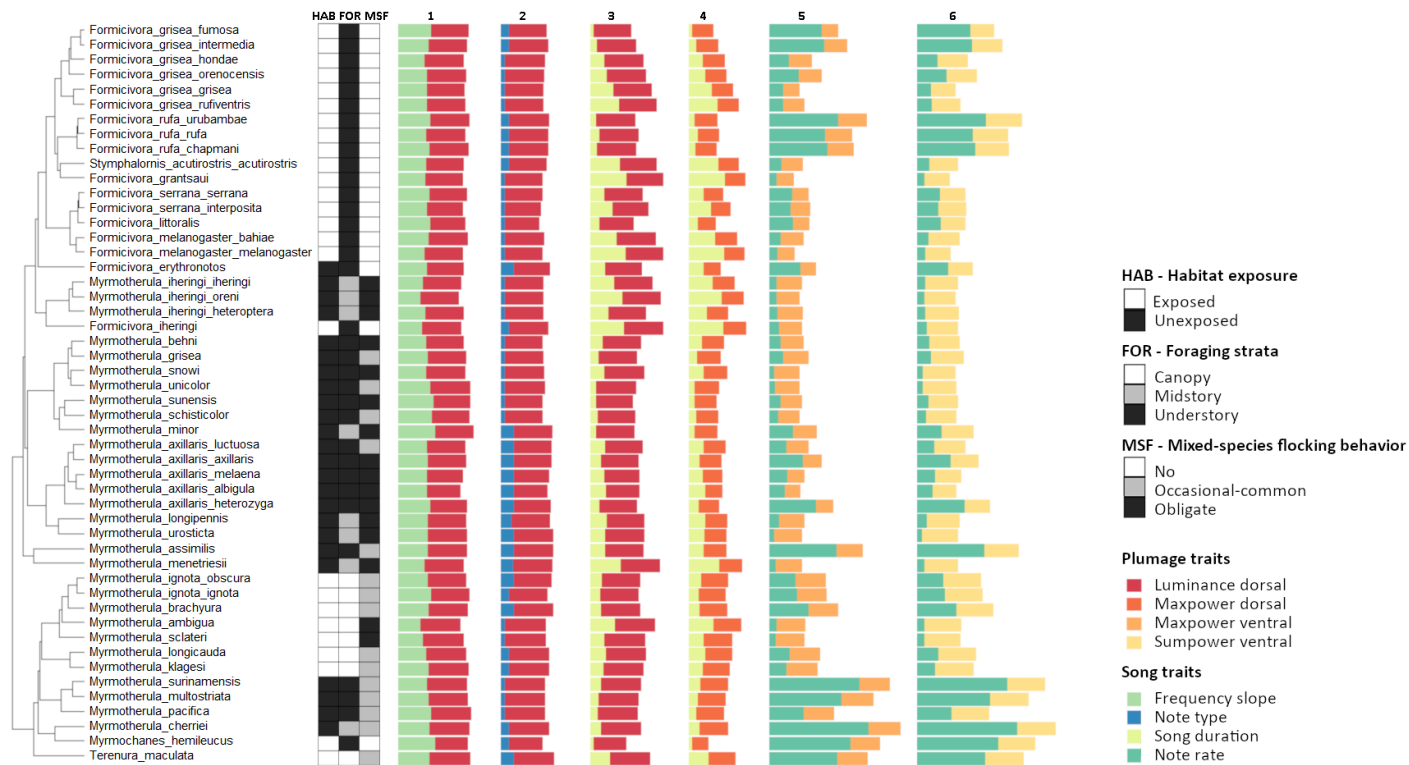


Figure S26. Formicivorini phylogeny with the mapping of ecological, behavioral, plumage and vocal traits of each taxa in males. Habitat exposure, foraging strata and mixed-species flocking behavior are represented in a heatmap. Plumage and vocal traits that had significant relationships are represented in different barplots: 1. Dorsal luminance versus frequency slope, 2. Dorsal luminance versus note type, 3. Dorsal luminance versus song duration, 4. Dorsal maximum energy versus song duration, 5. Ventral maximum energy versus note rate, and 6. Ventral summed energy versus note rate.

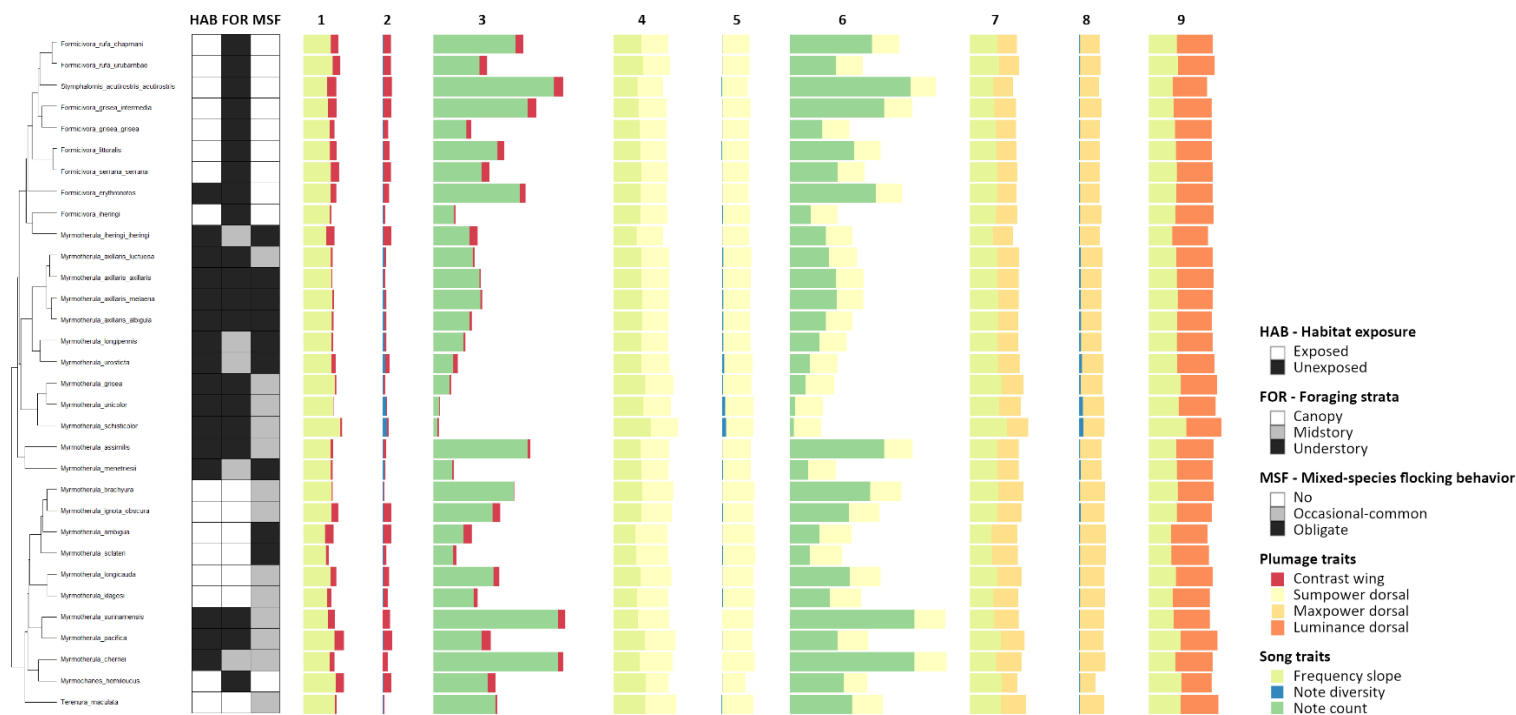


Figure S27. Formicivorini phylogeny with the mapping of ecological, behavioral, plumage and vocal traits of each taxa in females. Habitat exposure, foraging strata and mixed-species flocking behavior are represented in a heatmap. Plumage and vocal traits that had significant relationships are represented in different barplots: 1. Wing contrast versus frequency slope, 2. Wing contrast versus note diversity, 3. Wing contrast versus note count, 4. Dorsal summed energy versus frequency slope, 5. Dorsal summed energy versus note diversity, 6. Dorsal summed energy versus note count, 7. Dorsal maximum energy versus frequency slope, 8. Dorsal maximum energy versus note diversity, and 9. Dorsal luminance versus frequency slope.

Appendix B. Supplementary Tables

Table S1. Description of each vocal character used in this study.

Vocal trait	Description
Song duration	Duration of the song
Note count	Number of notes in a song
Note types	Number of different note types in a song
Note rate	Number of notes in a song divided by the song duration
Note diversity	Number of different note types divided by the total number of notes in a song
Low frequency	Upper frequency bound of a song
High frequency	Lower frequency bound of a song
Peak frequency	Frequency at which peak energy (maximum power) occurs in a song
Song bandwidth	Difference between the highest and lowest frequency in a song
Frequency slope	Song bandwidth divided by the song duration

Table S2. PGLS results of the relationship between selected male plumage and song traits. The first row of each relationship corresponds to the best model and the others correspond to the competing models ($\Delta AIC \leq 2$). β is the effect size of each correlation and SE is its standard error. An asterisk indicates when the relationship is significant (P value ≤ 0.05). HAB = Habitat exposure, FOR = Foraging strata and MSF = Mixed-species flocking behavior.

Plumage character	Song character	Model	Evolutionary model	ΔAIC	ω_i	$\beta \pm SE$	P
Luminance dorsal	Duration	MSF	BM	0.00	0.27	0.19 ± 0.09	0.04*
Luminance dorsal	Duration	HAB + MSF	BM	1.66	0.12	0.19 ± 0.09	0.05*
Luminance dorsal	Frequency slope	HAB + MSF	OU	0.00	0.24	-0.19 ± 0.07	0.01*
Luminance dorsal	Frequency slope	MSF	OU	0.06	0.24	-0.21 ± 0.07	0.005*
Luminance dorsal	Frequency slope	FOR + MSF	OU	0.15	0.23	-0.18 ± 0.07	0.02*
Luminance dorsal	Frequency slope	HAB + FOR + MSF	OU	1.03	0.14	-0.18 ± 0.07	0.02*
Luminance dorsal	Note count	MSF	BM	0.00	0.15	0.10 ± 0.09	0.27
Luminance dorsal	Note count	FOR	OU	0.21	0.13	0.03 ± 0.07	0.63
Luminance dorsal	Note count	FOR + MSF	OU	0.49	0.12	0.00 ± 0.08	0.98
Luminance dorsal	Note count	HAB + MSF	OU	0.73	0.10	0.02 ± 0.08	0.80
Luminance dorsal	Note count	HAB + MSF	BM	1.15	0.08	0.11 ± 0.09	0.24
Luminance dorsal	Note count	FOR	BM	1.66	0.06	0.11 ± 0.09	0.25
Luminance dorsal	Note count	HAB + FOR + MSF	OU	1.68	0.06	0.01 ± 0.08	0.93
Luminance dorsal	Note diversity	FOR	OU	0.00	0.21	-0.11 ± 0.07	0.10
Luminance dorsal	Note diversity	FOR + MSF	OU	0.87	0.14	-0.10 ± 0.07	0.18
Luminance dorsal	Note diversity	HAB + MSF	OU	1.22	0.12	-0.10 ± 0.08	0.18
Luminance dorsal	Note diversity	HAB + FOR	OU	1.43	0.11	-0.13 ± 0.07	0.08

Luminance dorsal	Note rate	FOR + MSF	OU	0.00	0.16	-0.05 ± 0.07	0.51
Luminance dorsal	Note rate	HAB + MSF	OU	0.21	0.15	-0.05 ± 0.07	0.47
Luminance dorsal	Note rate	FOR	OU	0.46	0.13	0.01 ± 0.06	0.89
Luminance dorsal	Note rate	MSF	BM	0.76	0.11	-0.07 ± 0.09	0.46
Luminance dorsal	Note rate	HAB + FOR + MSF	OU	1.25	0.09	-0.04 ± 0.07	0.53
Luminance dorsal	Note rate	MSF	OU	1.42	0.08	-0.06 ± 0.07	0.39
Luminance dorsal	Note type	FOR + MSF	OU	0.00	0.30	-0.22 ± 0.11	0.05*
Luminance dorsal	Note type	FOR	OU	0.64	0.22	-0.21 ± 0.11	0.06
Luminance dorsal	Note type	HAB + FOR + MSF	OU	1.82	0.12	-0.20 ± 0.11	0.07
Luminance wing	Duration	HAB + MSF	BM	0.00	0.26	0.07 ± 0.06	0.25
Luminance wing	Duration	MSF	BM	0.88	0.17	0.08 ± 0.06	0.18
Luminance wing	Duration	base	BM	1.10	0.15	0.09 ± 0.06	0.15
Luminance wing	Duration	HAB + FOR + MSF	BM	1.32	0.14	0.07 ± 0.06	0.23
Luminance wing	Duration	FOR	BM	1.52	0.12	0.07 ± 0.06	0.26
Luminance wing	Frequency slope	HAB + MSF	BM	0.00	0.26	-0.05 ± 0.05	0.30
Luminance wing	Frequency slope	HAB + FOR + MSF	BM	0.94	0.16	-0.06 ± 0.05	0.22
Luminance wing	Frequency slope	MSF	BM	1.05	0.15	-0.06 ± 0.05	0.24
Luminance wing	Frequency slope	base	BM	1.30	0.13	-0.06 ± 0.05	0.21
Luminance wing	Frequency slope	FOR	BM	1.35	0.13	-0.05 ± 0.05	0.29
Luminance wing	Note count	HAB + MSF	BM	0.00	0.32	0.07 ± 0.06	0.27
Luminance wing	Note count	HAB + FOR + MSF	BM	1.26	0.17	0.07 ± 0.06	0.24
Luminance wing	Note count	FOR	BM	1.65	0.14	0.06 ± 0.06	0.31
Luminance wing	Note count	MSF	BM	1.74	0.13	0.06 ± 0.06	0.34

Luminance wing	Note diversity	HAB + MSF	BM	0.00	0.27	-0.08 ± 0.06	0.15
Luminance wing	Note diversity	FOR	BM	0.70	0.19	-0.10 ± 0.06	0.10
Luminance wing	Note diversity	HAB + FOR + MSF	BM	0.89	0.17	-0.09 ± 0.06	0.12
Luminance wing	Note diversity	MSF	BM	1.94	0.10	-0.07 ± 0.06	0.22
Luminance wing	Note rate	HAB + MSF	BM	0.00	0.28	0.00 ± 0.06	0.94
Luminance wing	Note rate	MSF	BM	1.18	0.15	-0.02 ± 0.06	0.69
Luminance wing	Note rate	FOR	BM	1.38	0.14	-0.01 ± 0.06	0.92
Luminance wing	Note rate	base	BM	1.50	0.13	-0.03 ± 0.06	0.62
Luminance wing	Note rate	HAB + FOR + MSF	BM	1.51	0.13	0.00 ± 0.06	0.97
Luminance wing	Note type	HAB + MSF	BM	0.00	0.22	-0.07 ± 0.10	0.50
Luminance wing	Note type	HAB + FOR + MSF	BM	0.20	0.20	-0.10 ± 0.11	0.40
Luminance wing	Note type	FOR	BM	1.18	0.12	-0.13 ± 0.11	0.21
Luminance wing	Note type	MSF	BM	1.37	0.11	-0.07 ± 0.11	0.50
Luminance wing	Note type	base	BM	1.76	0.09	-0.07 ± 0.11	0.49
MaxPower dorsal	Duration	HAB + MSF	BM	0.00	0.52	0.19 ± 0.09	0.05*
MaxPower dorsal	Duration	MSF	BM	0.83	0.35	0.20 ± 0.09	0.03*
MaxPower dorsal	Frequency slope	HAB + MSF	BM	0.00	0.49	-0.13 ± 0.08	0.08
MaxPower dorsal	Frequency slope	MSF	BM	1.10	0.28	-0.14 ± 0.08	0.07
MaxPower dorsal	Note count	HAB + MSF	BM	0.00	0.59	0.14 ± 0.09	0.12
MaxPower dorsal	Note diversity	HAB + MSF	BM	0.00	0.54	-0.16 ± 0.088	0.07
MaxPower dorsal	Note rate	HAB + MSF	BM	0.00	0.51	-0.02 ± 0.09	0.80
MaxPower dorsal	Note rate	MSF	BM	1.20	0.28	-0.05 ± 0.09	0.57
MaxPower dorsal	Note type	HAB + MSF	BM	0.00	0.47	-0.15 ± 0.16	0.34
MaxPower dorsal	Note type	MSF	BM	1.54	0.22	-0.16 ± 0.16	0.35

MaxPower dorsal	Note type	FOR + MSF	BM	1.83	0.19	-0.25 ± 0.17	0.15
MaxPower ventral	Duration	MSF	BM	0.00	0.24	0.29 ± 0.20	0.15
MaxPower ventral	Duration	base	BM	0.52	0.19	0.27 ± 0.20	0.18
MaxPower ventral	Duration	HAB + MSF	BM	1.49	0.12	0.27 ± 0.20	0.18
MaxPower ventral	Duration	FOR + MSF	BM	1.56	0.11	0.27 ± 0.20	0.17
MaxPower ventral	Duration	HAB + FOR + MSF	BM	1.69	0.10	0.27 ± 0.20	0.17
MaxPower ventral	Frequency slope	MSF	BM	0.00	0.22	-0.11 ± 0.16	0.52
MaxPower ventral	Frequency slope	base	BM	0.35	0.19	-0.08 ± 0.16	0.64
MaxPower ventral	Frequency slope	FOR + MSF	BM	1.23	0.12	-0.12 ± 0.16	0.45
MaxPower ventral	Frequency slope	HAB + MSF	BM	1.32	0.12	-0.09 ± 0.16	0.57
MaxPower ventral	Frequency slope	HAB + FOR + MSF	BM	1.33	0.12	-0.13 ± 0.16	0.43
MaxPower ventral	Frequency slope	FOR	BM	1.52	0.11	-0.06 ± 0.16	0.72
MaxPower ventral	Note count	MSF	BM	0.00	0.20	0.32 ± 0.18	0.09
MaxPower ventral	Note count	base	BM	0.19	0.18	0.33 ± 0.19	0.08
MaxPower ventral	Note count	HAB + FOR + MSF	BM	0.73	0.14	0.35 ± 0.18	0.06
MaxPower ventral	Note count	FOR	BM	0.89	0.13	0.34 ± 0.19	0.07
MaxPower ventral	Note count	HAB + MSF	BM	0.89	0.13	0.34 ± 0.18	0.07
MaxPower ventral	Note count	FOR + MSF	BM	1.24	0.11	0.32 ± 0.18	0.08
MaxPower ventral	Note diversity	MSF	BM	0.00	0.17	-0.27 ± 0.19	0.15
MaxPower ventral	Note diversity	FOR + MSF	BM	0.05	0.16	-0.35 ± 0.19	0.07
MaxPower ventral	Note diversity	HAB + FOR + MSF	BM	0.14	0.15	-0.34 ± 0.19	0.07
MaxPower ventral	Note diversity	base	BM	0.26	0.15	-0.28 ± 0.19	0.15
MaxPower ventral	Note diversity	FOR	BM	0.31	0.14	-0.33 ± 0.19	0.09

MaxPower ventral	Note diversity	HAB + MSF	BM	0.93	0.10	-0.29 ± 0.19	0.13
MaxPower ventral	Note rate	MSF	BM	0.00	0.17	0.06 ± 0.19	0.74
MaxPower ventral	Note rate	base	BM	0.04	0.17	0.08 ± 0.18	0.66
MaxPower ventral	Note rate	FOR	BM	0.75	0.12	0.14 ± 0.19	0.47
MaxPower ventral	Note rate	HAB + FOR + MSF	OU	1.01	0.10	0.32 ± 0.15	0.04*
MaxPower ventral	Note rate	HAB + MSF	BM	1.07	0.10	0.09 ± 0.19	0.62
MaxPower ventral	Note rate	FOR + MSF	BM	1.34	0.09	0.08 ± 0.19	0.67
MaxPower ventral	Note rate	HAB + FOR + MSF	BM	1.36	0.09	0.11 ± 0.19	0.58
MaxPower ventral	Note type	MSF	BM	0.00	0.21	0.07 ± 0.34	0.83
MaxPower ventral	Note type	base	BM	0.07	0.21	0.11 ± 0.34	0.76
MaxPower ventral	Note type	HAB + MSF	BM	1.23	0.12	0.07 ± 0.34	0.83
MaxPower ventral	Note type	FOR	BM	1.25	0.11	-0.03 ± 0.35	0.93
MaxPower ventral	Note type	FOR + MSF	BM	1.35	0.11	-0.12 ± 0.36	0.74
MaxPower ventral	Note type	HAB + FOR + MSF	BM	1.65	0.09	-0.03 ± 0.37	0.94
MaxPower wing	Duration	HAB + FOR + MSF	BM	0.00	0.39	0.02 ± 0.08	0.80
MaxPower wing	Duration	HAB + FOR	BM	0.51	0.30	0.01 ± 0.08	0.92
MaxPower wing	Duration	FOR	BM	1.90	0.15	0.01 ± 0.08	0.94
MaxPower wing	Frequency slope	HAB + FOR + MSF	BM	0.00	0.36	0.01 ± 0.06	0.82
MaxPower wing	Frequency slope	HAB + FOR	BM	0.23	0.32	0.03 ± 0.06	0.62
MaxPower wing	Frequency slope	FOR	BM	1.44	0.17	0.04 ± 0.06	0.52
MaxPower wing	Note count	HAB + FOR + MSF	BM	0.00	0.42	0.08 ± 0.07	0.29
MaxPower wing	Note count	HAB + FOR	BM	0.62	0.31	0.07 ± 0.07	0.31

MaxPower wing	Note diversity	HAB + FOR + MSF	BM	0.00	0.42	-0.08 ± 0.07	0.30
MaxPower wing	Note diversity	HAB + FOR	BM	0.50	0.32	-0.08 ± 0.07	0.30
MaxPower wing	Note rate	HAB + FOR + MSF	BM	0.00	0.39	0.05 ± 0.07	0.47
MaxPower wing	Note rate	HAB + FOR	BM	0.28	0.33	0.06 ± 0.07	0.41
MaxPower wing	Note rate	FOR	BM	1.84	0.15	0.05 ± 0.07	0.46
MaxPower wing	Note type	HAB + FOR + MSF	BM	0.00	0.38	0.01 ± 0.14	0.92
MaxPower wing	Note type	HAB + FOR	BM	0.46	0.30	0.00 ± 0.13	0.99
MaxPower wing	Note type	FOR	BM	1.84	0.15	0.01 ± 0.13	0.93
SumPower dorsal	Duration	HAB + MSF	BM	0.00	0.48	0.14 ± 0.08	0.09
SumPower dorsal	Duration	MSF	BM	0.87	0.31	0.16 ± 0.08	0.06
SumPower dorsal	Frequency slope	HAB + MSF	BM	0.00	0.48	-0.12 ± 0.07	0.08
SumPower dorsal	Frequency slope	MSF	BM	1.08	0.28	-0.13 ± 0.07	0.06
SumPower dorsal	Note count	HAB + MSF	BM	0.00	0.57	0.12 ± 0.08	0.13
SumPower dorsal	Note diversity	HAB + MSF	BM	0.00	0.51	-0.14 ± 0.08	0.07
SumPower dorsal	Note diversity	FOR + MSF	BM	2.00	0.19	-0.14 ± 0.08	0.07
SumPower dorsal	Note rate	HAB + MSF	BM	0.00	0.51	0.00 ± 0.08	0.99
SumPower dorsal	Note rate	MSF	BM	1.35	0.26	-0.03 ± 0.08	0.74
SumPower dorsal	Note type	HAB + MSF	BM	0.00	0.43	-0.15 ± 0.14	0.29
SumPower dorsal	Note type	FOR + MSF	BM	1.10	0.25	-0.24 ± 0.15	0.12
SumPower dorsal	Note type	MSF	BM	1.54	0.20	-0.15 ± 0.14	0.29
SumPower ventral	Duration	MSF	BM	0.00	0.24	0.28 ± 0.19	0.14
SumPower ventral	Duration	base	BM	0.55	0.18	0.26 ± 0.19	0.17
SumPower ventral	Duration	HAB + MSF	BM	1.42	0.12	0.26 ± 0.19	0.17
SumPower ventral	Duration	FOR + MSF	BM	1.64	0.11	0.27 ± 0.19	0.16

SumPower ventral	Duration	HAB + FOR + MSF	BM	1.85	0.09	0.26 ± 0.19	0.17
SumPower ventral	Frequency slope	MSF	BM	0.00	0.23	-0.11 ± 0.15	0.49
SumPower ventral	Frequency slope	base	BM	0.39	0.18	-0.08 ± 0.15	0.61
SumPower ventral	Frequency slope	HAB + MSF	BM	1.24	0.12	-0.10 ± 0.16	0.54
SumPower ventral	Frequency slope	FOR + MSF	BM	1.28	0.12	-0.13 ± 0.15	0.42
SumPower ventral	Frequency slope	HAB + FOR + MSF	BM	1.45	0.11	-0.13 ± 0.15	0.41
SumPower ventral	Frequency slope	FOR	BM	1.63	0.10	-0.06 ± 0.15	0.69
SumPower ventral	Note count	MSF	BM	0.00	0.20	0.30 ± 0.18	0.09
SumPower ventral	Note count	base	BM	0.19	0.18	0.31 ± 0.18	0.09
SumPower ventral	Note count	HAB + MSF	BM	0.79	0.13	0.32 ± 0.18	0.08
SumPower ventral	Note count	HAB + FOR + MSF	BM	0.88	0.13	0.33 ± 0.17	0.07
SumPower ventral	Note count	FOR	BM	0.95	0.12	0.32 ± 0.18	0.08
SumPower ventral	Note count	FOR + MSF	BM	1.28	0.11	0.30 ± 0.17	0.09
SumPower ventral	Note diversity	MSF	BM	0.00	0.17	-0.25 ± 0.18	0.16
SumPower ventral	Note diversity	FOR + MSF	BM	0.13	0.16	-0.32 ± 0.18	0.08
SumPower ventral	Note diversity	base	BM	0.27	0.15	-0.26 ± 0.18	0.16
SumPower ventral	Note diversity	HAB + FOR + MSF	BM	0.31	0.14	-0.32 ± 0.18	0.08
SumPower ventral	Note diversity	FOR	BM	0.39	0.14	-0.31 ± 0.18	0.10
SumPower ventral	Note diversity	HAB + MSF	BM	0.83	0.11	-0.27 ± 0.18	0.14
SumPower ventral	Note rate	HAB + FOR + MSF	OU	0.00	0.17	0.29 ± 0.14	0.05*
SumPower ventral	Note rate	MSF	BM	0.25	0.15	0.05 ± 0.18	0.77
SumPower ventral	Note rate	base	BM	0.31	0.15	0.07 ± 0.18	0.68
SumPower ventral	Note rate	FOR	BM	1.08	0.10	0.13 ± 0.18	0.48

SumPower ventral	Note rate	FOR + MSF	OU	1.18	0.09	0.28 ± 0.14	0.06
SumPower ventral	Note rate	HAB + MSF	BM	1.24	0.09	0.08 ± 0.18	0.64
SumPower ventral	Note rate	FOR + MSF	BM	1.63	0.08	0.07 ± 0.18	0.68
SumPower ventral	Note rate	HAB + FOR + MSF	BM	1.74	0.07	0.10 ± 0.18	0.60
SumPower ventral	Note type	MSF	BM	0.00	0.21	0.07 ± 0.32	0.83
SumPower ventral	Note type	base	BM	0.08	0.20	0.11 ± 0.32	0.75
SumPower ventral	Note type	HAB + MSF	BM	1.13	0.12	0.07 ± 0.32	0.82
SumPower ventral	Note type	FOR	BM	1.32	0.11	-0.02 ± 0.33	0.94
SumPower ventral	Note type	FOR + MSF	BM	1.41	0.10	-0.11 ± 0.34	0.74
SumPower ventral	Note type	HAB + FOR + MSF	BM	1.78	0.09	-0.02 ± 0.35	0.95
SumPower wing	Duration	HAB + FOR	BM	0.00	0.39	0.01 ± 0.07	0.90
SumPower wing	Duration	HAB + FOR + MSF	BM	0.74	0.27	0.02 ± 0.07	0.80
SumPower wing	Duration	FOR	BM	1.57	0.18	0.01 ± 0.07	0.93
SumPower wing	Frequency slope	HAB + FOR	BM	0.00	0.40	0.03 ± 0.05	0.61
SumPower wing	Frequency slope	HAB + FOR + MSF	BM	1.02	0.24	0.02 ± 0.06	0.79
SumPower wing	Frequency slope	FOR	BM	1.37	0.20	0.04 ± 0.05	0.51
SumPower wing	Note count	HAB + FOR	BM	0.00	0.41	0.05 ± 0.06	0.40
SumPower wing	Note count	HAB + FOR + MSF	BM	0.72	0.28	0.06 ± 0.06	0.38
SumPower wing	Note count	FOR	BM	1.77	0.17	0.05 ± 0.07	0.46
SumPower wing	Note diversity	HAB + FOR	BM	0.00	0.41	-0.06 ± 0.06	0.38
SumPower wing	Note diversity	HAB + FOR + MSF	BM	0.76	0.28	-0.06 ± 0.06	0.38
SumPower wing	Note diversity	FOR	BM	1.93	0.16	-0.05 ± 0.07	0.50

SumPower wing	Note rate	HAB + FOR	BM	0.00	0.42	0.04 ± 0.06	0.51
SumPower wing	Note rate	HAB + FOR + MSF	BM	0.95	0.26	0.03 ± 0.06	0.59
SumPower wing	Note rate	FOR	BM	1.69	0.18	0.04 ± 0.06	0.57
SumPower wing	Note type	HAB + FOR	BM	0.00	0.39	-0.01 ± 0.12	0.93
SumPower wing	Note type	HAB + FOR + MSF	BM	0.81	0.26	0.00 ± 0.12	0.97
SumPower wing	Note type	FOR	BM	1.57	0.18	0.00 ± 0.12	0.98

Table S3. PGLS results of the relationship between selected female plumage and song traits. The first row of each relationship corresponds to the best model and the others correspond to the competing models ($\Delta AIC \leq 2$). β is the effect size of each correlation and SE is its standard error. An asterisk indicates when the relationship is significant (P value ≤ 0.05). HAB = Habitat exposure, FOR = Foraging strata and MSF = Mixed-species flocking behavior.

Plumage character	Song character	Model	Evolutionary model	ΔAIC	ω_i	$\beta \pm SE$	P
Contrast wing	Duration	base	BM	0.00	0.37	0.08 ± 0.17	0.66
Contrast wing	Duration	HAB	BM	2.00	0.14	0.08 ± 0.17	0.66
Contrast wing	Frequency slope	base	BM	0.00	0.30	-0.09 ± 0.15	0.56
Contrast wing	Frequency slope	MSF	OU	1.56	0.14	-0.31 ± 0.15	0.05*
Contrast wing	Frequency slope	HAB	BM	2.00	0.11	-0.09 ± 0.18	0.57
Contrast wing	Note count	MSF	OU	0.00	0.19	0.33 ± 0.13	0.02*
Contrast wing	Note count	base	BM	0.50	0.15	0.11 ± 0.15	0.48
Contrast wing	Note count	HAB	OU	0.98	0.12	0.35 ± 0.13	0.02*
Contrast wing	Note count	HAB + FOR	OU	1.07	0.11	0.33 ± 0.13	0.02*
Contrast wing	Note count	HAB + MSF	OU	1.18	0.11	0.32 ± 0.13	0.02*
Contrast wing	Note diversity	MSF	OU	0.00	0.35	-0.44 ± 0.13	0.002*
Contrast wing	Note diversity	HAB + MSF	OU	1.62	0.15	-0.43 ± 0.13	0.003*
Contrast wing	Note diversity	HAB	OU	1.97	0.13	-0.44 ± 0.13	0.002*
Contrast wing	Note rate	base	BM	0.00	0.30	0.04 ± 0.16	0.83
Contrast wing	Note rate	HAB	BM	2.00	0.11	0.04 ± 0.17	0.83
Luminance dorsal	Duration	base	OU	0.00	0.22	0.09 ± 0.09	0.30
Luminance dorsal	Duration	MSF	BM	0.87	0.14	0.06 ± 0.09	0.55
Luminance dorsal	Duration	MSF	OU	1.08	0.13	0.13 ± 0.09	0.17

Luminance dorsal	Duration	HAB	OU	1.88	0.09	0.10 ± 0.09	0.29
Luminance dorsal	Frequency slope	MSF	OU	0.00	0.18	-0.18 ± 0.08	0.03*
Luminance dorsal	Frequency slope	MSF	BM	0.08	0.17	-0.15 ± 0.09	0.08
Luminance dorsal	Frequency slope	base	OU	0.15	0.17	-0.14 ± 0.08	0.08
Luminance dorsal	Frequency slope	HAB	OU	1.68	0.08	-0.15 ± 0.08	0.07
Luminance dorsal	Frequency slope	HAB + MSF	OU	1.90	0.07	-0.19 ± 0.09	0.03*
Luminance dorsal	Frequency slope	HAB + MSF	BM	1.96	0.07	-0.15 ± 0.09	0.09
Luminance dorsal	Note count	base	OU	0.00	0.20	-0.01 ± 0.07	0.89
Luminance dorsal	Note count	MSF	BM	0.14	0.18	0.01 ± 0.09	0.95
Luminance dorsal	Note count	HAB + MSF	BM	1.92	0.07	0.01 ± 0.09	0.88
Luminance dorsal	Note count	HAB	OU	1.98	0.07	-0.01 ± 0.08	0.91
Luminance dorsal	Note diversity	MSF	BM	0.00	0.19	-0.08 ± 0.10	0.40
Luminance dorsal	Note diversity	base	OU	0.30	0.16	-0.04 ± 0.07	0.55
Luminance dorsal	Note diversity	HAB + FOR	BM	1.57	0.09	-0.10 ± 0.10	0.30
Luminance dorsal	Note diversity	HAB + MSF	BM	1.63	0.08	-0.09 ± 0.10	0.37
Luminance dorsal	Note diversity	MSF	OU	1.98	0.07	-0.07 ± 0.08	0.39
Luminance dorsal	Note rate	base	OU	0.00	0.24	-0.09 ± 0.08	0.28
Luminance dorsal	Note rate	MSF	BM	1.14	0.14	-0.04 ± 0.10	0.66
Luminance dorsal	Note rate	MSF	OU	1.36	0.12	-0.18 ± 0.09	0.19
Luminance dorsal	Note rate	HAB	OU	1.99	0.09	-0.09 ± 0.08	0.30
Luminance wing	Duration	base	BM	0.00	0.21	-0.02 ± 0.08	0.79
Luminance wing	Duration	HAB + MSF	OU	0.35	0.17	0.04 ± 0.08	0.61
Luminance wing	Duration	HAB + FOR + MSF	OU	1.24	0.11	0.02 ± 0.08	0.78
Luminance wing	Duration	FOR	OU	1.28	0.11	-0.03 ± 0.08	0.70
Luminance wing	Duration	HAB	BM	1.90	0.08	-0.02 ± 0.08	0.80

Luminance wing	Frequency slope	HAB + MSF	OU	0.00	0.25	-0.10 ± 0.07	0.19
Luminance wing	Frequency slope	HAB + FOR + MSF	OU	0.85	0.16	-0.09 ± 0.07	0.23
Luminance wing	Frequency slope	base	BM	1.00	0.15	-0.05 ± 0.07	0.52
Luminance wing	Note count	base	BM	0.00	0.21	-0.04 ± 0.07	0.58
Luminance wing	Note count	HAB + MSF	OU	0.23	0.19	0.05 ± 0.06	0.44
Luminance wing	Note count	HAB + FOR + MSF	OU	1.13	0.12	0.04 ± 0.06	0.55
Luminance wing	Note count	FOR	OU	1.42	0.10	0.03 ± 0.06	0.62
Luminance wing	Note count	HAB	BM	1.94	0.08	-0.04 ± 0.07	0.61
Luminance wing	Note diversity	HAB + MSF	OU	0.00	0.24	-0.08 ± 0.06	0.25
Luminance wing	Note diversity	base	BM	0.95	0.15	0.02 ± 0.08	0.84
Luminance wing	Note diversity	FOR	OU	1.22	0.13	-0.06 ± 0.06	0.32
Luminance wing	Note diversity	HAB + FOR + MSF	OU	1.24	0.13	-0.06 ± 0.07	0.38
Luminance wing	Note rate	base	BM	0.00	0.19	-0.02 ± 0.08	0.75
Luminance wing	Note rate	FOR	OU	0.39	0.16	0.07 ± 0.07	0.33
Luminance wing	Note rate	HAB + MSF	OU	0.45	0.16	0.04 ± 0.08	0.65
Luminance wing	Note rate	HAB + FOR + MSF	OU	1.03	0.12	0.04 ± 0.08	0.61
Luminance wing	Note rate	HAB	BM	1.92	0.07	-0.02 ± 0.08	0.79
MaxPower dorsal	Duration	FOR + MSF	OU	0.00	0.22	0.15 ± 0.10	0.17
MaxPower dorsal	Duration	HAB + MSF	OU	0.30	0.19	0.18 ± 0.10	0.09
MaxPower dorsal	Duration	MSF	BM	0.37	0.18	0.11 ± 0.10	0.29
MaxPower dorsal	Duration	HAB + MSF	BM	1.05	0.13	0.11 ± 0.10	0.31
MaxPower dorsal	Duration	HAB + FOR + MSF	BM	1.67	0.09	-0.30 ± 0.19	0.13
MaxPower dorsal	Duration	FOR + MSF	BM	1.91	0.08	0.09 ± 0.11	0.40

MaxPower dorsal	Duration	HAB + FOR + MSF	OU	1.96	0.08	0.15 ± 0.11	0.18
MaxPower dorsal	Frequency slope	HAB + MSF	OU	0.00	0.33	-0.29 ± 0.08	0.002*
MaxPower dorsal	Frequency slope	FOR + MSF	OU	0.02	0.33	-0.27 ± 0.09	0.004*
MaxPower dorsal	Frequency slope	HAB + FOR + MSF	OU	2.00	0.12	-0.27 ± 0.09	0.01*
MaxPower dorsal	Note count	FOR + MSF	OU	0.00	0.24	0.11 ± 0.08	0.18
MaxPower dorsal	Note count	HAB + MSF	OU	0.61	0.18	0.13 ± 0.08	0.11
MaxPower dorsal	Note count	MSF	BM	0.97	0.15	0.07 ± 0.10	0.45
MaxPower dorsal	Note count	HAB + MSF	BM	1.02	0.14	0.10 ± 0.10	0.31
MaxPower dorsal	Note count	FOR + MSF	BM	1.61	0.11	0.09 ± 0.10	0.34
MaxPower dorsal	Note count	HAB + FOR + MSF	OU	1.94	0.09	0.11 ± 0.08	0.18
MaxPower dorsal	Note diversity	FOR + MSF	OU	0.00	0.39	-0.22 ± 0.08	0.01*
MaxPower dorsal	Note diversity	HAB + MSF	OU	1.66	0.17	-0.22 ± 0.08	0.01*
MaxPower dorsal	Note diversity	HAB + FOR + MSF	OU	2.00	0.14	-0.22 ± 0.08	0.01*
MaxPower dorsal	Note rate	MSF	BM	0.00	0.23	-0.03 ± 0.11	0.82
MaxPower dorsal	Note rate	FOR + MSF	OU	0.53	0.18	0.04 ± 0.10	0.70
MaxPower dorsal	Note rate	HAB + MSF	BM	0.68	0.17	0.01 ± 0.11	0.94
MaxPower dorsal	Note rate	FOR + MSF	BM	1.09	0.14	0.03 ± 0.11	0.81
MaxPower wing	Duration	base	BM	0.00	0.47	0.08 ± 0.13	0.54
MaxPower wing	Duration	HAB	BM	2.00	0.17	0.08 ± 0.14	0.54
MaxPower wing	Frequency slope	base	BM	0.00	0.44	-0.16 ± 0.12	0.20
MaxPower wing	Frequency slope	HAB	BM	1.99	0.16	-0.16 ± 0.12	0.21
MaxPower wing	Note count	base	BM	0.00	0.46	0.16 ± 0.12	0.19
MaxPower wing	Note count	HAB	BM	1.95	0.17	0.16 ± 0.12	0.19

MaxPower wing	Note diversity	base	BM	0.00	0.44	-0.18 ± 0.14	0.19
MaxPower wing	Note diversity	HAB	BM	1.95	0.16	-0.19 ± 0.14	0.19
MaxPower wing	Note rate	base	BM	0.00	0.42	0.08 ± 0.13	0.54
MaxPower wing	Note rate	FOR	BM	1.71	0.18	0.14 ± 0.14	0.33
MaxPower wing	Note rate	HAB	BM	1.99	0.15	0.08 ± 0.13	0.55
SumPower dorsal	Duration	MSF	BM	0.00	0.33	0.09 ± 0.09	0.33
SumPower dorsal	Duration	HAB + MSF	BM	0.80	0.22	0.09 ± 0.09	0.35
SumPower dorsal	Duration	FOR + MSF	BM	1.66	0.15	0.08 ± 0.10	0.45
SumPower dorsal	Frequency slope	MSF	BM	0.00	0.25	-0.22 ± 0.08	0.01*
SumPower dorsal	Frequency slope	FOR + MSF	OU	0.61	0.19	-0.25 ± 0.08	0.01*
SumPower dorsal	Frequency slope	HAB + MSF	OU	0.81	0.17	-0.28 ± 0.08	0.002*
SumPower dorsal	Frequency slope	HAB + MSF	BM	0.84	0.17	-0.21 ± 0.08	0.02*
SumPower dorsal	Frequency slope	FOR + MSF	BM	1.77	0.10	-0.20 ± 0.08	0.02*
SumPower dorsal	Note count	HAB + MSF	BM	0.00	0.20	0.12 ± 0.09	0.19
SumPower dorsal	Note count	MSF	BM	0.04	0.20	0.09 ± 0.09	0.29
SumPower dorsal	Note count	FOR + MSF	OU	0.52	0.16	0.14 ± 0.07	0.07
SumPower dorsal	Note count	FOR + MSF	BM	0.63	0.15	0.11 ± 0.09	0.21
SumPower dorsal	Note count	HAB + MSF	OU	1.19	0.11	0.16 ± 0.07	0.04*
SumPower dorsal	Note diversity	FOR + MSF	OU	0.00	0.38	-0.24 ± 0.07	0.003*
SumPower dorsal	Note diversity	HAB + FOR + MSF	OU	2.00	0.14	-0.24 ± 0.07	0.003*
SumPower dorsal	Note rate	MSF	BM	0.00	0.26	0.02 ± 0.10	0.85
SumPower dorsal	Note rate	HAB + MSF	BM	0.47	0.21	0.05 ± 0.10	0.61
SumPower dorsal	Note rate	FOR + MSF	BM	0.73	0.18	0.07 ± 0.10	0.50
SumPower wing	Duration	base	BM	0.00	0.48	0.08 ± 0.12	0.49
SumPower wing	Duration	HAB	BM	2.00	0.18	0.08 ± 0.12	0.50

SumPower wing	Frequency slope	base	BM	0.00	0.44	-0.14 ± 0.10	0.18
SumPower wing	Frequency slope	HAB	BM	2.00	0.16	-0.14 ± 0.11	0.19
SumPower wing	Note count	base	BM	0.00	0.48	0.16 ± 0.10	0.14
SumPower wing	Note count	HAB	BM	1.94	0.18	0.16 ± 0.11	0.15
SumPower wing	Note diversity	base	BM	0.00	0.46	-0.18 ± 0.12	0.14
SumPower wing	Note diversity	HAB	BM	1.95	0.17	-0.18 ± 0.12	0.14
SumPower wing	Note rate	base	BM	0.00	0.44	0.08 ± 0.11	0.50
SumPower wing	Note rate	HAB	BM	1.99	0.16	0.08 ± 0.12	0.50

Table S4. List of the recordings analyzed in this study. Acronyms for the online repositories: ML = Macaulay Library; XC = Xeno-canto; FNJV = Fonoteca Neotropical Jacques Vielliard. Acronyms indicating the recordists from private audio collections: BMW = B. M. Whitney; KJZ = K. J. Zimmer; AW = A. Whittaker; DFL = D. F. Lane; MBR = M. B. Robbins; MISC = M. R. Bornschein and B. L. Reinert; SKH = S. K. Herzog. Recordings marked with an asterisk were taken from Isler and Whitney 2002 audio CD.

Species	Subspecies	Catalog	Number	Sex
<i>Formicivora erythronotos</i>		KJZ	071 026	female
<i>Formicivora erythronotos</i>		XC	80178	female
<i>Formicivora erythronotos</i>		ML	137375	male
<i>Formicivora erythronotos</i>		ML	46466	male
<i>Formicivora erythronotos</i>		ML	81843	male
<i>Formicivora grantsau</i>		KJZ	008 023	male
<i>Formicivora grantsau</i>		XC	24915	male
<i>Formicivora grantsau</i>		XC	80196	male
<i>Formicivora grisea</i>	<i>fumosa</i>	ML	61971	male
<i>Formicivora grisea</i>	<i>grisea</i>	BMW	223 032	female
<i>Formicivora grisea</i>	<i>grisea</i>	KJZ	027 009	female
<i>Formicivora grisea</i>	<i>grisea</i>	ML	72343	female
<i>Formicivora grisea</i>	<i>grisea</i>	FNJV	2787	male
<i>Formicivora grisea</i>	<i>grisea</i>	ML	134348	male
<i>Formicivora grisea</i>	<i>grisea</i>	ML	134735	male
<i>Formicivora grisea</i>	<i>grisea</i>	ML	145201	male
<i>Formicivora grisea</i>	<i>grisea</i>	ML	2111	male
<i>Formicivora grisea</i>	<i>hondae</i>	ML	81675	male
<i>Formicivora grisea</i>	<i>intermedia</i>	BMW	168 002	female
<i>Formicivora grisea</i>	<i>intermedia</i>	KJZ	021 022	female
<i>Formicivora grisea</i>	<i>intermedia</i>	KJZ	006 010	male
<i>Formicivora grisea</i>	<i>intermedia</i>	ML	30609	male
<i>Formicivora grisea</i>	<i>intermedia</i>	ML	47826	male
<i>Formicivora grisea</i>	<i>orenocensis</i>	ML	45525	male
<i>Formicivora grisea</i>	<i>rufiventris</i>	ML*	61982	male
<i>Formicivora iheringi</i>		BMW	C.0162	female
<i>Formicivora iheringi</i>		KJZ	079 013	female
<i>Formicivora iheringi</i>		XC	331283	female
<i>Formicivora iheringi</i>		KJZ	079 013	male
<i>Formicivora iheringi</i>		ML	102994	male
<i>Formicivora iheringi</i>		ML*	35680	male
<i>Formicivora littoralis</i>		KJZ	070 027	female
<i>Formicivora littoralis</i>		BMW*	80 23	male

<i>Formicivora littoralis</i>		KJZ	070 027	male
<i>Formicivora littoralis</i>		XC	80186	male
<i>Formicivora melanogaster</i>	<i>bahiae</i>	BMW*	74 20	male
<i>Formicivora melanogaster</i>	<i>bahiae</i>	ML	46825	male
<i>Formicivora melanogaster</i>	<i>bahiae</i>	XC	237411	male
<i>Formicivora melanogaster</i>	<i>melanogaster</i>	KJZ	016 010	male
<i>Formicivora melanogaster</i>	<i>melanogaster</i>	KJZ	050 015	male
<i>Formicivora melanogaster</i>	<i>melanogaster</i>	XC	237418	male
<i>Formicivora rufa</i>	<i>chapmani</i>	BMW	224 002	female
<i>Formicivora rufa</i>	<i>chapmani</i>	BMW	224 006	female
<i>Formicivora rufa</i>	<i>chapmani</i>	BMW	224 002	male
<i>Formicivora rufa</i>	<i>chapmani</i>	BMW	224 006	male
<i>Formicivora rufa</i>	<i>rufa</i>	ML*	65514	male
<i>Formicivora rufa</i>	<i>urubambae</i>	DFL	016 041	female
<i>Formicivora rufa</i>	<i>urubambae</i>	DFL	016 041	male
<i>Formicivora rufa</i>	<i>urubambae</i>	DFL	017 021	male
<i>Formicivora rufa</i>	<i>urubambae</i>	DFL	017 022	male
<i>Formicivora serrana</i>	<i>interposita</i>	KJZ	071 012	male
<i>Formicivora serrana</i>	<i>interposita</i>	XC	277794	male
<i>Formicivora serrana</i>	<i>serrana</i>	KJZ	119 015	female
<i>Formicivora serrana</i>	<i>serrana</i>	BMW	209 099	male
<i>Formicivora serrana</i>	<i>serrana</i>	BMW*	46 04	male
<i>Formicivora serrana</i>	<i>serrana</i>	KJZ	119 038	male
<i>Myrmochanes hemileucus</i>		BMW	163 008	female
<i>Myrmochanes hemileucus</i>		ML	127466	female
<i>Myrmochanes hemileucus</i>		ML	29221	female
<i>Myrmochanes hemileucus</i>		ML	31790	male
<i>Myrmochanes hemileucus</i>		ML	48418	male
<i>Myrmochanes hemileucus</i>		XC	86640	male
<i>Myrmotherula ambigua</i>		KJZ	087 003	female
<i>Myrmotherula ambigua</i>		KJZ	087 005	female
<i>Myrmotherula ambigua</i>		BMW*	79 18	male
<i>Myrmotherula ambigua</i>		KJZ	087 003	male
<i>Myrmotherula ambigua</i>		KJZ	087 005	male
<i>Myrmotherula assimilis</i>	<i>assimilis</i>	BMW	C.0122	female
<i>Myrmotherula assimilis</i>	<i>assimilis</i>	KJZ	027 333	female
<i>Myrmotherula assimilis</i>	<i>assimilis</i>	KJZ	116 027	female
<i>Myrmotherula assimilis</i>	<i>assimilis</i>	ML	132770	male
<i>Myrmotherula assimilis</i>	<i>assimilis</i>	ML	34248	male
<i>Myrmotherula assimilis</i>	<i>assimilis</i>	ML	37532	male
<i>Myrmotherula axillaris</i>	<i>albigula</i>	KJZ	008 008	female
<i>Myrmotherula axillaris</i>	<i>albigula</i>	BMW	005 018	male
<i>Myrmotherula axillaris</i>	<i>albigula</i>	KJZ	012 014	male
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	BMW	172 035	female
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	KJZ	083 019	female
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	ML	117239	male
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	ML	172561	male
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	ML	35603	male

<i>Myrmotherula axillaris</i>	<i>axillaris</i>	ML	72302	male
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	ML	88316	male
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	ML	88638	male
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	ML	98742	male
<i>Myrmotherula axillaris</i>	<i>fresnayana</i>	ML	38935	male
<i>Myrmotherula axillaris</i>	<i>fresnayana</i>	ML	90895	male
<i>Myrmotherula axillaris</i>	<i>heterozyga</i>	ML	13633	male
<i>Myrmotherula axillaris</i>	<i>heterozyga</i>	ML	166278	male
<i>Myrmotherula axillaris</i>	<i>heterozyga</i>	ML	31922	male
<i>Myrmotherula axillaris</i>	<i>heterozyga</i>	ML	35546	male
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	KJZ	080 047	female
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	KJZ	097 033	female
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	KJZ	098 005	female
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	FNJV	8263	male
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	KJZ	098 005	male
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	ML	113348	male
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	ML	32245	male
<i>Myrmotherula axillaris</i>	<i>melaena</i>	BMW	036 033	female
<i>Myrmotherula axillaris</i>	<i>melaena</i>	DFL	017 032	female
<i>Myrmotherula axillaris</i>	<i>melaena</i>	ML	82305	female
<i>Myrmotherula axillaris</i>	<i>melaena</i>	ML	135342	male
<i>Myrmotherula axillaris</i>	<i>melaena</i>	ML	187965	male
<i>Myrmotherula axillaris</i>	<i>melaena</i>	ML	28632	male
<i>Myrmotherula axillaris</i>	<i>melaena</i>	ML	34190	male
<i>Myrmotherula axillaris</i>	<i>melaena</i>	ML	52734	male
<i>Myrmotherula axillaris</i>	<i>melaena</i>	ML	82307	male
<i>Myrmotherula axillaris</i>	<i>melaena</i>	ML*	31859	male
<i>Myrmotherula behni</i>	<i>behni</i>	XC	260778	male
<i>Myrmotherula brachyura</i>		KJZ	004 025	female
<i>Myrmotherula brachyura</i>		KJZ	019 037	female
<i>Myrmotherula brachyura</i>		ML	145436	male
<i>Myrmotherula brachyura</i>		ML	24272	male
<i>Myrmotherula brachyura</i>		ML	25349	male
<i>Myrmotherula brachyura</i>		ML	29435	male
<i>Myrmotherula brachyura</i>		ML	31855	male
<i>Myrmotherula brachyura</i>		ML	52188	male
<i>Myrmotherula brachyura</i>		ML	72368	male
<i>Myrmotherula cherriei</i>		BMW	149 023	female
<i>Myrmotherula cherriei</i>		XC	81759	female
<i>Myrmotherula cherriei</i>		KJZ*	18 03	male
<i>Myrmotherula cherriei</i>		ML	113216	male
<i>Myrmotherula cherriei</i>		ML	117023	male
<i>Myrmotherula cherriei</i>		ML	64580	male
<i>Myrmotherula grisea</i>		ML	107130	female
<i>Myrmotherula grisea</i>		SKH*	1 31	male
<i>Myrmotherula grisea</i>		ML	120977	male
<i>Myrmotherula grisea</i>		XC	82803	male
<i>Myrmotherula ignota</i>	<i>ignota</i>	XC	248167	male

<i>Myrmotherula ignota</i>	<i>ignota</i>	XC	251233	male
<i>Myrmotherula ignota</i>	<i>obscura</i>	BMW	226 086	female
<i>Myrmotherula ignota</i>	<i>obscura</i>	ML	228480	female
<i>Myrmotherula ignota</i>	<i>obscura</i>	BMW	226 086	male
<i>Myrmotherula ignota</i>	<i>obscura</i>	ML	30881	male
<i>Myrmotherula ignota</i>	<i>obscura</i>	ML	49285	male
<i>Myrmotherula iheringi</i>	<i>heteroptera</i>	XC	284935	male
<i>Myrmotherula iheringi</i>	<i>iheringi</i>	AW	018 006	female
<i>Myrmotherula iheringi</i>	<i>iheringi</i>	BMW	158 023	male
<i>Myrmotherula iheringi</i>	<i>iheringi</i>	BMW	222 075	male
<i>Myrmotherula iheringi</i>	<i>iheringi</i>	BMW	228 098	male
<i>Myrmotherula iheringi</i>	<i>oreni</i>	ML	29040	male
<i>Myrmotherula iheringi</i>	<i>oreni</i>	ML	29514	male
<i>Myrmotherula iheringi</i>	<i>oreni</i>	ML	31968	male
<i>Myrmotherula iheringi</i>	<i>oreni</i>	ML	33986	male
<i>Myrmotherula iheringi</i>	<i>oreni</i>	ML	47730	male
<i>Myrmotherula iheringi</i>	<i>oreni</i>	ML	75903	male
<i>Myrmotherula klagesi</i>		KJZ	013 024	female
<i>Myrmotherula klagesi</i>		KJZ	026 009	female
<i>Myrmotherula klagesi</i>		KJZ	026 012	female
<i>Myrmotherula klagesi</i>		BMW*	65 12	male
<i>Myrmotherula klagesi</i>		KJZ	026 012	male
<i>Myrmotherula klagesi</i>		ML	106040	male
<i>Myrmotherula longicauda</i>	<i>australis</i>	XC	3598	female
<i>Myrmotherula longicauda</i>	<i>australis</i>	ML	120976	male
<i>Myrmotherula longicauda</i>	<i>australis</i>	ML	30043	male
<i>Myrmotherula longicauda</i>	<i>longicauda</i>	XC	20682	female
<i>Myrmotherula longicauda</i>	<i>longicauda</i>	XC	20682	male
<i>Myrmotherula longicauda</i>	<i>pseudoaustralis</i>	ML	135345	male
<i>Myrmotherula longicauda</i>	<i>pseudoaustralis</i>	ML	135353	male
<i>Myrmotherula longicauda</i>	<i>pseudoaustralis</i>	ML	17783	male
<i>Myrmotherula longicauda</i>	<i>pseudoaustralis</i>	ML	31891	male
<i>Myrmotherula longicauda</i>	<i>soderstromi</i>	XC	249456	male
<i>Myrmotherula longipennis</i>	<i>garbei</i>	BMW	210 113	female
<i>Myrmotherula longipennis</i>	<i>garbei</i>	KJZ	131 046	female
<i>Myrmotherula longipennis</i>	<i>garbei</i>	ML	26532	male
<i>Myrmotherula longipennis</i>	<i>garbei</i>	ML	30001	male
<i>Myrmotherula longipennis</i>	<i>garbei</i>	ML*	35489	male
<i>Myrmotherula longipennis</i>	<i>longipennis</i>	MBR*	1 07	male
<i>Myrmotherula longipennis</i>	<i>longipennis</i>	ML	144438	male
<i>Myrmotherula longipennis</i>	<i>longipennis</i>	ML	144658	male
<i>Myrmotherula longipennis</i>	<i>longipennis</i>	ML	87533	male
<i>Myrmotherula longipennis</i>	<i>ochrogyna</i>	BMW	200 042	female
<i>Myrmotherula longipennis</i>	<i>ochrogyna</i>	BMW	201 028	female
<i>Myrmotherula longipennis</i>	<i>ochrogyna</i>	BMW	211 012	female
<i>Myrmotherula longipennis</i>	<i>ochrogyna</i>	ML	165732	male
<i>Myrmotherula longipennis</i>	<i>paraensis</i>	BMW	132 018	female
<i>Myrmotherula longipennis</i>	<i>paraensis</i>	BMW	175 002	female

<i>Myrmotherula longipennis</i>	<i>paraensis</i>	BMW	214 024	female
<i>Myrmotherula longipennis</i>	<i>paraensis</i>	ML	115224	male
<i>Myrmotherula longipennis</i>	<i>paraensis</i>	ML	143900	male
<i>Myrmotherula longipennis</i>	<i>paraensis</i>	ML	88445	male
<i>Myrmotherula longipennis</i>	<i>transitiva</i>	BMW	205 003	female
<i>Myrmotherula longipennis</i>	<i>transitiva</i>	BMW	C0384	female
<i>Myrmotherula longipennis</i>	<i>transitiva</i>	BMW	C0521	female
<i>Myrmotherula longipennis</i>	<i>transitiva</i>	BMW	205 003	male
<i>Myrmotherula longipennis</i>	<i>transitiva</i>	BMW	222 105	male
<i>Myrmotherula longipennis</i>	<i>transitiva</i>	BMW	C0384	male
<i>Myrmotherula longipennis</i>	<i>zimmeri</i>	ML	17573	male
<i>Myrmotherula longipennis</i>	<i>zimmeri</i>	ML	73750	male
<i>Myrmotherula menetriesii</i>	<i>berlepschi</i>	BMW	C0482	female
<i>Myrmotherula menetriesii</i>	<i>berlepschi</i>	BMW	C0482	male
<i>Myrmotherula menetriesii</i>	<i>berlepschi</i>	ML	185532	male
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	ML	134360	male
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	ML	134550	male
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	ML	134656	male
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	ML	144641	male
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	ML	77921	male
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	ML	89831	male
<i>Myrmotherula menetriesii</i>	<i>menetriesii</i>	ML	121730	female
<i>Myrmotherula menetriesii</i>	<i>menetriesii</i>	ML	163826	male
<i>Myrmotherula menetriesii</i>	<i>menetriesii</i>	ML	24202	male
<i>Myrmotherula menetriesii</i>	<i>menetriesii</i>	ML	28929	male
<i>Myrmotherula menetriesii</i>	<i>menetriesii</i>	ML	75772	male
<i>Myrmotherula menetriesii</i>	<i>omissa</i>	BMW	087 029	female
<i>Myrmotherula menetriesii</i>	<i>omissa</i>	BMW	087 029	male
<i>Myrmotherula menetriesii</i>	<i>omissa</i>	BMW	154 031	male
<i>Myrmotherula menetriesii</i>	<i>omissa</i>	XC	88768	male
<i>Myrmotherula menetriesii</i>	<i>pallida</i>	ML	188522	male
<i>Myrmotherula menetriesii</i>	<i>pallida</i>	ML	228484	male
<i>Myrmotherula menetriesii</i>	<i>pallida</i>	ML	34236	male
<i>Myrmotherula minor</i>		BMW	078 008	male
<i>Myrmotherula minor</i>		XC	395495	male
<i>Myrmotherula multostriata</i>		ML	126871	male
<i>Myrmotherula multostriata</i>		ML	47788	male
<i>Myrmotherula multostriata</i>		ML*	65311	male
<i>Myrmotherula pacifica</i>		KJZ	018 015	female
<i>Myrmotherula pacifica</i>		XC	397650	female
<i>Myrmotherula pacifica</i>		KJZ	018 015	male
<i>Myrmotherula pacifica</i>		ML	28341	male
<i>Myrmotherula pacifica</i>		ML	68246	male
<i>Myrmotherula schisticolor</i>	<i>interior</i>	ML	217929	male
<i>Myrmotherula schisticolor</i>	<i>interior</i>	XC	88621	male
<i>Myrmotherula schisticolor</i>	<i>interior</i>	XC	88623	male
<i>Myrmotherula schisticolor</i>	<i>schisticolor</i>	KJZ	095 017	female
<i>Myrmotherula schisticolor</i>	<i>schisticolor</i>	KJZ	039 027	male

<i>Myrmotherula schisticolor</i>	<i>schisticolor</i>	KJZ	095 017	male
<i>Myrmotherula schisticolor</i>	<i>schisticolor</i>	ML*	50961	male
<i>Myrmotherula sclateri</i>		BMW	222 100	female
<i>Myrmotherula sclateri</i>		BMW	C0429	female
<i>Myrmotherula sclateri</i>		BMW	C0437	female
<i>Myrmotherula sclateri</i>		ML	127590	male
<i>Myrmotherula sclateri</i>		ML	13626	male
<i>Myrmotherula sclateri</i>		ML	23829	male
<i>Myrmotherula sclateri</i>		ML	43307	male
<i>Myrmotherula snowi</i>		BMW	210 061	male
<i>Myrmotherula snowi</i>		BMW*	83 04	male
<i>Myrmotherula snowi</i>		KJZ	098 023	male
<i>Myrmotherula sunensis</i>		BMW	220 023	male
<i>Myrmotherula sunensis</i>		KJZ	123 066	male
<i>Myrmotherula sunensis</i>		KJZ	124 001	male
<i>Myrmotherula surinamensis</i>		BMW	146 010	female
<i>Myrmotherula surinamensis</i>		ML	227703	male
<i>Myrmotherula surinamensis</i>		ML	25365	male
<i>Myrmotherula surinamensis</i>		ML	72330	male
<i>Myrmotherula surinamensis</i>		ML*	61936	male
<i>Myrmotherula unicolor</i>		ML	63866	female
<i>Myrmotherula unicolor</i>		XC	41787	female
<i>Myrmotherula unicolor</i>		BMW*	65 20	male
<i>Myrmotherula unicolor</i>		XC	278069	male
<i>Myrmotherula unicolor</i>		XC	336061	male
<i>Myrmotherula urosticta</i>		XC	15656	female
<i>Myrmotherula urosticta</i>		BMW	003 014	male
<i>Myrmotherula urosticta</i>		BMW*	44 13	male
<i>Myrmotherula urosticta</i>		ML	113336	male
<i>Stymphalornis acutirostris</i>	<i>acutirostris</i>	BMW	152 010	female
<i>Stymphalornis acutirostris</i>	<i>acutirostris</i>	KJZ	118 013	female
<i>Stymphalornis acutirostris</i>	<i>acutirostris</i>	XC	20817	female
<i>Stymphalornis acutirostris</i>	<i>acutirostris</i>	MISC*	4 12	male
<i>Stymphalornis acutirostris</i>	<i>acutirostris</i>	ML	166761	male
<i>Stymphalornis acutirostris</i>	<i>acutirostris</i>	XC	20814	male
<i>Stymphalornis acutirostris</i>	<i>paludicola</i>	BMW	228 026	male
<i>Stymphalornis acutirostris</i>	<i>paludicola</i>	KJZ	009 016	male
<i>Stymphalornis acutirostris</i>	<i>paludicola</i>	XC	78734	male
<i>Terenura maculata</i>		XC	200800	female
<i>Terenura maculata</i>		FNJV	2865	male
<i>Terenura maculata</i>		BMW*	43 06	male
<i>Terenura sicki</i>		XC	107707	male

Table S5. List of the museum specimens that were photographed and analyzed in this study. MZUSP = Museu de Zoologia da Universidade de São Paulo; MPEG = Museu Paraense Emílio Goeldi; MNRJ = Museu nacional do Rio de Janeiro; MCZ = Museum of Comparative Zoology of Harvard University; LSUMZ = Louisiana State University Museum of Natural Science; AMNH = American Museum of Natural History; ANSP = Academy of Natural Sciences of Philadelphia; USNM = Smithsonian National Museum of Natural History; FMNH = Field Museum of Natural History.

Species	Subspecies	Museum	Catalog number	Sex
<i>Formicivora erythronotos</i>		MZUSP	76679	female
<i>Formicivora erythronotos</i>		MZUSP	76678	male
<i>Formicivora erythronotos</i>		MNRJ	33300	male
<i>Formicivora erythronotos</i>		MCZ	84709	male
<i>Formicivora erythronotos</i>		AMNH	156326	male
<i>Formicivora erythronotos</i>		AMNH	490402	male
<i>Formicivora grantsaui</i>		MZUSP	76677	female
<i>Formicivora grantsaui</i>		MZUSP	76676	male
<i>Formicivora grisea</i>	<i>alticincta</i>	LSUMZ	178893	female
<i>Formicivora grisea</i>	<i>alticincta</i>	LSUMZ	178889	female
<i>Formicivora grisea</i>	<i>alticincta</i>	LSUMZ	178887	female
<i>Formicivora grisea</i>	<i>alticincta</i>	AMNH	233234	female
<i>Formicivora grisea</i>	<i>alticincta</i>	AMNH	233235	female
<i>Formicivora grisea</i>	<i>alticincta</i>	LSUMZ	178892	male
<i>Formicivora grisea</i>	<i>alticincta</i>	LSUMZ	178890	male
<i>Formicivora grisea</i>	<i>alticincta</i>	AMNH	233230	male
<i>Formicivora grisea</i>	<i>alticincta</i>	MCZ	40421	male
<i>Formicivora grisea</i>	<i>alticincta</i>	MCZ	40423	male
<i>Formicivora grisea</i>	<i>fumosa</i>	MCZ	134851	female
<i>Formicivora grisea</i>	<i>fumosa</i>	FMNH	43584	female
<i>Formicivora grisea</i>	<i>fumosa</i>	FMNH	43585	female
<i>Formicivora grisea</i>	<i>fumosa</i>	MCZ	134850	male
<i>Formicivora grisea</i>	<i>fumosa</i>	FMNH	43583	male
<i>Formicivora grisea</i>	<i>grisea</i>	MZUSP	95386	female
<i>Formicivora grisea</i>	<i>grisea</i>	MZUSP	92829	female
<i>Formicivora grisea</i>	<i>grisea</i>	MZUSP	93803	female
<i>Formicivora grisea</i>	<i>grisea</i>	MPEG	28691	female
<i>Formicivora grisea</i>	<i>grisea</i>	MPEG	46478	female
<i>Formicivora grisea</i>	<i>grisea</i>	MZUSP	95387	male
<i>Formicivora grisea</i>	<i>grisea</i>	MZUSP	93804	male
<i>Formicivora grisea</i>	<i>grisea</i>	MZUSP	101295	male

<i>Formicivora grisea</i>	<i>grisea</i>	MPEG	28684	male
<i>Formicivora grisea</i>	<i>grisea</i>	MPEG	46476	male
<i>Formicivora grisea</i>	<i>hondae</i>	MZUSP	13324	female
<i>Formicivora grisea</i>	<i>hondae</i>	MZUSP	5261	female
<i>Formicivora grisea</i>	<i>hondae</i>	AMNH	111915	female
<i>Formicivora grisea</i>	<i>hondae</i>	AMNH	133469	female
<i>Formicivora grisea</i>	<i>hondae</i>	LSUMZ	61581	female
<i>Formicivora grisea</i>	<i>hondae</i>	MZUSP	13305	male
<i>Formicivora grisea</i>	<i>hondae</i>	MZUSP	5259	male
<i>Formicivora grisea</i>	<i>hondae</i>	AMNH	133465	male
<i>Formicivora grisea</i>	<i>hondae</i>	AMNH	121901	male
<i>Formicivora grisea</i>	<i>hondae</i>	LSUMZ	38686	male
<i>Formicivora grisea</i>	<i>intermedia</i>	AMNH	490820	female
<i>Formicivora grisea</i>	<i>intermedia</i>	AMNH	177327	female
<i>Formicivora grisea</i>	<i>intermedia</i>	AMNH	490824	female
<i>Formicivora grisea</i>	<i>intermedia</i>	AMNH	490818	female
<i>Formicivora grisea</i>	<i>intermedia</i>	AMNH	73473	female
<i>Formicivora grisea</i>	<i>intermedia</i>	MCZ	249734	male
<i>Formicivora grisea</i>	<i>intermedia</i>	MCZ	249732	male
<i>Formicivora grisea</i>	<i>intermedia</i>	MCZ	249733	male
<i>Formicivora grisea</i>	<i>intermedia</i>	AMNH	188274	male
<i>Formicivora grisea</i>	<i>intermedia</i>	AMNH	490809	male
<i>Formicivora grisea</i>	<i>orenocensis</i>	AMNH	490798	female
<i>Formicivora grisea</i>	<i>orenocensis</i>	AMNH	490797	female
<i>Formicivora grisea</i>	<i>orenocensis</i>	AMNH	490802	female
<i>Formicivora grisea</i>	<i>orenocensis</i>	USNM	316503	female
<i>Formicivora grisea</i>	<i>orenocensis</i>	USNM	328977	female
<i>Formicivora grisea</i>	<i>orenocensis</i>	AMNH	821366	male
<i>Formicivora grisea</i>	<i>orenocensis</i>	AMNH	490795	male
<i>Formicivora grisea</i>	<i>orenocensis</i>	AMNH	490793	male
<i>Formicivora grisea</i>	<i>orenocensis</i>	USNM	328974	male
<i>Formicivora grisea</i>	<i>orenocensis</i>	USNM	329521	male
<i>Formicivora grisea</i>	<i>rufiventris</i>	MPEG	79059	female
<i>Formicivora grisea</i>	<i>rufiventris</i>	AMNH	273809	female
<i>Formicivora grisea</i>	<i>rufiventris</i>	AMNH	273806	female
<i>Formicivora grisea</i>	<i>rufiventris</i>	USNM	328959	female
<i>Formicivora grisea</i>	<i>rufiventris</i>	USNM	328971	female
<i>Formicivora grisea</i>	<i>rufiventris</i>	MPEG	79057	male
<i>Formicivora grisea</i>	<i>rufiventris</i>	MPEG	17352	male
<i>Formicivora grisea</i>	<i>rufiventris</i>	AMNH	273802	male
<i>Formicivora grisea</i>	<i>rufiventris</i>	AMNH	273801	male
<i>Formicivora grisea</i>	<i>rufiventris</i>	USNM	328956	male
<i>Formicivora grisea</i>	<i>tobagensis</i>	AMNH	156285	female
<i>Formicivora grisea</i>	<i>tobagensis</i>	AMNH	490855	female
<i>Formicivora grisea</i>	<i>tobagensis</i>	AMNH	176389	male
<i>Formicivora grisea</i>	<i>tobagensis</i>	AMNH	156284	male
<i>Formicivora grisea</i>	<i>tobagensis</i>	AMNH	490846	male
<i>Formicivora grisea</i>	<i>tobagensis</i>	FMNH	394484	male

<i>Formicivora iheringi</i>		MZUSP	7639	female
<i>Formicivora iheringi</i>		AMNH	243058	male
<i>Formicivora iheringi</i>		AMNH	243057	male
<i>Formicivora iheringi</i>		AMNH	243056	male
<i>Formicivora iheringi</i>		AMNH	243055	male
<i>Formicivora littoralis</i>		MZUSP	73507	female
<i>Formicivora littoralis</i>		MNRJ	39173	female
<i>Formicivora littoralis</i>		MNRJ	37408	female
<i>Formicivora littoralis</i>		MNRJ	43736	female
<i>Formicivora littoralis</i>		MNRJ	37539	female
<i>Formicivora littoralis</i>		MZUSP	73506	male
<i>Formicivora littoralis</i>		MNRJ	43737	male
<i>Formicivora melanogaster</i>	<i>bahiae</i>	MZUSP	81535	female
<i>Formicivora melanogaster</i>	<i>bahiae</i>	MZUSP	84401	female
<i>Formicivora melanogaster</i>	<i>bahiae</i>	MZUSP	77741	female
<i>Formicivora melanogaster</i>	<i>bahiae</i>	MPEG	68080	female
<i>Formicivora melanogaster</i>	<i>bahiae</i>	MPEG	68084	female
<i>Formicivora melanogaster</i>	<i>bahiae</i>	MZUSP	83295	male
<i>Formicivora melanogaster</i>	<i>bahiae</i>	MZUSP	77735	male
<i>Formicivora melanogaster</i>	<i>bahiae</i>	MZUSP	81536	male
<i>Formicivora melanogaster</i>	<i>bahiae</i>	MPEG	68082	male
<i>Formicivora melanogaster</i>	<i>bahiae</i>	MPEG	68081	male
<i>Formicivora melanogaster</i>	<i>melanogaster</i>	MZUSP	76450	female
<i>Formicivora melanogaster</i>	<i>melanogaster</i>	MZUSP	74117	female
<i>Formicivora melanogaster</i>	<i>melanogaster</i>	MPEG	44932	female
<i>Formicivora melanogaster</i>	<i>melanogaster</i>	MPEG	51178	female
<i>Formicivora melanogaster</i>	<i>melanogaster</i>	MPEG	51177	female
<i>Formicivora melanogaster</i>	<i>melanogaster</i>	MZUSP	34024	male
<i>Formicivora melanogaster</i>	<i>melanogaster</i>	MZUSP	32449	male
<i>Formicivora melanogaster</i>	<i>melanogaster</i>	MZUSP	27832	male
<i>Formicivora melanogaster</i>	<i>melanogaster</i>	MPEG	51176	male
<i>Formicivora melanogaster</i>	<i>melanogaster</i>	MPEG	51175	male
<i>Formicivora rufa</i>	<i>chapmani</i>	MPEG	46480	female
<i>Formicivora rufa</i>	<i>chapmani</i>	MPEG	54370	female
<i>Formicivora rufa</i>	<i>chapmani</i>	MPEG	54369	female
<i>Formicivora rufa</i>	<i>chapmani</i>	MPEG	69868	female
<i>Formicivora rufa</i>	<i>chapmani</i>	MCZ	174894	female
<i>Formicivora rufa</i>	<i>chapmani</i>	MZUSP	82405	male
<i>Formicivora rufa</i>	<i>chapmani</i>	MPEG	69869	male
<i>Formicivora rufa</i>	<i>chapmani</i>	MPEG	54367	male
<i>Formicivora rufa</i>	<i>chapmani</i>	MCZ	174895	male
<i>Formicivora rufa</i>	<i>rufa</i>	MZUSP	75293	female
<i>Formicivora rufa</i>	<i>rufa</i>	MZUSP	98575	female
<i>Formicivora rufa</i>	<i>rufa</i>	MZUSP	97196	female
<i>Formicivora rufa</i>	<i>rufa</i>	MPEG	49507	female
<i>Formicivora rufa</i>	<i>rufa</i>	MPEG	71113	female
<i>Formicivora rufa</i>	<i>rufa</i>	MZUSP	79624	male
<i>Formicivora rufa</i>	<i>rufa</i>	MZUSP	75289	male

<i>Formicivora rufa</i>	<i>rufa</i>	MZUSP	98574	male
<i>Formicivora rufa</i>	<i>rufa</i>	MPEG	49508	male
<i>Formicivora rufa</i>	<i>rufa</i>	MPEG	49506	male
<i>Formicivora rufa</i>	<i>urubambae</i>	AMNH	145131	female
<i>Formicivora rufa</i>	<i>urubambae</i>	AMNH	792017	female
<i>Formicivora rufa</i>	<i>urubambae</i>	AMNH	792016	female
<i>Formicivora rufa</i>	<i>urubambae</i>	LSUMZ	84861	female
<i>Formicivora rufa</i>	<i>urubambae</i>	LSUMZ	84859	female
<i>Formicivora rufa</i>	<i>urubambae</i>	AMNH	145134	male
<i>Formicivora rufa</i>	<i>urubambae</i>	AMNH	792013	male
<i>Formicivora rufa</i>	<i>urubambae</i>	AMNH	792015	male
<i>Formicivora rufa</i>	<i>urubambae</i>	LSUMZ	190511	male
<i>Formicivora rufa</i>	<i>urubambae</i>	LSUMZ	84857	male
<i>Formicivora serrana</i>	<i>interposita</i>	MZUSP	94905	female
<i>Formicivora serrana</i>	<i>interposita</i>	MZUSP	94906	male
<i>Formicivora serrana</i>	<i>interposita</i>	MZUSP	94907	male
<i>Formicivora serrana</i>	<i>interposita</i>	MNRJ	44439	male
<i>Formicivora serrana</i>	<i>interposita</i>	MNRJ	44423	male
<i>Formicivora serrana</i>	<i>serrana</i>	MZUSP	10385	female
<i>Formicivora serrana</i>	<i>serrana</i>	MZUSP	10384	female
<i>Formicivora serrana</i>	<i>serrana</i>	MZUSP	85997	female
<i>Formicivora serrana</i>	<i>serrana</i>	MZUSP	25243	male
<i>Formicivora serrana</i>	<i>serrana</i>	MZUSP	87033	male
<i>Formicivora serrana</i>	<i>serrana</i>	MZUSP	87032	male
<i>Myrmochanes hemileucus</i>		MPEG	73722	female
<i>Myrmochanes hemileucus</i>		MPEG	78890	female
<i>Myrmochanes hemileucus</i>		MPEG	79022	female
<i>Myrmochanes hemileucus</i>		LSUMZ	116231	female
<i>Myrmochanes hemileucus</i>		LSUMZ	110055	female
<i>Myrmochanes hemileucus</i>		MPEG	73754	male
<i>Myrmochanes hemileucus</i>		MPEG	50003	male
<i>Myrmochanes hemileucus</i>		MPEG	50004	male
<i>Myrmochanes hemileucus</i>		LSUMZ	119818	male
<i>Myrmochanes hemileucus</i>		LSUMZ	116234	male
<i>Myrmotherula ambigua</i>		AMNH	816728	female
<i>Myrmotherula ambigua</i>		FMNH	319158	female
<i>Myrmotherula ambigua</i>		MZUSP	64853	male
<i>Myrmotherula ambigua</i>		MPEG	53081	male
<i>Myrmotherula ambigua</i>		MPEG	77309	male
<i>Myrmotherula ambigua</i>		AMNH	273546	male
<i>Myrmotherula ambigua</i>		FMNH	343956	male
<i>Myrmotherula assimilis</i>	<i>assimilis</i>	MZUSP	100873	female
<i>Myrmotherula assimilis</i>	<i>assimilis</i>	MPEG	79030	female
<i>Myrmotherula assimilis</i>	<i>assimilis</i>	MPEG	78804	female
<i>Myrmotherula assimilis</i>	<i>assimilis</i>	MPEG	53108	female
<i>Myrmotherula assimilis</i>	<i>assimilis</i>	MPEG	49515	female
<i>Myrmotherula assimilis</i>	<i>assimilis</i>	MZUSP	100875	male
<i>Myrmotherula assimilis</i>	<i>assimilis</i>	MZUSP	100874	male

<i>Myrmotherula assimilis</i>	<i>assimilis</i>	MZUSP	100871	male
<i>Myrmotherula assimilis</i>	<i>assimilis</i>	MPEG	43188	male
<i>Myrmotherula assimilis</i>	<i>assimilis</i>	MPEG	78959	male
<i>Myrmotherula assimilis</i>	<i>transamazonica</i>	MZUSP	23440	female
<i>Myrmotherula assimilis</i>	<i>transamazonica</i>	MZUSP	3399	female
<i>Myrmotherula assimilis</i>	<i>transamazonica</i>	MPEG	56697	female
<i>Myrmotherula assimilis</i>	<i>transamazonica</i>	AMNH	490645	female
<i>Myrmotherula assimilis</i>	<i>transamazonica</i>	ANSP	167549	female
<i>Myrmotherula assimilis</i>	<i>transamazonica</i>	MZUSP	35946	male
<i>Myrmotherula assimilis</i>	<i>transamazonica</i>	MPEG	56696	male
<i>Myrmotherula assimilis</i>	<i>transamazonica</i>	ANSP	167550	male
<i>Myrmotherula axillaris</i>	<i>albigula</i>	MCZ	123990	female
<i>Myrmotherula axillaris</i>	<i>albigula</i>	MCZ	123960	female
<i>Myrmotherula axillaris</i>	<i>albigula</i>	MCZ	123956	female
<i>Myrmotherula axillaris</i>	<i>albigula</i>	MCZ	123980	female
<i>Myrmotherula axillaris</i>	<i>albigula</i>	MCZ	123981	female
<i>Myrmotherula axillaris</i>	<i>albigula</i>	MCZ	123983	male
<i>Myrmotherula axillaris</i>	<i>albigula</i>	MCZ	117021	male
<i>Myrmotherula axillaris</i>	<i>albigula</i>	MCZ	123984	male
<i>Myrmotherula axillaris</i>	<i>albigula</i>	MCZ	123950	male
<i>Myrmotherula axillaris</i>	<i>albigula</i>	MCZ	123951	male
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	MZUSP	93795	female
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	MZUSP	100751	female
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	MZUSP	99014	female
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	MPEG	57852	female
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	MPEG	57853	female
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	MZUSP	93796	male
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	MZUSP	100750	male
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	MZUSP	99015	male
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	MPEG	61112	male
<i>Myrmotherula axillaris</i>	<i>axillaris</i>	MPEG	57851	male
<i>Myrmotherula axillaris</i>	<i>fresnayana</i>	MCZ	134835	female
<i>Myrmotherula axillaris</i>	<i>fresnayana</i>	LSUMZ	132713	female
<i>Myrmotherula axillaris</i>	<i>fresnayana</i>	LSUMZ	124167	female
<i>Myrmotherula axillaris</i>	<i>fresnayana</i>	LSUMZ	153366	female
<i>Myrmotherula axillaris</i>	<i>fresnayana</i>	LSUMZ	132716	female
<i>Myrmotherula axillaris</i>	<i>fresnayana</i>	MCZ	134834	male
<i>Myrmotherula axillaris</i>	<i>fresnayana</i>	LSUMZ	132712	male
<i>Myrmotherula axillaris</i>	<i>fresnayana</i>	LSUMZ	132728	male
<i>Myrmotherula axillaris</i>	<i>fresnayana</i>	LSUMZ	102112	male
<i>Myrmotherula axillaris</i>	<i>fresnayana</i>	LSUMZ	137152	male
<i>Myrmotherula axillaris</i>	<i>heterozyga</i>	MZUSP	19128	female
<i>Myrmotherula axillaris</i>	<i>heterozyga</i>	MZUSP	19131	female
<i>Myrmotherula axillaris</i>	<i>heterozyga</i>	MZUSP	68213	female
<i>Myrmotherula axillaris</i>	<i>heterozyga</i>	MPEG	61340	female
<i>Myrmotherula axillaris</i>	<i>heterozyga</i>	MPEG	63543	female
<i>Myrmotherula axillaris</i>	<i>heterozyga</i>	MZUSP	23644	male
<i>Myrmotherula axillaris</i>	<i>heterozyga</i>	MZUSP	3622	male

<i>Myrmotherula axillaris</i>	<i>heterozyga</i>	MZUSP	3621	male
<i>Myrmotherula axillaris</i>	<i>heterozyga</i>	MPEG	63542	male
<i>Myrmotherula axillaris</i>	<i>heterozyga</i>	MPEG	63341	male
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	MZUSP	98437	female
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	MZUSP	98440	female
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	MZUSP	85827	female
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	AMNH	317545	female
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	MZUSP	98439	male
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	MZUSP	98441	male
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	MZUSP	98438	male
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	AMNH	317538	male
<i>Myrmotherula axillaris</i>	<i>luctuosa</i>	AMNH	242991	male
<i>Myrmotherula axillaris</i>	<i>melaena</i>	MZUSP	59492	female
<i>Myrmotherula axillaris</i>	<i>melaena</i>	MPEG	62828	female
<i>Myrmotherula axillaris</i>	<i>melaena</i>	MPEG	59590	female
<i>Myrmotherula axillaris</i>	<i>melaena</i>	MCZ	299292	female
<i>Myrmotherula axillaris</i>	<i>melaena</i>	MCZ	179711	female
<i>Myrmotherula axillaris</i>	<i>melaena</i>	MZUSP	59490	male
<i>Myrmotherula axillaris</i>	<i>melaena</i>	MPEG	62824	male
<i>Myrmotherula axillaris</i>	<i>melaena</i>	MPEG	59594	male
<i>Myrmotherula axillaris</i>	<i>melaena</i>	MCZ	138324	male
<i>Myrmotherula axillaris</i>	<i>melaena</i>	MCZ	138328	male
<i>Myrmotherula behni</i>	<i>behni</i>	MCZ	299303	female
<i>Myrmotherula behni</i>	<i>behni</i>	MCZ	299298	female
<i>Myrmotherula behni</i>	<i>behni</i>	MCZ	299300	female
<i>Myrmotherula behni</i>	<i>behni</i>	AMNH	179280	female
<i>Myrmotherula behni</i>	<i>behni</i>	ANSP	185461	female
<i>Myrmotherula behni</i>	<i>behni</i>	MCZ	299299	male
<i>Myrmotherula behni</i>	<i>behni</i>	MCZ	299297	male
<i>Myrmotherula behni</i>	<i>behni</i>	MCZ	299301	male
<i>Myrmotherula behni</i>	<i>behni</i>	AMNH	490588	male
<i>Myrmotherula behni</i>	<i>behni</i>	ANSP	185459	male
<i>Myrmotherula behni</i>	<i>camanii</i>	MPEG	22742	male
<i>Myrmotherula behni</i>	<i>inornata</i>	AMNH	490587	male
<i>Myrmotherula behni</i>	<i>inornata</i>	LSUMZ	175410	male
<i>Myrmotherula behni</i>	<i>yavii</i>	FMNH	319208	female
<i>Myrmotherula brachyura</i>		MZUSP	82112	female
<i>Myrmotherula brachyura</i>		MZUSP	93832	female
<i>Myrmotherula brachyura</i>		MZUSP	100752	female
<i>Myrmotherula brachyura</i>		MPEG	56079	female
<i>Myrmotherula brachyura</i>		MPEG	56084	female
<i>Myrmotherula brachyura</i>		MZUSP	93830	male
<i>Myrmotherula brachyura</i>		MZUSP	93831	male
<i>Myrmotherula brachyura</i>		MZUSP	84848	male
<i>Myrmotherula brachyura</i>		MPEG	65428	male
<i>Myrmotherula brachyura</i>		MPEG	64175	male
<i>Myrmotherula cherriei</i>		MZUSP	93835	female
<i>Myrmotherula cherriei</i>		MPEG	79045	female

<i>Myrmotherula cherriei</i>		MPEG	50596	female
<i>Myrmotherula cherriei</i>		MPEG	62812	female
<i>Myrmotherula cherriei</i>		MZUSP	93833	male
<i>Myrmotherula cherriei</i>		MZUSP	93834	male
<i>Myrmotherula cherriei</i>		MZUSP	93836	male
<i>Myrmotherula cherriei</i>		MPEG	62817	male
<i>Myrmotherula cherriei</i>		MPEG	50598	male
<i>Myrmotherula fluminensis</i>		MPEG	40786	male
<i>Myrmotherula grisea</i>		ANSP	120272	female
<i>Myrmotherula grisea</i>		ANSP	120273	female
<i>Myrmotherula grisea</i>		ANSP	120274	female
<i>Myrmotherula grisea</i>		LSUMZ	179664	female
<i>Myrmotherula grisea</i>		LSUMZ	90719	female
<i>Myrmotherula grisea</i>		LSUMZ	37716	male
<i>Myrmotherula grisea</i>		LSUMZ	179663	male
<i>Myrmotherula grisea</i>		LSUMZ	90720	male
<i>Myrmotherula grisea</i>		LSUMZ	162681	male
<i>Myrmotherula grisea</i>		LSUMZ	90721	male
<i>Myrmotherula ignota</i>	<i>ignota</i>	USNM	470085	female
<i>Myrmotherula ignota</i>	<i>ignota</i>	USNM	411359	female
<i>Myrmotherula ignota</i>	<i>ignota</i>	USNM	411358	female
<i>Myrmotherula ignota</i>	<i>ignota</i>	USNM	470082	female
<i>Myrmotherula ignota</i>	<i>ignota</i>	LSUMZ	162115	female
<i>Myrmotherula ignota</i>	<i>ignota</i>	USNM	386160	male
<i>Myrmotherula ignota</i>	<i>ignota</i>	USNM	232435	male
<i>Myrmotherula ignota</i>	<i>ignota</i>	USNM	411355	male
<i>Myrmotherula ignota</i>	<i>ignota</i>	USNM	402186	male
<i>Myrmotherula ignota</i>	<i>ignota</i>	LSUMZ	164145	male
<i>Myrmotherula ignota</i>	<i>obscura</i>	LSUMZ	109916	female
<i>Myrmotherula ignota</i>	<i>obscura</i>	LSUMZ	92369	female
<i>Myrmotherula ignota</i>	<i>obscura</i>	LSUMZ	156502	female
<i>Myrmotherula ignota</i>	<i>obscura</i>	LSUMZ	109911	female
<i>Myrmotherula ignota</i>	<i>obscura</i>	LSUMZ	109913	female
<i>Myrmotherula ignota</i>	<i>obscura</i>	LSUMZ	109914	male
<i>Myrmotherula ignota</i>	<i>obscura</i>	LSUMZ	115267	male
<i>Myrmotherula ignota</i>	<i>obscura</i>	LSUMZ	161752	male
<i>Myrmotherula ignota</i>	<i>obscura</i>	LSUMZ	109915	male
<i>Myrmotherula ignota</i>	<i>obscura</i>	LSUMZ	87963	male
<i>Myrmotherula iheringi</i>	<i>heteroptera</i>	MZUSP	78802	female
<i>Myrmotherula iheringi</i>	<i>heteroptera</i>	MZUSP	96715	male
<i>Myrmotherula iheringi</i>	<i>heteroptera</i>	MZUSP	90450	male
<i>Myrmotherula iheringi</i>	<i>heteroptera</i>	MPEG	52757	male
<i>Myrmotherula iheringi</i>	<i>heteroptera</i>	MPEG	60200	male
<i>Myrmotherula iheringi</i>	<i>heteroptera</i>	MPEG	60201	male
<i>Myrmotherula iheringi</i>	<i>iheringi</i>	MZUSP	97353	female
<i>Myrmotherula iheringi</i>	<i>iheringi</i>	MZUSP	96272	female
<i>Myrmotherula iheringi</i>	<i>iheringi</i>	MZUSP	96268	female

<i>Myrmotherula iheringi</i>	<i>iheringi</i>	LSUMZ	80930 (Field Number)	female
<i>Myrmotherula iheringi</i>	<i>iheringi</i>	MZUSP	92900	male
<i>Myrmotherula iheringi</i>	<i>iheringi</i>	MZUSP	92901	male
<i>Myrmotherula iheringi</i>	<i>iheringi</i>	MZUSP	96271	male
<i>Myrmotherula iheringi</i>	<i>iheringi</i>	MZUSP	84907	male
<i>Myrmotherula iheringi</i>	<i>iheringi</i>	MCZ	134824	male
<i>Myrmotherula iheringi</i>	<i>oreni</i>	MZUSP	80195	female
<i>Myrmotherula iheringi</i>	<i>oreni</i>	LSUMZ	188902	female
<i>Myrmotherula iheringi</i>	<i>oreni</i>	MZUSP	80197	male
<i>Myrmotherula iheringi</i>	<i>oreni</i>	MPEG	24609	male
<i>Myrmotherula iheringi</i>	<i>oreni</i>	LSUMZ	188901	male
<i>Myrmotherula iheringi</i>	<i>oreni</i>	LSUMZ	98334	male
<i>Myrmotherula klagesi</i>		MZUSP	96228	female
<i>Myrmotherula klagesi</i>		MPEG	54101	female
<i>Myrmotherula klagesi</i>		MPEG	54100	female
<i>Myrmotherula klagesi</i>		MPEG	53084	female
<i>Myrmotherula klagesi</i>		MPEG	73811	female
<i>Myrmotherula klagesi</i>		MZUSP	96226	male
<i>Myrmotherula klagesi</i>		MPEG	53082	male
<i>Myrmotherula klagesi</i>		MPEG	78974	male
<i>Myrmotherula klagesi</i>		MPEG	79165	male
<i>Myrmotherula klagesi</i>		MZUSP	96227	male
<i>Myrmotherula longicauda</i>	<i>australis</i>	AMNH	137078	female
<i>Myrmotherula longicauda</i>	<i>australis</i>	LSUMZ	37711	female
<i>Myrmotherula longicauda</i>	<i>australis</i>	LSUMZ	36094	female
<i>Myrmotherula longicauda</i>	<i>australis</i>	LSUMZ	37713	female
<i>Myrmotherula longicauda</i>	<i>australis</i>	LSUMZ	102101	female
<i>Myrmotherula longicauda</i>	<i>australis</i>	AMNH	147684	male
<i>Myrmotherula longicauda</i>	<i>australis</i>	LSUMZ	36095	male
<i>Myrmotherula longicauda</i>	<i>australis</i>	LSUMZ	37710	male
<i>Myrmotherula longicauda</i>	<i>australis</i>	LSUMZ	162679	male
<i>Myrmotherula longicauda</i>	<i>australis</i>	LSUMZ	171312	male
<i>Myrmotherula longicauda</i>	<i>longicauda</i>	MCZ	299147	female
<i>Myrmotherula longicauda</i>	<i>longicauda</i>	AMNH	169710	female
<i>Myrmotherula longicauda</i>	<i>longicauda</i>	AMNH	132713	female
<i>Myrmotherula longicauda</i>	<i>longicauda</i>	MCZ	299148	male
<i>Myrmotherula longicauda</i>	<i>longicauda</i>	AMNH	169706	male
<i>Myrmotherula longicauda</i>	<i>longicauda</i>	AMNH	408605	male
<i>Myrmotherula longicauda</i>	<i>longicauda</i>	AMNH	169703	male
<i>Myrmotherula longicauda</i>	<i>longicauda</i>	AMNH	169705	male
<i>Myrmotherula longicauda</i>	<i>pseudoaustralis</i>	AMNH	408323	female
<i>Myrmotherula longicauda</i>	<i>pseudoaustralis</i>	LSUMZ	173982	female
<i>Myrmotherula longicauda</i>	<i>pseudoaustralis</i>	FMNH	50637	female
<i>Myrmotherula longicauda</i>	<i>pseudoaustralis</i>	FMNH	50636	female
<i>Myrmotherula longicauda</i>	<i>pseudoaustralis</i>	FMNH	65753	female
<i>Myrmotherula longicauda</i>	<i>pseudoaustralis</i>	AMNH	129697	male
<i>Myrmotherula longicauda</i>	<i>pseudoaustralis</i>	AMNH	167213	male

<i>Myrmotherula longicauda</i>	<i>pseudoaustralis</i>	LSUMZ	64192	male
<i>Myrmotherula longicauda</i>	<i>pseudoaustralis</i>	FMNH	50635	male
<i>Myrmotherula longicauda</i>	<i>pseudoaustralis</i>	FMNH	50634	male
<i>Myrmotherula longicauda</i>	<i>soderstromi</i>	AMNH	408322	female
<i>Myrmotherula longicauda</i>	<i>soderstromi</i>	AMNH	156795	male
<i>Myrmotherula longicauda</i>	<i>soderstromi</i>	ANSP	165055	male
<i>Myrmotherula longipennis</i>	<i>garbei</i>	MZUSP	23485	female
<i>Myrmotherula longipennis</i>	<i>garbei</i>	MPEG	59988	female
<i>Myrmotherula longipennis</i>	<i>garbei</i>	MPEG	63347	female
<i>Myrmotherula longipennis</i>	<i>garbei</i>	MPEG	60196	female
<i>Myrmotherula longipennis</i>	<i>garbei</i>	MPEG	60188	female
<i>Myrmotherula longipennis</i>	<i>garbei</i>	MZUSP	76620	male
<i>Myrmotherula longipennis</i>	<i>garbei</i>	MZUSP	23476	male
<i>Myrmotherula longipennis</i>	<i>garbei</i>	MZUSP	2782	male
<i>Myrmotherula longipennis</i>	<i>garbei</i>	MPEG	60675	male
<i>Myrmotherula longipennis</i>	<i>garbei</i>	MPEG	60674	male
<i>Myrmotherula longipennis</i>	<i>longipennis</i>	MZUSP	93816	female
<i>Myrmotherula longipennis</i>	<i>longipennis</i>	MZUSP	93815	female
<i>Myrmotherula longipennis</i>	<i>longipennis</i>	MZUSP	93814	female
<i>Myrmotherula longipennis</i>	<i>longipennis</i>	MPEG	77582	female
<i>Myrmotherula longipennis</i>	<i>longipennis</i>	MZUSP	93813	male
<i>Myrmotherula longipennis</i>	<i>longipennis</i>	MZUSP	93811	male
<i>Myrmotherula longipennis</i>	<i>longipennis</i>	MZUSP	93808	male
<i>Myrmotherula longipennis</i>	<i>longipennis</i>	MPEG	62844	male
<i>Myrmotherula longipennis</i>	<i>longipennis</i>	MPEG	50592	male
<i>Myrmotherula longipennis</i>	<i>ochrogyna</i>	MZUSP	97352	female
<i>Myrmotherula longipennis</i>	<i>ochrogyna</i>	MZUSP	96266	female
<i>Myrmotherula longipennis</i>	<i>ochrogyna</i>	MZUSP	84936	female
<i>Myrmotherula longipennis</i>	<i>ochrogyna</i>	MPEG	67202	female
<i>Myrmotherula longipennis</i>	<i>ochrogyna</i>	MPEG	67203	female
<i>Myrmotherula longipennis</i>	<i>ochrogyna</i>	MZUSP	97351	male
<i>Myrmotherula longipennis</i>	<i>ochrogyna</i>	MZUSP	97348	male
<i>Myrmotherula longipennis</i>	<i>ochrogyna</i>	MZUSP	96264	male
<i>Myrmotherula longipennis</i>	<i>ochrogyna</i>	MPEG	67201	male
<i>Myrmotherula longipennis</i>	<i>ochrogyna</i>	MPEG	76130	male
<i>Myrmotherula longipennis</i>	<i>paraensis</i>	MZUSP	101329	female
<i>Myrmotherula longipennis</i>	<i>paraensis</i>	MZUSP	77336	female
<i>Myrmotherula longipennis</i>	<i>paraensis</i>	MZUSP	101326	female
<i>Myrmotherula longipennis</i>	<i>paraensis</i>	MPEG	61808	female
<i>Myrmotherula longipennis</i>	<i>paraensis</i>	MPEG	61798	female
<i>Myrmotherula longipennis</i>	<i>paraensis</i>	MZUSP	77331	male
<i>Myrmotherula longipennis</i>	<i>paraensis</i>	MZUSP	77334	male
<i>Myrmotherula longipennis</i>	<i>paraensis</i>	MZUSP	101330	male
<i>Myrmotherula longipennis</i>	<i>paraensis</i>	MPEG	61799	male
<i>Myrmotherula longipennis</i>	<i>paraensis</i>	MPEG	74949	male
<i>Myrmotherula longipennis</i>	<i>transitiva</i>	MZUSP	99635	female
<i>Myrmotherula longipennis</i>	<i>transitiva</i>	MZUSP	80604	female
<i>Myrmotherula longipennis</i>	<i>transitiva</i>	MZUSP	80605	female

<i>Myrmotherula longipennis</i>	<i>transitiva</i>	MPEG	40033	female
<i>Myrmotherula longipennis</i>	<i>transitiva</i>	MPEG	40029	female
<i>Myrmotherula longipennis</i>	<i>transitiva</i>	MZUSP	99641	male
<i>Myrmotherula longipennis</i>	<i>transitiva</i>	MZUSP	99640	male
<i>Myrmotherula longipennis</i>	<i>transitiva</i>	MZUSP	99645	male
<i>Myrmotherula longipennis</i>	<i>transitiva</i>	MPEG	58208	male
<i>Myrmotherula longipennis</i>	<i>transitiva</i>	MPEG	54971	male
<i>Myrmotherula longipennis</i>	<i>zimmeri</i>	AMNH	231778	female
<i>Myrmotherula longipennis</i>	<i>zimmeri</i>	AMNH	255847	female
<i>Myrmotherula longipennis</i>	<i>zimmeri</i>	LSUMZ	83156	female
<i>Myrmotherula longipennis</i>	<i>zimmeri</i>	LSUMZ	83155	female
<i>Myrmotherula longipennis</i>	<i>zimmeri</i>	AMNH	231771	male
<i>Myrmotherula longipennis</i>	<i>zimmeri</i>	AMNH	231770	male
<i>Myrmotherula longipennis</i>	<i>zimmeri</i>	AMNH	255836	male
<i>Myrmotherula longipennis</i>	<i>zimmeri</i>	AMNH	255833	male
<i>Myrmotherula menetriesii</i>	<i>berlepschi</i>	MZUSP	100755	female
<i>Myrmotherula menetriesii</i>	<i>berlepschi</i>	MZUSP	97357	female
<i>Myrmotherula menetriesii</i>	<i>berlepschi</i>	MZUSP	97358	female
<i>Myrmotherula menetriesii</i>	<i>berlepschi</i>	MPEG	40041	female
<i>Myrmotherula menetriesii</i>	<i>berlepschi</i>	MPEG	40042	female
<i>Myrmotherula menetriesii</i>	<i>berlepschi</i>	MZUSP	97359	male
<i>Myrmotherula menetriesii</i>	<i>berlepschi</i>	MZUSP	92289	male
<i>Myrmotherula menetriesii</i>	<i>berlepschi</i>	MPEG	40038	male
<i>Myrmotherula menetriesii</i>	<i>berlepschi</i>	MPEG	75928	male
<i>Myrmotherula menetriesii</i>	<i>berlepschi</i>	MZUSP	100757	male
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	MPEG	17684	female
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	MPEG	40458	female
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	MPEG	29280	female
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	MPEG	29167	female
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	MPEG	25353	female
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	MZUSP	42810	male
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	MPEG	29146	male
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	MPEG	40457	male
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	MPEG	66249	male
<i>Myrmotherula menetriesii</i>	<i>cinereiventris</i>	MPEG	29232	male
<i>Myrmotherula menetriesii</i>	<i>menetriesii</i>	MZUSP	96716	female
<i>Myrmotherula menetriesii</i>	<i>menetriesii</i>	MZUSP	96717	female
<i>Myrmotherula menetriesii</i>	<i>menetriesii</i>	MZUSP	19132	female
<i>Myrmotherula menetriesii</i>	<i>menetriesii</i>	MPEG	48260	female
<i>Myrmotherula menetriesii</i>	<i>menetriesii</i>	LSUMZ	102116	female
<i>Myrmotherula menetriesii</i>	<i>menetriesii</i>	MZUSP	80196	male
<i>Myrmotherula menetriesii</i>	<i>menetriesii</i>	MZUSP	78804	male
<i>Myrmotherula menetriesii</i>	<i>menetriesii</i>	MPEG	52137	male
<i>Myrmotherula menetriesii</i>	<i>menetriesii</i>	MPEG	48257	male
<i>Myrmotherula menetriesii</i>	<i>menetriesii</i>	LSUMZ	102118	male
<i>Myrmotherula menetriesii</i>	<i>omissa</i>	MZUSP	92288	female
<i>Myrmotherula menetriesii</i>	<i>omissa</i>	MZUSP	101331	female
<i>Myrmotherula menetriesii</i>	<i>omissa</i>	MZUSP	96247	female

<i>Myrmotherula menetriesii</i>	<i>omissa</i>	MPEG	72337	female
<i>Myrmotherula menetriesii</i>	<i>omissa</i>	MPEG	56074	female
<i>Myrmotherula menetriesii</i>	<i>omissa</i>	MZUSP	101332	male
<i>Myrmotherula menetriesii</i>	<i>omissa</i>	MZUSP	77323	male
<i>Myrmotherula menetriesii</i>	<i>omissa</i>	MZUSP	92881	male
<i>Myrmotherula menetriesii</i>	<i>omissa</i>	MPEG	56073	male
<i>Myrmotherula menetriesii</i>	<i>omissa</i>	MPEG	53898	male
<i>Myrmotherula menetriesii</i>	<i>pallida</i>	MZUSP	93791	female
<i>Myrmotherula menetriesii</i>	<i>pallida</i>	MZUSP	93788	female
<i>Myrmotherula menetriesii</i>	<i>pallida</i>	MZUSP	64852	female
<i>Myrmotherula menetriesii</i>	<i>pallida</i>	MPEG	45931	female
<i>Myrmotherula menetriesii</i>	<i>pallida</i>	MPEG	45932	female
<i>Myrmotherula menetriesii</i>	<i>pallida</i>	MZUSP	93809	male
<i>Myrmotherula menetriesii</i>	<i>pallida</i>	MZUSP	93789	male
<i>Myrmotherula menetriesii</i>	<i>pallida</i>	MZUSP	93792	male
<i>Myrmotherula menetriesii</i>	<i>pallida</i>	MPEG	45927	male
<i>Myrmotherula menetriesii</i>	<i>pallida</i>	MPEG	45924	male
<i>Myrmotherula minor</i>		MZUSP	70595	female
<i>Myrmotherula minor</i>		MZUSP	28294	female
<i>Myrmotherula minor</i>		MNRJ	20942	female
<i>Myrmotherula minor</i>		MZUSP	92466	male
<i>Myrmotherula minor</i>		MZUSP	90925	male
<i>Myrmotherula minor</i>		MZUSP	60794	male
<i>Myrmotherula minor</i>		MNRJ	38588	male
<i>Myrmotherula multostriata</i>		MPEG	33691	female
<i>Myrmotherula multostriata</i>		MPEG	69208	female
<i>Myrmotherula multostriata</i>		MPEG	36045	female
<i>Myrmotherula multostriata</i>		MPEG	55754	female
<i>Myrmotherula multostriata</i>		MPEG	52616	female
<i>Myrmotherula multostriata</i>		MZUSP	83052	male
<i>Myrmotherula multostriata</i>		MZUSP	92874	male
<i>Myrmotherula multostriata</i>		MZUSP	97339	male
<i>Myrmotherula multostriata</i>		MPEG	52615	male
<i>Myrmotherula multostriata</i>		MPEG	60176	male
<i>Myrmotherula pacifica</i>		MZUSP	13259	female
<i>Myrmotherula pacifica</i>		MCZ	87223	female
<i>Myrmotherula pacifica</i>		MCZ	107282	female
<i>Myrmotherula pacifica</i>		MCZ	140628	female
<i>Myrmotherula pacifica</i>		MCZ	140623	female
<i>Myrmotherula pacifica</i>		MCZ	87222	male
<i>Myrmotherula pacifica</i>		MCZ	107281	male
<i>Myrmotherula pacifica</i>		MCZ	140627	male
<i>Myrmotherula pacifica</i>		MCZ	140630	male
<i>Myrmotherula pacifica</i>		MCZ	140625	male
<i>Myrmotherula schisticolor</i>	<i>interior</i>	MCZ	299276	female
<i>Myrmotherula schisticolor</i>	<i>interior</i>	MCZ	179713	female
<i>Myrmotherula schisticolor</i>	<i>interior</i>	LSUMZ	87986	female
<i>Myrmotherula schisticolor</i>	<i>interior</i>	LSUMZ	84841	female

<i>Myrmotherula schisticolor</i>	<i>interior</i>	LSUMZ	173984	female
<i>Myrmotherula schisticolor</i>	<i>interior</i>	MCZ	179712	male
<i>Myrmotherula schisticolor</i>	<i>interior</i>	MCZ	299274	male
<i>Myrmotherula schisticolor</i>	<i>interior</i>	LSUMZ	190507	male
<i>Myrmotherula schisticolor</i>	<i>interior</i>	LSUMZ	179010	male
<i>Myrmotherula schisticolor</i>	<i>interior</i>	LSUMZ	173986	male
<i>Myrmotherula schisticolor</i>	<i>sanctaemartae</i>	MCZ	249729	female
<i>Myrmotherula schisticolor</i>	<i>sanctaemartae</i>	USNM	387388	female
<i>Myrmotherula schisticolor</i>	<i>sanctaemartae</i>	USNM	387385	female
<i>Myrmotherula schisticolor</i>	<i>sanctaemartae</i>	USNM	373554	female
<i>Myrmotherula schisticolor</i>	<i>sanctaemartae</i>	USNM	387392	female
<i>Myrmotherula schisticolor</i>	<i>sanctaemartae</i>	MCZ	249728	male
<i>Myrmotherula schisticolor</i>	<i>sanctaemartae</i>	USNM	387384	male
<i>Myrmotherula schisticolor</i>	<i>sanctaemartae</i>	USNM	373557	male
<i>Myrmotherula schisticolor</i>	<i>sanctaemartae</i>	USNM	369228	male
<i>Myrmotherula schisticolor</i>	<i>sanctaemartae</i>	USNM	369235	male
<i>Myrmotherula schisticolor</i>	<i>schisticolor</i>	MCZ	118908	female
<i>Myrmotherula schisticolor</i>	<i>schisticolor</i>	MCZ	117018	female
<i>Myrmotherula schisticolor</i>	<i>schisticolor</i>	MCZ	124005	female
<i>Myrmotherula schisticolor</i>	<i>schisticolor</i>	MCZ	124002	female
<i>Myrmotherula schisticolor</i>	<i>schisticolor</i>	LSUMZ	32506	female
<i>Myrmotherula schisticolor</i>	<i>schisticolor</i>	MCZ	117016	male
<i>Myrmotherula schisticolor</i>	<i>schisticolor</i>	MCZ	124016	male
<i>Myrmotherula schisticolor</i>	<i>schisticolor</i>	MCZ	124019	male
<i>Myrmotherula schisticolor</i>	<i>schisticolor</i>	MCZ	124011	male
<i>Myrmotherula schisticolor</i>	<i>schisticolor</i>	LSUMZ	163590	male
<i>Myrmotherula sclateri</i>		MZUSP	92297	female
<i>Myrmotherula sclateri</i>		MZUSP	86510	female
<i>Myrmotherula sclateri</i>		MZUSP	92299	female
<i>Myrmotherula sclateri</i>		MPEG	39996	female
<i>Myrmotherula sclateri</i>		MPEG	39997	female
<i>Myrmotherula sclateri</i>		MZUSP	92298	male
<i>Myrmotherula sclateri</i>		MZUSP	96230	male
<i>Myrmotherula sclateri</i>		MZUSP	65967	male
<i>Myrmotherula sclateri</i>		MPEG	39992	male
<i>Myrmotherula sclateri</i>		MPEG	39989	male
<i>Myrmotherula snowi</i>		MNRJ	32041	female
<i>Myrmotherula snowi</i>		MNRJ	32042	female
<i>Myrmotherula snowi</i>		MNRJ	32040	male
<i>Myrmotherula sunensis</i>	<i>sunensis</i>	MCZ	138447	male
<i>Myrmotherula sunensis</i>	<i>sunensis</i>	ANSP	165066	male
<i>Myrmotherula sunensis</i>	<i>yessupi</i>	ANSP	92182	female
<i>Myrmotherula sunensis</i>	<i>yessupi</i>	ANSP	92174	male
<i>Myrmotherula sunensis</i>	<i>yessupi</i>	ANSP	92176	male
<i>Myrmotherula surinamensis</i>		MPEG	21105	female
<i>Myrmotherula surinamensis</i>		MPEG	21104	female
<i>Myrmotherula surinamensis</i>		MPEG	21102	female
<i>Myrmotherula surinamensis</i>		MPEG	20258	female

<i>Myrmotherula surinamensis</i>		MPEG	20262	female
<i>Myrmotherula surinamensis</i>		MZUSP	32115	male
<i>Myrmotherula surinamensis</i>		MZUSP	6779	male
<i>Myrmotherula surinamensis</i>		MZUSP	7829	male
<i>Myrmotherula surinamensis</i>		MPEG	47768	male
<i>Myrmotherula surinamensis</i>		MPEG	20264	male
<i>Myrmotherula unicolor</i>		MZUSP	91202	female
<i>Myrmotherula unicolor</i>		MZUSP	66953	female
<i>Myrmotherula unicolor</i>		MZUSP	66744	female
<i>Myrmotherula unicolor</i>		AMNH	314552	female
<i>Myrmotherula unicolor</i>		MZUSP	91204	male
<i>Myrmotherula unicolor</i>		MZUSP	100463	male
<i>Myrmotherula unicolor</i>		MZUSP	66746	male
<i>Myrmotherula unicolor</i>		MZUSP	47930	male
<i>Myrmotherula urosticta</i>		MZUSP	6437	female
<i>Myrmotherula urosticta</i>		MZUSP	34551	female
<i>Myrmotherula urosticta</i>		MZUSP	76217	female
<i>Myrmotherula urosticta</i>		AMNH	318147	female
<i>Myrmotherula urosticta</i>		AMNH	317567	female
<i>Myrmotherula urosticta</i>		MZUSP	76219	male
<i>Myrmotherula urosticta</i>		MZUSP	33388	male
<i>Myrmotherula urosticta</i>		MZUSP	10254	male
<i>Myrmotherula urosticta</i>		MCZ	76896	male
<i>Myrmotherula urosticta</i>		MCZ	273685	male
<i>Stymphalornis acutirostris</i>	<i>acutirostris</i>	MZUSP	78798	female
<i>Stymphalornis acutirostris</i>	<i>acutirostris</i>	MZUSP	78797	male
<i>Stymphalornis acutirostris</i>	<i>acutirostris</i>	MNRJ	42978	male
<i>Stymphalornis acutirostris</i>	<i>acutirostris</i>	MNRJ	42980	male
<i>Stymphalornis acutirostris</i>	<i>acutirostris</i>	MNRJ	42979	male
<i>Stymphalornis acutirostris</i>	<i>paludicola</i>	MZUSP	78793	female
<i>Stymphalornis acutirostris</i>	<i>paludicola</i>	MZUSP	78788	female
<i>Stymphalornis acutirostris</i>	<i>paludicola</i>	MZUSP	78794	male
<i>Stymphalornis acutirostris</i>	<i>paludicola</i>	MZUSP	78789	male
<i>Stymphalornis acutirostris</i>	<i>paludicola</i>	MZUSP	78787	male
<i>Terenura maculata</i>		MZUSP	43459	female
<i>Terenura maculata</i>		MZUSP	66962	female
<i>Terenura maculata</i>		MZUSP	31038	female
<i>Terenura maculata</i>		MNRJ	38465	female
<i>Terenura maculata</i>		AMNH	318151	female
<i>Terenura maculata</i>		MZUSP	66961	male
<i>Terenura maculata</i>		MZUSP	101636	male
<i>Terenura maculata</i>		MZUSP	101635	male
<i>Terenura maculata</i>		MNRJ	34376	male
<i>Terenura maculata</i>		AMNH	318505	male
<i>Terenura sicki</i>		MNRJ	34405	female
<i>Terenura sicki</i>		MNRJ	34407	female
<i>Terenura sicki</i>		MNRJ	34561	male
<i>Terenura sicki</i>		MNRJ	34406	male

Terenura sicki

MNRJ

34404

male
