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Diet of some Atlantic Forest birds

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RESUMO. **Dieta de algumas aves da Mata Atlântica.** Para muitas espécies de aves Neotropicais simplesmente inexistem dados relativos à sua dieta, uma informação fundamental para o estabelecimento de estratégias de conservação. Neste estudo são apresentados dados sobre a dieta de 88 espécies de aves da Mata Atlântica, sendo analisados 326 conteúdos estomacais obtidos através da regurgitação forçada por tártaro emético. Os insetos encontrados foram agrupados em ordens e os demais artrópodes em classes. As sementes foram classificadas em morfotipos, agrupadas em classes de tamanho e contadas. Os principais artrópodes ingeridos foram os Coleoptera e Formicidae. Já entre as sementes predominaram as compreendidas entre 0,1 e 1,5 mm. A publicação de novos e detalhados estudos sobre a dieta de aves Neotropicais é fortemente recomendada.
PALAVRAS-CHAVE**:** aves, dieta, Mata Atlântica, neotrópicos, tártaro emético.

ABSTRACT. The diet of many neotropical birds is unknown and these data are essential for the development of conservation strategies. Here we describe the diet of 88 Atlantic Forest bird species, from 326 individuals whose stomach contents were obtained by regurgitation by the use of tartar emetic. Stomach contents were examined in the laboratory under a stereomicroscope. Insects were grouped by Order and other arthropods by Class. Seeds were counted, measured, and identified to family level when possible. The main arthropods in the diet were Coleoptera and Hymenoptera (Formicidae). Seeds ingested were mostly small (< 1.5 mm). New diet studies for neotropical birds are strongly recommended.
KEY WORDS: birds, diet, Atlantic Forest, neotropical, tartar emetic.

The knowledge about the diet of Brazilian birds is exiguous. Even though such kind of data is essential for the understanding of a species' natural history and to the development of conservation strategies for it (Bartholomew 1986), long and descriptive diet studies are nowadays hardly ever published. Until quite recently, there were only three studies that examined in details the diet of a large number of Brazilian birds. Those studies were conducted by Moojen *et al*. (1941), Hempel (1949), and Schubart *et al*. (1965), forming the bases of our knowledge about the diet of Brazilian birds. More recently, Durães and Marini (2005) presented a detailed account about the diet of some Brazilian Atlantic Forest birds.

In the Neotropics, other important works are those of Marelli (1919), Aravena (1927, 1928), Zotta (1932, 1934, 1936, 1940) and Olrog (1956), who have examined the stomach contents of several birds from Argentina, many of then also occurring in Brazil. Studies conducted in Costa Rica (Sherry 1984) and Venezuela (Poulin *et al.* 1994a), should also be noted. Nevertheless, these studies, with the exception of those of Poulin *et al.* (1994a) and Durães and Marini (2005), were performed through specimens collected for museums, resulting in a lack of large samples for each species, turning difficult or even precluding broader conclusions.

Currently, what we observe in the literature is a large number of papers related to avian frugivory on one or a few tree species (e.g. Francisco and Galetti 2001, Valente 2001, Zimmermann 2001), occasional observations of some "curiosities" (e.g. Ghizoni Jr. *et al*. 2000, Andrade *et al*. 2001), diet description of one or a few species (e.g. Marini and Cavalcanti 1998, Gomes *et al.* 2001, Mallet-Rodrigues *et al.* 2001), or the stomach content analysis of birds collected for other purposes (e.g. Pacheco and Gonzaga 1995, Simon and Pacheco 1996). The result is that almost 40 years after the publication of the very important paper of Schubart *et al.* (1965), we had advanced very little on the comprehension of the diet of Brazilian birds. Believing that a detailed knowledge about a species' diet is essential for its conservation, we present stomach content data for 88 bird species from the southeast Brazilian Atlantic Forest.

STUDY AREAS AND METHODS

We sampled nine large Atlantic Forest fragments (more than 1000 ha) from the Minas Gerais State, southeastern Brazil (table 1). Some small fragments (less than 30 ha) nearby those large ones were also sampled. Birds were mist-netted and the stomach contents obtained through oral administration of a solution of potassium antimony tartrate (1.2%), in a dosage of 0.8 ml per 100 g body mass (Durães and Marini 2003). Birds captured during the first hour of the day did not received any treatment, being immediately

Table 1. Atlantic Forest fragments sampled. n = number of stomach contents sampled.

Study area	Municipality	Fragment size (ha)	Sampling date	n
RPPN Mata do Sossego	Simonésia	ca. 1,000	08/2000	32
Mata do Jambreiro	Nova Lima	ca. 1,000	10/2000, 07/2001	44
Reserva Biológica da Mata Escura	Jequitinhonha	ca. 50,000	09/2000, 11/2001	46
Parque Estadual da Serra do Brigadeiro	Ervália	13,200	09/2000, 12/2001	35
Parque Estadual do Rio Doce	Marliéria	35,973	02 and 05/2001	10
Grande Mata de São Bartolomeu	São Bartolomeu	ca. 4,000?	03/2001	05
Fazenda Santana	Salto da Divisa	1,100	06 and 10/2001	86
RPPN Feliciano Miguel Abdala	Caratinga	ca. 1,000	08 - 10/2001	61
Fazenda Pirapitinga	Canápolis	ca. 3,000	11/2001	07

released, avoiding the administration of the tartar emetic on individuals that had not enough time to feed. This simple procedure reduces significantly the risk of death caused by the tartar emetic (Durães and Marini 2003). We administered the tartar emetic to individuals captured until two hours before sunset, thus permitting that individuals had enough time to recover from capture and even feed before dusk.

After the administration of the tartar emetic, birds were settled in a carton box lined with absorbent paper and stayed there until they regurgitated or for a maximum period of 20 minutes. The occurrence of regurgitation could be easily verified through the increase in the level of activity of the bird, which suddenly became agitated. Stomach contents obtained were conserved in a 70% ethanol solution and examined in laboratory under a stereomicroscope.

Arthropods found were examined through well-illustrated textbooks in entomology as Peterson (1962), Borror *et al.* (1989), and CSIRO (1991). We also used for comparison arthropod fragments mounted on clear microscope slides, as well as a reference collection composed by arthropods conserved in alcohol as proposed by Rosenberg and Cooper (1990). In many occasions we were forced to consult experienced entomologists. Once identified, arthropod fragments were counted and grouped in orders (insects) or classes (other arthropods). The only exception was the Formicidae, which, because of its easiness of identification and its abundance in the diet of birds, were split in a separate Family. Larvae where also split from adult insects. We generally did not distinguish between adult insects and their nymphs. Each arthropod, seed, gastropod, or even vertebrate, was counted as being one food item.

The arthropods were normally encountered very fragmented in the stomach contents, what substantially difficult the precise count of the arthropods ingested. We counted the number of parts observed in the stomach content and estimated the minimum number of preys ingested. For example, three heads, two right elytra, and two posterior left wings of Coleoptera indicate the consumption of at least three adult beetles.

Due to the difficulty in determining if an insect egg found in a sample was preyed directly from the environment or ingested along with the adult insect (i.e. in its abdomen), we decided no to include such eggs in the total count of food items. Such a procedure was adopted after we verified that many of the insect eggs observed in the samples corresponded in morphology to that of adult insects observed in the stomach of the same bird. However, we must stress that bird predation upon insect eggs occurs in natural conditions, as demonstrated by the observation of insect eggs parasitized by microhymenopteran, a kind of parasitism that only occurs after oviposition (Borror *et al.* 1989).

Seeds were counted and grouped in morphotypes, because the small period of sampling in each area precluded the assemblage of a reference collection, fundamental to the identification of many plant species (Rosenberg and Cooper 1990).

RESULTS AND DISCUSSION

We examined 326 stomach contents from 88 bird species, identifying 4,970 food items. The results of these analyses are presented in the Appendix. Once we did not perform a rigid control of the regurgitation success during the initial stage of data collection, it was not possible to determine the efficiency of the methodology for all individuals treated. However, a control performed with 175 individuals revealed a regurgitation success of identifiable material of 60.5% and a mortality of 2.3%. The efficiency obtained with the methodology was very inferior to the 88% obtained by Poulin *et al.* (1994b), the 82% by Mallet-Rodrigues *et al.* (1997) and the 70% by Durães and Marini (2003). The mortality, however, was lower than the 10% obtained by Durães and Marini (2003), similar to the 2% obtained by Poulin *et al.* (1994b) and the 2.6% obtained by Mallet-Rodrigues (1997).

Three threatened species (Collar *et al.* 1992, IBAMA 2003) had their diet studied, one for the first time (*Rhopornis ardesiacus*) and two (*Dysithamnus plumbeus* and *Synallaxis cinerea*) had only anecdotal information available in the literature (Schubart *et al.* 1965, Collar *et al.* 1992, Pacheco and Gonzaga 1995). Six other species studied here (*Conopophaga lineata, Thamnophilus caerulescens, Xiphorhynchus fuscus, Automolus leucophthalmus, Sclerurus scansor,* and *Platyrinchus mystaceus*) have also one or more subspecies classified as threatened by IBAMA (2003).

Figure 1 provides us an idea about the proportion of each food item observed in the diet of Passerines. The high consumption of Formicidae and Coleoptera by birds is not surprisingly, being also reported in previous studies (Poulin *et*

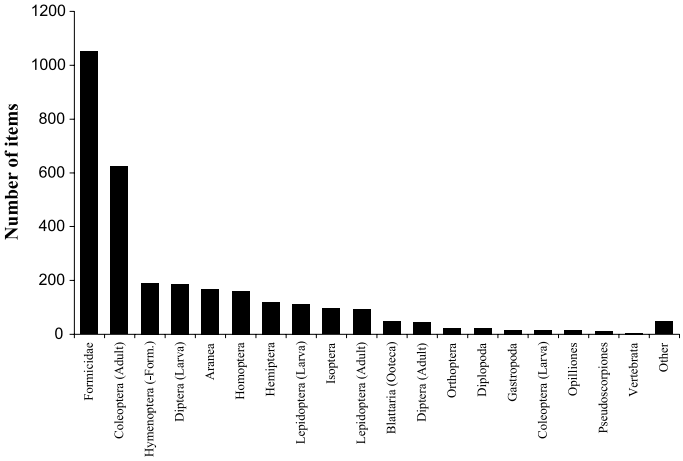

Figure 1. Total number of food items of each animal taxa found in 326 stomach contents of 88 birds species from the southeast Brazilian Atlantic Forest.

al. 1994a, Durães and Marini 2005). Probably the natural abundance of these groups, as well as their social habits, in the case of ants, contribute to its high consumption (Poulin and Lefebvre 1997, Durães and Marini 2005). Nevertheless, those proportions must be cautiously interpreted, because stomach content analysis is not bias free (Rosenberg and Cooper 1990 and references). For example, the hard elytra of the Coleoptera are poorly digestible and easily identifiable, which could result in an overestimation of its abundance (Durães and Marini 2005). The same is observed with scales from Lepidoptera wings, which could persist in the digestive tract of birds for a long period (Argel-de-Oliveira *et al.* 1998).

The methodology used in data collection did not permit controlling for seasonal variation in the diet of birds, what could result in an additional source of bias. A good example of such high seasonal variability was observed in Fazenda Santana, where we recorded a large consumption of Diptera larvae (Stratiomyidae) in June 2001 (especially by the Thamnophilidae *Rhopornis ardesiacus*) and of periodic cicadas (Cicadidae: Homoptera) and Lepidoptera larvae in November 2001 (Figure 2). In this occasion, an impressing abundance of cicadas and caterpillars were observed in the forest interior (A.M.F. pers. obs.).

The great number of Stratiomyidae larvae (Diptera) ingested by four *R. ardesiacus* specimens captured in June 2001 (40.7 ± 12.5 larvae per stomach) must be highlighted. The two specimens collected by Rômulo Ribon and Marcos Maldonado-Coelho in April 2000 (IBAMA, collection permit number 11392/99) that had their stomach contents analyzed here also ingested Stratiomyidae larvae, but in a small quantity (four and three larvae ingested). Formicidae and Coleoptera predominated in the diet of those individuals. The four individuals captured in November 2001 did not ingest any Stratiomyidae larvae, and their diet was more variable, containing, among others, Lepidoptera larvae and cicadas, two food items also observed in the diet of most species sampled in this area in November (Figure 2). The Stratiomyidae larvae also represented a very important component of the diet of *Myrmeciza ruficauda* during June 2001 (Marini *et al.* 2003) in the same area. This prey was found in a substantially small quantity in the diet of only three other bird species sampled during the same period: *Drymophila squamata*, *Conopophaga melanops* and *Xiphocolaptes albicollis.*

The forest fragment of Fazenda Santana present an understory extremely rich in terrestrial bromeliads (Ribon and Maldonado-Coelho 2001, pers. observ.), a microhabitat where *R. ardesiacus* is considered to be a specialist (Willis and Oniki 1981, Ribon and Maldonado-Coelho 2001). Since some species of Stratiomyidae reproduce in the water trapped in tank bromeliads (e.g. Laessle 1961), it seems reasonable to investigate the possibility that it is in that microenvironment where *R. ardesiacus* and *M. ruficauda* catches these larvae.

Although the Pipridae, Turdidae and Thraupidae represented only 21% of the samples analyzed, these three groups accounted for the consumption of 88% of the 1,912 seeds found. Given that seeds were often found intact in the stomach of those groups, what did not occurred for example with the Columbidae and the Emberizidae specimens examined here, we suggest that these groups can act as important seed dispersers in the Atlantic Forest.

The great majority of seeds observed were very small, with less than 1.5 mm length (Figure 3), and almost all of them belonged to the family Melastomataceae. Large seeds, such as those of Lauraceae (some of then with more than 15 mm length) were rarely found, being consumed only by Turdidae species. It is hard to ascertain if the species studied rarely ingests large seeds or if those seeds were ingested and promptly regurgitated, being so underestimated in the samples.

The tartar emetic proved to be an efficient method in sample gathering and safe to the birds, being an ethical and philosophical alternative to specimens' collection. On the other hand, stomach content analysis of specimens collected for museum preparations are strongly recommended, independently of the collection purpose. The publication of such studies should be encouraged, because this is the only way to supplant the large gap observed today in our knowledge about the diet of neotropical birds.

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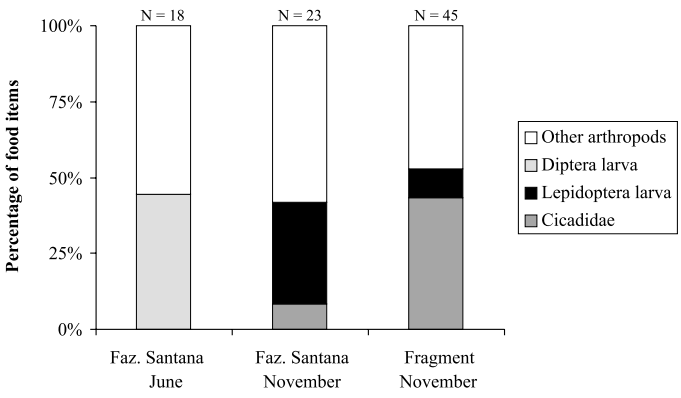

Figure 2. Observed differences in arthropod consumption by Passerine birds between dry (June) and wet (November) season in two adjacent sites of Atlantic Forest in southeast Brazil.

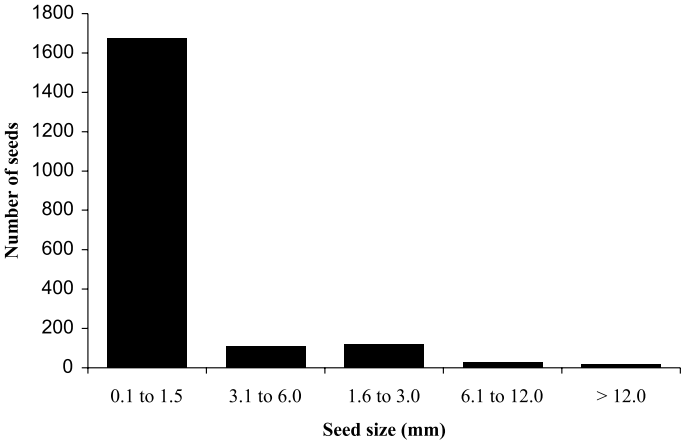

Figure 3. Total number of seeds by size class (mm) found in 326 stomach contents of birds from southeast Brazilian Atlantic Forest.

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APPENDIX

Food itens observed in 326 stomach contents of 88 species of Atlantic Forest birds. Taxonomy of species and families follows the Brazilian Ornithological Records Committee (CBRO 2005). For each sample analyzed we presented first the initials of the area where it was collected as follows: Reserva Particular do Patrimônio Natural Mata do Sossego (RPPNMS), Mata do Jambreiro (MJ), Reserva Biológica da Mata Escura (ME), Parque Estadual da Serra do Brigadeiro (PESB), Parque Estadual do Rio Doce (PERD), Grande Mata de São Bartolomeu (GMSB), Fazenda Santana (FS), Reserva Privada do Patrimônio Natural Feliciano Miguel Abdala (RPPNFMA), and Fazenda Pirapitinga (FP). The ^{f} indicates that the sample was collected in the small fragment adjacent to the main one. The name of each prey groups was abbreviated in the following way: Ephemeroptera (Eph.), Odonata (Odo.), Phasmida (Pha.), Orthoptera (Ort.), Mantodea (Man.), Blattaria (Bla.), Isopoda (Iso.), Dermaptera (Der.), Psocoptera (Pso.), Mallophaga (Mal.), Hemiptera (Hem.), Homoptera (Hom.), Neuroptera (Neu.), Coleoptera (Col.), Diptera (Dipt.), Trichoptera (Tri.), Lepidoptera (Lep.), Hymenoptera (Hym.), Formicidae (For.), Araneae (Ara.), Scorpiones (Sco.), Pseudoscorpiones (Pse.), Opilliones (Opi.), Acari (Aca.), Diplopoda (Dipl.), Chilopoda (Chi.), Gastropoda (Gas.). Unidentified arthropod fragments, although commonly observed, are only mentioned when no single arthropod group could be identified. By the same way, fruit pulp, is only mentioned when no single seed was found.

FAMILY COLUMBIDAE

***Leptotila rufaxilla* (Grey-fronted Dove)**

PERD^{f} = unident. veg. matter.

FAMILY CUCULIDAE

***Tapera naevia* (Striped Cuckoo)**

SD^{f} = Ort. 1, Man. 1, Hem. 2, Hom. 7.

FAMILY GALBULIDAE

***Galbula ruficauda* (Rufous-tailed Jacamar)**

SD = Pha. 1, Hem. 1, Lep. 1, Hym. 3, For. 1.

FAMILY BUCCONIDAE

***Malacoptila striata* (Crescent-chested Puffbird)**

RPPNFMA^{f} = Ort. 1, Hem. 1, Col. 3, Lep. larva 1.

***Nonnula rubecula* (Rusty-breasted Nunlet)**

FP = Hom. 1, Col. 2, Dipt. 1, For. 4, Ara. 2.

FAMILY PICIDAE

***Picumnus cirratus* (White-barred Piculet)**

MJ^{f} = For. 52, Ara. 1.

***Veniliornis maculifrons* (Yellow-eared Woodpecker)**

RPPNFMA = Col. larva 1, unident. insect larva 2.

***Veniliornis passerinus* (Little Woodpecker)**

FS^{f} = Col. larva 3.

FAMILY THAMNOPHILIDAE

***Drymophila ferruginea* (Ferruginous Antbird)**

ME = Col. 1, Hym. 1, For. 1.

ME = Col. 1, Lep. 1.

***Drymophila ochropyga* (Ochre-rumped Antbird)**

MJ = Hem. 1, Hom. 5, Col. 5, Lep. 1, For. 1, Ara. 2.

PESB^{f} = Bla. ootheca 1, Hem. 1, Col. 1, Lep. 1, Ara. 1.

RPPNMS = Ort. 2, Bla. 1, Hem. 3, Neu. larva 1, Col. 1, Lep. 1, Hym. 5, For. 4, Ara. 4.

***Drymophila squamata* (Scaled Antbird)**

RPPNFMA = Hem. 2, Col. 3, Dipt. 1, Hym. 4, For. 6, Ara. 1.

RPPNFMA = Der. 1, Hom. 1, Col. 2, Hym. 2, For. 11.

RPPNFMA = Col. 1, Hym. 2, For. 1, Ara. 1.

RPPNFMA = Hom. 1, Col. 1, Lep. 1, Hym. 1, For. 4, Ara. 1.

RPPNFMA = Lep. 1, Lep. larva 1, Hym. 2, For. 3, Ara. 2.

RPPNFMA = Bla. ootheca 1, Hom. 1, Col. 3, Lep. 1, Hym. 2, For. 1, Ara. 1.

RPPNFMA = Hem. 1, Col. 1, Hym. 1, Ara. 2.

SD = Dipt. larva 1, Lep. 1, For. 1, Ara. 1.

***Dysithamnus mentalis* (Plain Antvireo)**

SD = Col. 3, Lep. larva 1, Ara. 1.

***Dysithamnus plumbeus* (Plumbeous Antvireo)**

RPPNFMA = Ort. 1, Col. 3, Lep. 1, Lep. larva 1, Ara. 1.

RPPNFMA = Bla. ootheca 2, Hem. 2, Col. 3, Hym. 1, For. 3.

RPPNFMA = Col. 3, Lep. 1, For. 1, Ara. 1.

***Myrmeciza loricata* (White-bibbed Antbird)**

PESB = Odo. nymph 1, Ort. 3, Pso. 1, Hem. 2, Hom. 4, Col. 2, Dipt. 1, Lep. 2, Lep. larva 2, Lep. pupa 1, Hym. 3, Ara. 2.

PESB = Ort. 1, Hem. 1, Col. 6, Lep. 1, Hym. 3, For. 7, Ara. 1.

***Pyriglena leucoptera* (White-shouldered Fire-eye)**

ME = Hom. 2, Col. 2, Dipt. 5, Lep. 1, Hym. 5, For. 37, Ara. 1, Dipl. 1.

ME = Hom. 1, Col. 1, Hym. 1, For. 97, Opi. 1.

PESB^{f} = Hem. 1, Col. 2, Lep. 1, Hym. 1, For. 8, Ara. 1.

RPPNFMA^{f} = Hem. 2, Hym. 2, For. 1, Ara. 1.

RPPNFMA^{f} = Hom. 1, Col. 1, Hym. 5, For. 5, Ara. 1, Pse. 1.

RPPNFMA^{f} = Col. 4, Lep. 1, For. 1, Ara. 3.

RPPNFMA^{f} = Col. 1.

RPPNMS^{f} = Hom. 1, Col. 3, Hym. 3, For. 6.

SD = Hem. 1, Col. 2, Col. larva 1, For. 3.

SD = Col. 1, Ara. 3.

***Rhopornis ardesiacus* (Slender Antbird)**

SD = Ort. 1, Hem. 2, Col. 19, Dipt. larva 4, Lep. 1, Lep. larva 1, For. 22, Ara. 2, Chi. 1.

SD = Col. 2, Col. larva 1, Dipt. larva 3, For. 51, Opi. 1, Dipl. 1.

SD = Hem. 1, Col. 5, Col. larva 1, Dipt. larva 49, Lep. 1, For. 5, Ara. 2, Dipl. 1.

SD = Col. 13, Col. larva 1, Dipt. larva 53, For. 4, Ara. 1,Opi. 1, Dipl. 1, Gas. 1.

SD = Hem. 4, Col. 15, Dipt. larva 35, Lep. 1, Hym. 1, For. 8, Ara. 1, Pse. 1, Gas. 2

SD = Hem. 2, Col. 3, Dipt. larva 26, Hym. 1, For. 12, Dipl.

1, Chi. 1, Gas. 1.
SD = Col. 4, Lep. larva 9, For. 3, Opi. 1.
SD[f] = Hom. 3, Lep. 1, Lep. larva 6, Ara. 1.
SD[f] = Hem. 1, Hom. 1, Ara. 1.
SD[f] = Col. 1, Lep. larva 1, Hym. 1, Ara. 1.

***Thamnophilus ambiguus* (Sooretama Slaty-Antshrike)**
PERD[f] = Ort. 1, Hem. 2, Col. 2, Ara. 2.
PERD[f] = Pha. 1, Iso. 7, Hem. 1, Col. 2, Ara. 1.
PERD[f] = Col. 1, Hym. 1, Ara. 1.
RPPNFMA = Ort. 1, Hem. 1, Col. 4, Lep. 1, Lep. larva 3, For. 4, Ara. 2.
RPPNFMA = Hem. 7, Col. 1, Hym. 1, For. 3.

***Thamnophilus caerulescens* (Variable Antshrike)**
MJ = Bla. ootheca 1, Hem. 1, Col. 1.
MJ = Bla. ootheca 1, Hom. 1, Col. 3, Dipt. 1, Lep. 1, Hym. 1, For. 1.
MJ[f] = Col. 1, For. 22.
MJ[f] = Hem. 1, Hym. 2, For. 4, Ara. 1.
ME = Col. 1, Lep. 1, Hym. 7.
PESB = Col. 6, Lep. 1, Hym. 1.
PESB[f] = Col. 1, Lep. 1, Hym. 3, seed (3.5 mm) 6.

***Thamnophilus pelzelni* (Planalto Slaty-Antshrike)**
FP = Hem. 1, Col. 8, For. 1.
ME[f] = Hym. 1, Ara. 1.
ME[f] = Eph. 1, Odo. 1, Hem. 2, Col. 1, Lep. 1, Lep. larva 1, Hym. 1, Ara. 1.
ME[f] = Bla. ootheca 1, Hom. 1, Col. 1, Hym. 1, For. 2, Ara. 1.
ME[f] = Col. 1, Lep. 1, Hym. 1.
SD = Col. 2, Dipl. 1.
SD = Bla. ootheca 1, oot. Man. 1, Man. 1, Hem. 1, Col. 2, Lep. 1, For. 1, *Solanum* sp. seed (3.2 mm) 1.
SD = Bla. ootheca 1, Hem. 3, Col. 2, Lep. 1, For. 2.
SD = Bla. ootheca 1, For. 3, Dipl. 1.
SD = Col. 1.
SD = Ort. 1, Col. 1, Dipt. 1, Dipl. 1
SD = Col. 1, Gas. 1.
SD = Col. 1, Lep. larva 5, Ara. 1, Dipl. 1, Gas. 1.
SD = Col. 2.
SD = Iso. 1, Hom. 1, Col. 1, Lep. larva 3.
SD = Col. 1, Lep. larva 1.
SD[f] = Hom. 1, Lep. 1, Lep. larva 1, Dipl. 1.
SD[f] = Hom. 2, Col. 1.
SD[f] = Col. 1.

FAMILY CONOPOPHAGIDAE

***Conopophaga lineata* (Rufous Gnateater)**
GMSB = Hem. 1, Col. 2, Lep. 1, Ara. 1.
ME = Col. 1, For. 20, Ara. 1.
MJ = Neu. larva 1, Col. 7, Lep. 1, Lep. larva 1, For. 19, Ara. 1.
MJ = Col. 2, Lep. 1, For. 12, Ara. 1, Pse. 1.
MJ[f] = Col. 1, For. 11.
MJ[f] = Hem. 1, Col. 1, Hym. 1, For. 27.
MJ[f] = Col. 1, For. 15.
MJ[f] = For. 11, seed (4 mm) 2.
MJ[f] = Col. 3, Col. larva 1, For. 30, Ara. 2, Sco. 1, Opi. 1.
MJ[f] = Hem. 1, Col. 2, Hym. 1, For. 22, Ara. 1.
MJ[f] = Hem. 1, Col. 1, For. 42, Ara. 1.
MJ[f] = For. 11, Ara. 1.
MJ[f] = Hem. 1, Col. 1, For. 18, Pse. 2.
PESB = Col. 2, For. 2.
PESB[f] = Col. 2, For. 8.
PESB[f] = Col. 1, For. 1.
PESB[f] = Col. 1, For. 8.
PESB[f] = Col. 2, Hym. 2, For. 1, seed (1.2 mm) 4, seed (3.5 mm) 12.
PESB[f] = Col. 4, Lep. 2, Lep. larva 1, For. 11, Ara. 2, Aca. 1, Dipl. 1.
RPPNFMA[f] = Col. 3, Hym. 2, For. 5.
RPPNMS[f] = Bla. ootheca 3, Hem. 2, Col. 1, For. 1, Ara. 2.
RPPNMS[f] = Hem. 3, Col. 3, Col. larva 1, Dipt. 1, Tri. 1, Lep. 1, Hym. 1, For. 20, Ara. 2.

***Conopophaga melanops* (Black-cheeked Gnateater)**
FS = Hem. 1, Col. 4, Dipt. larva 5, Lep. 1, Hym. 17, For. 32, Opi. 1, Dipl. 1.
FS = Col. 3, Lep. larva 1, Hym. 3.

FAMILY SCLERURIDAE

***Sclerurus scansor* (Rufous-breasted Leaftosser)**
ME = Ara. 1.

FAMILY DENDROCOLAPTIDAE

***Campylorhamphus falcularius* (Black-billed Scythebill)**
ME = Ort. 1, Hem. 1, Col. 2, For. 5, Ara. 1, Sco. 1, Dipl. 1.

***Dendrocincla turdina* (Thrush-like Woodcreeper)**
ME = Lep. 1, Hym. 1.
PERD = Col. 1, Hym 3, Ara. 1, Opi. 1.
RPPNFMA = Col. larva 1, Dipt. 1, Lep. 1, Hym. 2, Ara. 3.

***Lepidocolaptes squamatus* (Scaled Woodcreeper)**
RPPNFMA[f] = Col. 3, For. 10.
RPPNFMA[f] = Col. 6, Lep. 1, For. 3.

***Sittasomus griseicapillus* (Olivaceous Woodcreeper)**
GMSB = Bla. ootheca 4, Hem. 4, Col. 6, Lep. 1, Lep. larva 1, Hym. 2, For. 3, Ara. 1.
MJ = Col. 6, Lep. 1.
MJ = Hem. 2, Col. 2, Hym. 1.
SD = Bla. ootheca 3, Hem. 2, Col. 16, Lep. 1, Pse. 4.
SD = Hom. 1, Col. 1, Lep. 1, Lep. larva 2, For. 1, Ara. 1.

***Xiphocolaptes albicollis* (White-throated Woodcreeper)**
MJ = Arthrop. frags.
SD = Col. 2, Dipt. larva 6, Dipl. 1, unident. bones (Lacertilia?).

***Xiphorhynchus fuscus* (Lesser Woodcreeper)**
ME[f] = Hem. 1, Hom. 1, Col. 3. Dipt. larva 1, Lep. larva 2, Ara. 5, Dipl. 1
SD = Col. 2, Lep. larva 6, Ara. 1, Dipl. 1.
SD = Bla. ootheca 1, Hem. 1, Hom. 1, Col. 3, Pse. 1, Chi. 1.
SD = Col. 2, Lep. larva 2, Ara. 1, Pse. 1, Dipl. 2.
SD = Bla. ootheca 1, Col. 1, Ara. 1, Dipl. 1, Chi. 1.

FAMILY FURNARIIDAE

***Anabazenops fuscus* (White-collared Foliage-gleaner)**
ME = Hom. 1, Hym. 1, Ara. 1.
ME = Hom. 1, Col. 1, Lep. 1, Hym 1, For. 10, Ara. 3, Dipl. 1.
RPPNFMA[f] = Col. 3.
RPPNFMA[f] = Col. 6, Lep. 1, For. 2, Ara. 1.
RPPNFMA[f] = Col. 5, Ara. 1
RPPNFMA[f] = Bla. ootheca 1, Col. 3, Lep. larva 1, For. 40.
RPPNFMA[f] = Hem. 1, Col. 3, Ara. 1.
RPPNMS = Ort. 4, Iso, 7, Hem. 2, Col. 1, Dipt. larva 1, For. 1, Ara. 3, Opi. 3.
RPPNMS = Hem. 3, Hym. 1.

***Automolus leucophthalmus* (White-eyed Foliage-gleaner)**
ME = Col. 1, Lep. 1.
PERD = Lep. larva 1, For. 1.

***Furnarius leucopus* (Pale-legged Hornero)**
ME[f] = Hem. 2, Col. larva 1, Lep. 1, Ara. 5, seed (1 mm) 1.

SD[f] = Hom. 1, Col. 3, Lep. larva 1, For. 2, Opi. 1.
SD[f] = Col. 11, For. 2.
***Lochmias nematura* (Sharp-tailed Streamcreeper)**
MJ[f] = Col. 3, Col. larva 1, Dipt. 3, Lep. 1, Lep. larva 1, For. 7, Ara. 1, Anura 1.
RPPNMS = Bla. ootheca 2, Hem. 1, Col. 4, Dipt. larva 2, For. 1, Pse. 1, Gas. 2.
RPPNMS[f] = Hem. 1, Col. 31, For. 1, seed (2.2 mm) 3.
***Philydor lichtensteini* (Ochre-breasted Foliage-gleaner)**
ME = Mal. 8, Hem. 1, Col. 3, For. 9, Ara. 1.
***Philydor rufum* (Buff-fronted Foliage-gleaner)**
MJ = Hem. 1, Col. 3, Lep. larva 2, Hym. 1, Ara. 1.
MJ = Bla. ootheca 1, Hem. 2, Hom. 1, Col. 4, Lep. 1, Ara. 1.
PESB = Col. 5.
***Synallaxis cinerea* (Bahia Spinetail)**
ME = Bla. ootheca 2, Hem. 1, Col. 4, Hym. 1, For. 1, Ara. 1, unident. insect pupa 1.
***Synallaxis frontalis* (Sooty-fronted Spinetail)**
SD[f] = Hom. 1, Col. 3, Lep. 1, Lep. larva 2.
SD[f] = Col. 3.
SD[f] = Arthrop. frags.
SD[f] = Man. 1, Hom. 3, Col. 2, Lep. larva 2, Ara. 1.
***Synallaxis ruficapilla* (Rufous-capped Spinetail)**
PESB = Bla. ootheca 1, Col. 5, Hym. 1, For. 16.
RPPNFMA[f] = Col. 4, For. 2,
RPPNMS[f] = Hem. 1, Col. 7, Lep. 1, Lep. larva 1, Hym. 1, For. 5, Ara. 2, unident. insect pupa 1, seed (2 mm) 1.
***Synallaxis spixi* (Spix's Spinetail)**
RPPNFMA[f] = Bla. ootheca 1, Hem. 1, Col. 5, Dipl. 1.
RPPNFMA[f] = Ort. 1, Bla. ootheca 1, Bla. 1, Hem. 1, Col. 2, Ara. 1, Gas. 1.
***Syndactyla rufosuperciliata* (Buff-browed Foliage-gleaner)**
MJ = Col. 1, For. 8, Ara. 4, Aca. 6.
MJ[f] = For. 35, Ara. 1.
MJ[f] = Col. 1, For. 3.
FAMILY TYRANNIDAE
***Attila rufus* (Grey-hooded Attila)**
PESB = Hem. 1, Anura 1.
RPPNMS = Col. 1, Lep. 1, Anura 1.
***Casiornis fuscus* (Ash-throated Casiornis)**
ME[f] = Col. 1, Lep. 1.
ME[f] = Hom. 3, Col. 1, Dipt. 1, Lep. 1, Hym. 1.
SD[f] = Hom. 1, Col. 1, Ara. 1, Gas. 1.
SD[f] = Hom. 3.
***Cnemotriccus fuscatus* (Fuscous Flycatcher)**
ME[f] = Col. 4, Lep. larva 7, For. 1.
***Corythopis delalandi* (Southern Antpipit)**
FP = Bla. 1, Pso. 1, Hem. 1, Hom. 3, Col. 12, Dipt. 5, Lep. larva 4, Hym 1, Ara. 6.
GMSB = Hem. 5, Hom. 1, Col. 2, Hym. 1, Ara. 1.
***Lathrotriccus euleri* (Euler's Flycatcher)**
GMSB = Hem. 1, Col. 4, Hym. 1, For. 1.
PESB[f] = Col. 10.
SD = For. 1.
SD = Hom. 2, Col. 2, Dipt. 1, Dipl. 1.
SD = Hem. 2, Col. 1, Dipt. 6, Lep. 1, Hym. 1.
SD = Col. 2, Lep. 1, Hym. 1, For. 5.
***Leptopogon amaurocephalus* (Sepia-capped Flycatcher)**
ME = Col. 1, Ara. 1.
RPPNFMA = Hem. 1, Col. 1, Ara. 1.
RPPNFMA = Hem. 1, Ara. 1.
RPPNFMA = Lep. 1, Ara. 1.
RPPNFMA = Ara. 2.
RPPNFMA[f] = Col. 1.
RPPNMS[f] = Bla. ootheca 2.
SD = Ara. 1.
SD = Hom. 1, Lep. larva 1.
SD = Hom. 1.
***Mionectes rufiventris* (Grey-hooded Flycatcher)**
MJ = Ara. 1.
RPPNMS = Ara. 1, fruit pulp.
RPPNMS = fruit pulp.
***Myiarchus ferox* (Short-crested Flycatcher)**
PESB[f] = Lep. 1.
RPPNFMA[f] = Hem. 1, Hom. 1, Col. 1, Hym. 1.
***Myiarchus swainsoni* (Swainson's Flycatcher)**
RPPNFMA[f] = Odo. 2, Col. 1, Dipt. 4, seed (8 mm) 2.
***Myiarchus tuberculifer* (Dusky-capped Flycatcher)**
SD[f] = Hom. 2, Col. 2.
SD[f] = Hom. 1.
***Myiarchus tyrannulus* (Brown-crested Flycatcher)**
SD = Hom. 3, Lep. larva 4, Ara. 1.
SD = Hom. 1.
SD[f] = Lep. 1, For. 2.
SD[f] = Hom. 4, Col. 1, Lep. 1.
SD[f] = Hom. 1, Col. 2.
***Myiodynastes maculatus* (Streaked Flycatcher)**
PESB[f] = Hem. 6, Col. 4, For. 12.
***Myiopagis caniceps* (Grey Elaenia)**
RPPNFMA = Hom. 1, Col. 3, Hym. 1.
RPPNFMA = Col. 3.
***Myiopagis viridicata* (Greenish Elaenia)**
ME[f] = Lep. larva 3.
***Myiozetetes similis* (Social Flycatcher)**
PERD = Melastomataceae seed (0.7mm) 34, seed (2 mm) 36.
***Pitangus sulphuratus* (Great Kiskadee)**
RPPNMS[f] = Hym. 1, banana pulp.
SD[f] = Hom. 1.
SD[f] = Hom. 12.
SD[f] = Hom. 9.
***Platyrinchus mystaceus* (White-throated Spadebill)**
MJ[f] = Ara. 1.
PESB[f] = Col. 3, Hym. 1, For. 1, Ara. 1.
RPPNFMA[f] = Lep. 1.
RPPNMS[f] = Hem. 2, Lep. 1, Hym 1.
***Tolmomyias flaviventris* (Yellow-breasted Flycatcher)**
ME[f] = Bla. ootheca 12, Pha. 1, Col. 2, Lep. 1, Hym. 1.
ME[f] = Col. 6, For. 1.
SD[f] = Hom. 1, Col. 1.
SD[f] = Hom. 1, Col. 3, Dipt. 1.
SD[f] = Hom. 1, Col. 2, Dipl. 1.
SD[f] = Hom. 1, Col. 2, Hym. 1.
SD[f] = Hom. 2, Col. 3.
SD[f] = Col. 2, Hym. 1, For. 2.
***Tolmomyias sulphurescens* (Yellow-olive Flycatcher)**
FP = Hem. 1, Hom. 1, Col. 6, For. 1.
MJ = Lep. larva 3.
MJ[f] = For. 3.
RPPNFMA[f] = Col. 1.
RPPNFMA[f] = Col. 4, Lep. 1.
***Tyrannus melancholicus* (Tropical Kingbird)**
SD[f] = Hom. 12, Col. 3, Hym. 2.

FAMILY PIPRIDAE
***Antilophia galeata* (Helmeted Manakin)**
MJ = seed (3.5 mm) 1.
***Chiroxiphia caudata* (Swallow-tailed Manakin)**
ME = Ara. 1, seed (3 mm) 1.
RPPNMS = Melastomataceae seed (1 mm) 125, seed (1.2 mm) 3, seed (3.5 mm) 1.
***Manacus manacus* (White-bearded Manakin)**
PERD^{f} = seed (6 mm) 2.
RPPNFMA = Lep. larva 1, Melastomataceae seed (1 mm) 3, seed (7.5mm) 3.
RRPNMS^{f} = Hem. 1, Col. 3, Lep. 1, For. 4, Ara. 1.
FAMILY TITYRIDAE
***Pachyramphus polychopterus* (White-winged Becard)**
ME^{f} = Hom. 3, Lep. larva 13.
ME^{f} = Lep. larva 1.
SD^{f} = Hom. 1, Lep. larva 1.
SD^{f} = Hom. 2, Lep. larva 1.
SD^{f} = Hom. 2.
SD^{f} = Hom. 1.
SD^{f} = Hom. 2.
SD^{f} = Ort. 1, Hom. 2.
SD^{f} = Hom. 1, Lep. larva 3, Gas. 2.
***Schiffornis virescens* (Greenish Manakin)**
ME = Lep. 1, Lep. larva 2, seed (2.5 mm) 9.
FAMILY VIREONIDAE
***Cyclarhis gujanensis* (Rufous-browed Peppershrike)**
MJ = Ara. 1.
MJ^{f} = Col. 1, Col. larva 1, Lep. larva 2, Hym. 10.
***Hylophilus amaurocephalus* (Grey-eyed Greenlet)**
PESB^{f} = Hem. 1.
RPPNFMA^{f} = Col. 2, Ara. 3, fruit pulp.
FAMILY TROGLODYTIDAE
***Thryothorus genibarbis* (Moustached Wren)**
RPPNFMA = Bla. ootheca 1, Col. 1, Lep. 1, For. 2, Ara. 1.
SD^{f} = Col. 2, Lep. 1.
SD^{f} = Hom. 1, Ara. 1.
SD^{f} = Hom. 3, Col. 1.
***Troglodytes musculus* (House Wren)**
RPPNMS^{f} = Col. 1, Hym. 1.
SD^{f} = Hom. 1, Col. 1.
FAMILY TURDIDAE
***Turdus albicollis* (White-necked Thrush)**
PESB^{f} = Col. 1, seed (0.8 mm) 17, seed (1.2 mm) 4, seed (1.5mm) 6, seed (4.5 mm) 7.
PESB^{f} = Ort. 1.
***Turdus amaurochalinus* (Creamy-bellied Thrush)**
ME^{f} = Col. 5, Opi. 1, Gas. 1.
ME^{f} = Iso. 9, Col. 1, Lep. 1, For. 4, Opi. 2.
SD^{f} = Col. 1, For. 2.
***Turdus leucomelas* (Pale-breasted Thrush)**
ME^{f} = Iso. 24.
ME^{f} = Bla. 1, Iso. 6, Mal. 1, fruit pulp.
ME^{f} = Iso. 11, Col. larva 1, Opi. 1, seed (1 mm) 1, seed (5 mm) 1, chewing gum! 1.
ME^{f} = Col. 1, Lep. 1, Hym. 1, seed (3.5) 7.
ME^{f} = For. 2 Ara. 2, Gas. 2.
PESB^{f} = Dipt. 1, seed (8 mm) 2.
RPPNFMA^{f} = Col. 8, Lauraceae seed (15.6 mm) 1.
RPPNFMA^{f} = Col. 2, Col. larva 1, fruit pulp.
RPPNFMA^{f} = Arthrop. frags., Lauraceae seed (15.6 mm) 1.
***Turdus rufiventris* (Rufous-bellied Thrush)**
ME = For. 2, Melastomataceae seed (1.1 mm) 97.
MJ^{f} = Col. 1, fruit pulp.
RPPNFMA^{f} = Lauraceae pulp.
RPPNMS^{f} = unident. insect larva 1, Melastomataceae seed (1 mm) 225.
FAMILY THRAUPIDAE
***Habia rubica* (Red-crowned Ant-Tanager)**
PERD = Col. 1, Gas. 1, fruit pulp.
PESB = Col. 1, Melastomataceae seed (1mm) 192.
***Nemosia pileata* (Hooded Tanager)**
SD^{f} = Hom. 1, Col. 3, Lep. larva 2.
SD^{f} = Bla. ootheca 1, Hom. 5, Col. 1.
***Tachyphonus coronatus* (Ruby-crowned Tanager)**
GMSB = Ara. 1, seed (2 mm) 7.
MJ = Hym. 1, For. 1, seed (4 mm) 1.
MJ = Col. 1, For. 1, Melastomataceae seed (1 mm) 12.
PESB^{f} = seed (1 mm) 35, seed (3.5 mm) 1.
PESB^{f} = *Cecropia hololeuca* seed (4.5 mm) 22.
RPPNFMA^{f} = Col. 2, Hym. 1, seed (1.2 mm) 7.
RPPNMS^{f} = Hym. 1, banana pulp.
RPPNMS^{f} = Iso. 23, Melastomataceae seed (1 mm) 481.
***Tangara cayana* (Burnished-buff Tanager)**
MJ^{f} = Lep. 1, Hym. 4.
RPPNFMA^{f} = Arthrop. frags., seed (1.2 mm) 9, *Cecropia glaziovii* seed (2 mm) 4.
***Tangara desmaresti* (Brassy-breasted Tanager)**
RPPNMS = Arthrop. frags., Melastomataceae seed (1 mm) 117.
***Thraupis sayaca* (Sayaca Tanager)**
RPPNMS^{f} = Hym. 2, Ara. 1, seed (2.2 mm) 1, banana pulp.
RPPNMS^{f} = Hym. 1, Melastomataceae seed (1.2 mm) 36, banana pulp.
RPPNMS^{f} = Banana pulp.
RPPNMS^{f} = Hym. 1, banana pulp.
***Trichothraupis melanops* (Black-goggled Tanager)**
ME = Col. 1, Hym. 1, For. 6, Melastomataceae seed (1 mm) 81.
ME = Lep. 1, Hym. 5, Melastomataceae seed (1 mm) 23.
ME = Bla. ootheca 1, Hom. 1, Col. 2, Lep. 1, Hym. 2, Ara. 1, seed (4.5 mm) 1.
MJ^{f} = Col. 1, Hym. 2, Ara. 1, Sco. 1.
MJ^{f} = Hym. 2, seed (2.8 mm) 8.
MJ^{f} = Arthrop. frags., seed (4 mm) 9.
PESB = Hom. 2.
PESB^{f} = Col. 1, Lep. 1, Hym. 1, seed (3.5 mm) 2.
PESB^{f} = Col. 3, Lep. 1, seed (1.5 mm) 3, seed (3.5 mm) 12.
PESB^{f} = Col. 6, Lep. 1, Hym. 1.
PESB^{f} = Hem. 1, Col. 1.
PESB^{f} = Hom. 2, Col. 1, Dipt. 2, Lep. 1, For. 1.
RPPNFMA = Hym. 5, For. 1.
RPPNFMA^{f} = Col. 1, seed (2 mm) 3.
RPPNFMA^{f} = Arthrop. frags., seed (2 mm) 8.
RPPNFMA^{f} = Col. 1.
RPPNFMA^{f} = Col. 1.
RPPNFMA^{f} = Col. 3, Hym. 1.
RPPNFMA^{f} = Col. 3, Hym. 1, Gas. 1.
RPPNMS = Arthrop. frags., Melastomataceae seed (1 mm) 12, seed (4 mm) 3.
RPPNMS = Hom. 1, Col. 1, Hym. 1, seed (3 mm) 15.
RPPNMS^{f} = Col. 1, Hym. 1, Melastomataceae seed (1 mm) 61, seed (1.5 mm) 2, seed (2 mm) 1.

RPPNMS[f] = Arthrop. frags., seed (5.5 mm) 2.
FAMILY EMBERIZIDAE
***Coryphospingus pileatus* (Grey Pileated-Finch)**
ME[f] = Arthrop. frags., dry seed (1.5 mm) 4.
ME[f] = Hom. 1, Col. 1, For. 1, dry seed (1.8 mm) 15.
***Haplospiza unicolor* (Uniform Finch)**
PESB[f] = For. 2.
PESB[f] = For. 1, dry seed frags.
FAMILY CARDINALIDAE
***Saltator maximus* (Buff-throated Saltator)**
PERD[f] = Arthrop. frags.
***Saltator similis* (Green-winged Saltator)**
RPPNMS[f] = Col. 1, Melastomataceae seed (1 mm) 7.
FAMILY PARULIDAE
***Basileuterus culicivorus* (Golden-crowed Warbler)**
ME = Bla. ootheca 1, Hem. 1, Col. 5, Lep. 1, Hym. 2, For. 2.
PESB[f] = Bla. ootheca 1, Col. 3.
RPPNFMA = Col. 1, Hym. 3, Ara. 2.
RPPNFMA[f] = Hom. 1, Col. 5, Lep. 1, Ara. 1.
RPPNFMA[f] = Hem. 1, Col. 7, Hym. 1.
RPPNMS = Col. 6, Hym. 3, For. 1, Ara. 1.
***Basileuterus hypoleucus* (White-bellied Warbler)**
MJ[f] = Hem. 1, Col. 4, Hym. 1, For. 9.
***Basileuterus flaveolus* (Flavescent Warbler)**
FP = Ort. 3, Hem. 1, Hom. 5, Col. 3, Dipt. 5, Lep. 9, Hym. 1, For. 1, Ara. 9.
FP = Iso. 8, Hom. 1, Dipt. 2, Lep. 1, Ara. 1.
FP[f] = Hom. 1, Col. 1, Lep. 1.
ME[f] = Col. 1, Lep. 1, Hym. 2, For. 4, Ara. 1.
***Basileuterus leucoblepharus* (White-rimmed Warbler)**
MJ[f] = Col. 6, Hym. 2, For. 26.
MJ[f] = Col. 5, For. 45.
FAMILY FRINGILLIDAE
***Euphonia pectoralis* (Chestnut-bellied Euphonia)**
MJ = Hym. 1, For. 1, Melastomataceae seed (1 mm) 62, seed (1 mm) 9, seed (2.5 mm) 8, seed (4 mm) 15, seed (5 mm) 1.