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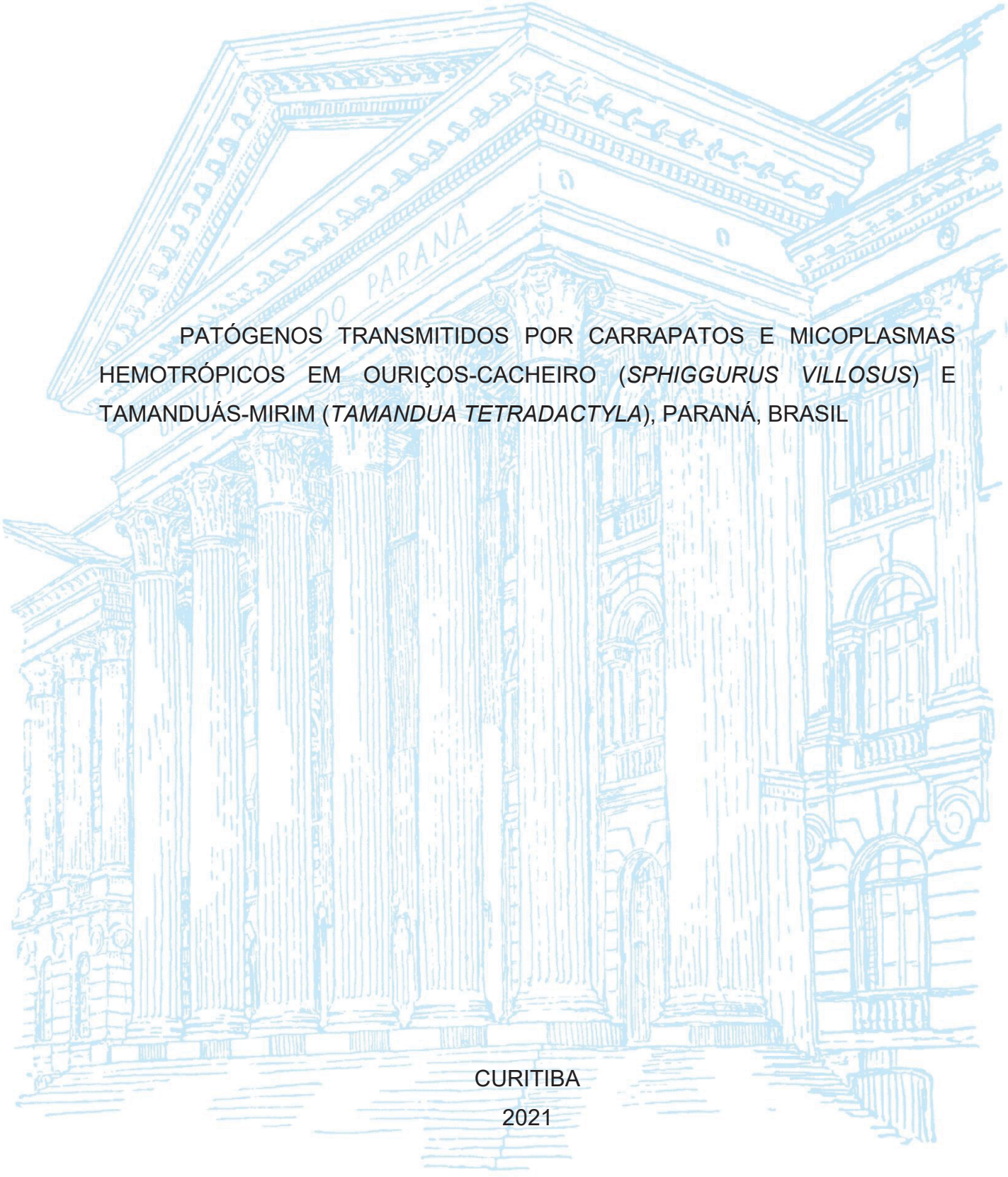
JESSICA DAMIANA MARINHO VALENTE



PATÓGENOS TRANSMITIDOS POR CARRAPATOS E MICOPLASMAS HEMOTRÓPICOS EM OURIÇOS-CACHEIRO (*SPHIGGURUS VILLOSUS*) E TAMANDUÁS-MIRIM (*TAMANDUA TETRADACTYLA*), PARANÁ, BRASIL

CURITIBA

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Tese apresentada ao Programa de Pós-Graduação em Ciências Veterinárias, Setor de Ciências Agrárias, Universidade Federal do Paraná, como requisito parcial à obtenção do título de Doutor em Ciências Veterinárias.

Orientador: Prof. Dr. Rafael Felipe da Costa Vieira

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TERMO DE APROVAÇÃO

Os membros da Banca Examinadora designada pelo Colegiado do Programa de Pós-Graduação em CIÊNCIAS VETERINÁRIAS da Universidade Federal do Paraná foram convocados para realizar a arguição da tese de Doutorado de **JESSICA DAMIANA MARINHO VALENTE** intitulada: **Patógenos transmitidos por carrapatos e micoplasmas hemotrópicos em ouriços-cacheiro (*Sphiggurus villosus*) e tamanduás-mirim (*Tamandua tetradactyla*), Paraná, Brasil.**, sob orientação do Prof. Dr. RAFAEL FELIPE DA COSTA VIEIRA, que após terem inquirido a aluna e realizada a avaliação do trabalho, são de parecer pela sua APROVAÇÃO no rito de defesa.

A outorga do título de doutor está sujeita à homologação pelo colegiado, ao atendimento de todas as indicações e correções solicitadas pela banca e ao pleno atendimento das demandas regimentais do Programa de Pós-Graduação.

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Dedico esse trabalho à parceira de trabalho e amiga Kelly (*in memoriam*).

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RESUMO

Os animais silvestres podem desempenhar um papel importante na propagação de carrapatos e patógenos de doenças transmitidas por carrapatos. No Brasil, ouriços-cacheiro (*Sphiggurus villosus*) e tamanduás-mirim (*Tamandua tetradactyla*) são amplamente distribuídos no bioma Mata Atlântica, e estão entre os animais mais atingidos e mortos em acidentes nas estradas. O objetivo deste estudo foi pesquisar ouriços-cacheiro e tamanduás-mirim de vida livre do Estado do Paraná, sul do Brasil, para infecção por micoplasmas hemotrópicos, *Anaplasma/Ehrlichia* spp. e piroplasmas. Amostras de sangue e/ou baço foram coletadas de nove ouriços-cacheiro e quatro tamanduás-mirim atendidos no Hospital Veterinário da Universidade Federal do Paraná, Estado do Paraná, sul do Brasil. Foi realizada pesquisa de ectoparasitas nos animais. O DNA das amostras de sangue e baço foi extraído e testados por PCR para os genes 16S rRNA/23S rRNA de hemoplasmas, gene 16S rRNA de *Anaplasma/Ehrlichia* spp. e gene 18S rRNA de piroplasmas. Ao todo, 275 carrapatos (34 machos, 11 fêmeas, 7 ninfas e 223 larvas) foram coletados de oito ouriços-cacheiro: *Amblyomma longirostre, Amblyomma parkeri* e *Amblyomma* spp. larvas. Dois dos quatro tamanduás estavam infestados por carrapatos *A. calcaratum* (quatro machos e duas fêmeas). Dois dos nove ouriços-cacheiro foram PCR-positivos para hemoplasmas. Uma das quatro amostras de tamanduá-mirim testou positivo para *Anaplasma/Ehrlichia* spp. por PCR. Todos os animais apresentaram resultados negativos para piroplasmas. A análise filogenética dos genes 16S e 23S rRNA confirmou que os ouriços-cacheiro foram infectados por um potencial novo *Mycoplasma* sp. hemotrópico. O nome '*Candidatus* Mycoplasma haemosphiggurus' é proposto para esse novo organismo, que deve ser totalmente caracterizado. Análise filogenética do gene 16S rRNA mostrou que a sequência de *Anaplasma* spp. de tamanduá posicionada próxima às sequências de *Anaplasma* spp. de tamanduás de São Paulo, Brasil. Pesquisas envolvendo animais silvestres, principalmente os atropelados, representam importantes ferramentas para detecção de agentes de doenças transmitidas por vetores, uma vez que o acesso a muitos desses animais é limitado.

PALAVRAS-CHAVE: Micoplasmas hemotrópicos, Anaplasmatacea, roedores silvestres, Xenarthra, carrapatos, *Amblyomma* spp.

ABSTRACT

Wild animals may play an important role in the spread of ticks and tick-borne diseases (TBD) pathogens. In Brazil, orange-spined hairy dwarf porcupines (*Sphiggurus villosus*) and collared anteaters (*Tamandua tetradactyla*) are widely distributed in the Atlantic Rainforest biome being among the animals most frequently hit and killed by cars on the roads. The aim of this study was to screen free-ranging Brazilian porcupines and collared anteaters from Paraná State, southern Brazil, for hemotropic *Mycoplasma*, *Anaplasma/Ehrlichia* spp., and piroplasms infection. Blood and/or spleen samples were collected from nine orange-spined hairy dwarf porcupines and four collared anteaters referred to the Veterinary Teaching Hospital, Universidade Federal do Paraná, Parana State, southern Brazil. The animals were screened for the presence of ectoparasites. DNA was extracted from all samples and further screened by PCR assays targeting the 16S rRNA/23S rRNA genes of hemoplasmas, 16S rRNA gene of *Anaplasma/Ehrlichia* spp., and 18S r RNA gene of piroplasms. A total of 275 ticks (34 males, 11 females, 7 nymphs and 223 larvae) were collected from eight porcupines: *Amblyomma longirostre*, *Amblyomma parkeri,* and *Amblyomma* spp. larvae. Two out of four anteaters were infested by *A. calcaratum* ticks (four males, and two females). Two out of nine porcupines were PCR-positive for hemoplasmas. One of four collared anteater sample tested positive for *Anaplasma/Ehrlichia* spp. by PCR. All animals tested negative for *Theileria*/*Babesia* spp. Phylogenetic and network analysis of the 16S and 23S rRNA gene fragments confirmed that porcupines were infected by a potentially novel hemotropic *Mycoplasma* sp. The name '*Candidatus* Mycoplasma haemosphiggurus' is proposed for this novel organism, that should be further fully characterized. Phylogenetic analysis of *Anaplasma* spp. 16S rRNA gene showed our anteater sequence positioned close to sequences of *Anaplasma* spp. of anteaters from São Paulo, Brazil. In conclusion, research involving wild animals, especially those killed by cars on the roads, represents an important tool for detecting vector-borne disease agents, since access to many of these animals is limited.

KEY-WORDS: Hemotropic mycoplasmas, Anaplasmatacea, wild rodents, Xenarthra, ticks, *Amblyomma* spp.

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1 INTRODUÇÃO

Os carrapatos (Acari: Ixodidae) são vetores de patógenos com importância na medicina e medicina veterinária. Nesse cenário, a fauna silvestre pode desempenhar um importante papel na epidemiologia de doenças transmitidas por carrapatos (DTC), bem como na disseminação e/ou manutenção de populações de carrapatos no ambiente (SZEKERES et al., 2019). Dentre os animais silvestres, Rodentia é uma das mais diversificadas e distribuídas ordens de mamíferos no mundo, sendo que mais de 200 espécies de roedores já foram descritas no Brasil (BONVICINO; OLIVEIRA; D'ANDREA, 2008). Os roedores silvestres são considerados reservatórios de diversos patógenos causadores de doenças, incluindo agentes com potencial zoonótico, tais como *Rickettsia rickettsii* (FORTES et al., 2011) *Bartonella vinsonii subsp. arupensis* (FAVACHO et al., 2015) e *Babesia microti* (USLUCA et al., 2019).

Além desses patógenos, duas espécies de hemoplasmas têm sido identificadas parasitando roedores, *Mycoplasma coccoides* e *Mycoplasma haemomuris*, sendo a segunda espécie subdividida em *'Candidatus* M. haemomuris subsp. musculi*'* e *'Candidatus* M. haemomuris subsp. ratti*'* (HARASAWA et al., 2015).

Estudos para detecção de hemoplasmas em animais silvestres foram realizados em diferentes regiões do Brasil, sendo já descritos em canídeos (ANDRÉ et al., 2011b; DE SOUSA et al., 2017), felídeos (ANDRÉ et al., 2011b; DE SOUSA et al., 2017; FURTADO et al., 2018; GUIMARAES et al., 2007), primatas não humanos (BONATO et al., 2015; CUBILLA et al., 2017a; DE MELO et al., 2019; RAMALHO et al., 2017; SANTOS et al., 2013), quatis (*Nasua nasua*) (CUBILLA et al., 2017b; DE SOUSA et al., 2017), gambás de orelha branca (*Didelphis albiventris*) (GONÇALVES et al., 2020; MASSINI et al., 2019; PONTAROLO et al., 2020), morcegos (IKEDA et al., 2017; SANTOS et al., 2020) e javalis (DIAS et al., 2019). Além disso, a ocorrência de *Mycoplasma* spp. em diversos mamíferos silvestres, incluindo roedores foi relatada nos cinco biomas brasileiros (DE SOUSA et al., 2017; GONÇALVES et al., 2015).

Ouriços-cacheiro (*Sphiggurus villosus*) (Rodentia: Erethizontidae) são roedores silvestres com grande distribuição no Sul e Sudeste do Brasil (OLIVEIRA; BONVICINO, 2006). Esses animais são frequentemente expostos ao parasitismo de carrapatos, sendo as espécies *Amblyomma parkeri* e *Amblyomma longirostre* comumente associadas com ouriços da família Erethizontidae (LUZ; FACCINI; MCINTOSH, 2017; MARTINS et al., 2013). Ouriços-cacheiro ocorrem primariamente

em regiões de Mata Atlântica, porém são encontrados em bordas de florestas e em áreas urbanas, onde podem causar lesões a seres humanos e animais domésticos devido aos seus espinhos (JORGE et al., 2016). Em roedores, espécies de hemoplasmas foram identificadas em pequenos roedores silvestres (DE SOUSA et al., 2017; GONÇALVES et al., 2015, 2020) e capivaras (*Hydrochoerus hydrochaeris*) (GONÇALVES et al., 2020; VIEIRA et al., 2009). Até o momento, poucos estudos foram realizados para investigar a ocorrência de doenças transmitidas por vetores em ouriços-cacheiro (BENEVENUTE et al., 2017; GONÇALVES et al., 2015, 2016; RICHINI-PEREIRA et al., 2014). Apenas um estudo investigou a ocorrência de hemoplasmas nessa espécie de roedor, no qual não foi detectada presença do patógeno (GONÇALVES et al., 2015).

Tamanduás (Pilosa: Myrmecophagidae) são mamíferos neotropicais com uma dieta baseada em cupins e formigas. No Brasil, tamanduá-bandeira (*Myrmecophaga tridactyla*) e tamanduá-mirim (*Tamandua tetradactyla*) são amplamente distribuídos e podem ser encontrados em todos os seis biomas (MEDRI; MOURÃO; RODRIGUES, 2006). Assim como os ouriços, os tamanduás são frequentemente expostos a carrapatos, principalmente *Amblyomma calcaratum, Amblyomma goeldii* e *Amblyomma nodosum* (SZABÓ et al., 2019).

A família Anaplasmataceae (ordem Rickettsiales) é formada pelos gêneros *Anaplasma, Ehrlichia* e *Neorickettsia* e *Wolbachia* (DUMLER et al., 2001). No Brasil, vários genótipos de *A. phagocytophilum, A. marginale, A. bovis, A. platys, E. canis, E. chafeensis* e potenciais novas espécies foram detectados em diferentes espécies de mamíferos silvestres, incluindo cervídeos (MACHADO et al., 2006; MONGRUEL et al., 2017; PICOLOTO et al., 2010; SACCHI et al., 2012; SILVEIRA et al., 2014, 2013; SILVEIRA; RABELO; RIBEIRO, 2012), canídeos selvagens (ALMEIDA et al., 2013; ANDRÉ et al., 2012; SOUSA et al., 2017), felinos selvagens (ANDRÉ et al., 2010, 2012; WIDMER et al., 2011), quatis (SOUSA et al., 2017), caititus e queixadas (SOARES et al., 2015), gambás (GUIMARÃES et al., 2019; LOPES et al., 2018) e roedores (BENEVENUTE et al., 2017; BRAGA et al., 2018; SOUSA et al., 2017). Dentre os estudos com roedores silvestres, um ouriço-cacheiro testou positivo para *Anaplasma* sp. (BENEVENUTE et al., 2017) geneticamente próximo a *Anaplasma odocoilei,* que foi detectada infectando cervídeos do Brasil e EUA (FOLEY; HASTY; LANE, 2016; SACCHI et al., 2012). Por fim, recentemente foi detectada presença de

Anaplasma spp. e *Ehrlichia* spp. em mamíferos da superordem Xenarthra (bichos-preguiça e tamanduás) no Brasil (CALCHI et al., 2020).

A fragmentação dos ecossistemas é a principal causa na redução de populações de animais silvestres, além das rodovias que são formas comuns de degradação de habitats, criando barreiras para movimentação dos organismos e causa de atropelamentos (FREITAS; JUSTINO; SETZ, 2014; LAURANCE; GOOSEM; LAURANCE, 2009). Por esses fatores, ouriços-cacheiro e tamanduás são constantemente encontrados em áreas antropizadas e estão entre os animais silvestres mais atropelados em rodovias no Brasil (COELHO; KINDEL; COELHO, 2008; FREITAS; JUSTINO; SETZ, 2014; SZABÓ et al., 2019).

1.1 OBJETIVOS

1.1.1 Objetivo geral

Identificar a presença de patógenos transmitidos por carrapatos em ouriços-cacheiro e tamanduás-mirim atendidos no setor de animais selvagens do Hospital Veterinário da Universidade Federal do Paraná, estado do Paraná, sul do Brasil.

1.1.2 Objetivos específicos

- Detectar o DNA de hemoplasmas nas amostras de sangue e baço por meio de PCR convencional para os genes 16S rRNA e 23S rRNA;
- Detectar o DNA de *Anaplasma/Ehrlichia* spp. nas amostras de sangue e baço por meio de PCR convencional para o gene 16S rRNA;
- Detectar o DNA de piroplasmas nas amostras de sangue e baço por meio de PCR convencional para o gene 18S rRNA;
- Identificar e caracterizar molecularmente as espécies de patógenos que forem identificadas no estudo e compará-las com sequências depositadas no banco genético (GenBank®);
- Coletar e identificar morfologicamente as espécies de ectoparasitos presentes nos animais.

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'*Candidatus* Mycoplasma haemosphiggurus' a novel haemoplasma species in orange-spined hairy dwarf porcupines (*Sphiggurus villosus*) from Southern Brazil

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Abstract

In Brazil, the orange-spined hairy dwarf porcupine (*Sphiggurus villosus*) is widely distributed in the Atlantic Rainforest biome being amongst the most frequently road-killed animal. Porcupines may also be commonly found on forest borders and occasionally, near urban areas where human and domestic dogs injuries caused by its spines may occur. Therefore, the aims of this study were (a) to screen porcupines for TBD pathogens and haemoplasmas and (b) to identify the tick species parasitizing these rodents in Paraná State, southern Brazil. Blood and/or spleen samples were collected from nine orange-spined hairy dwarf porcupines. A total of 275 ticks (34 males, 11 females, 7 nymphs and 223 larvae) were collected from eight porcupines: *Amblyomma longirostre*, *A. parkeri* and *Amblyomma* spp. larvae. Two out of nine (22%; 95% CI: 3%–60%) porcupines were PCR-positive for haemoplasmas. All animals tested negative for *Theileria/Babesia* spp. and *Ehrlichia/Anaplasma* spp. by PCR. Phylogenetic and network analysis of the 16S and 23S rRNA gene fragments confirmed that animals were infected by a potentially novel haemotropic *Mycoplasma* sp. The name '*Candidatus* Mycoplasma haemosphiggurus' is proposed for this novel organism that should be further fully characterized.

KEYWORDS

Amblyomma spp, haemotropic mycoplasmas, ticks, wild rodents

1 | INTRODUCTION

The order Rodentia is the largest order of mammals and is widespread through different habitats (Wilson & Reeder, 2005). Rodents of the family Erethizontidae include New World porcupines and comprises 15 species distributed across three genera: *Chaetomys*, *Coendou* and *Sphiggurus* (Woods & Kilpatrick, 2005). The orange-spined hairy dwarf porcupine (*Sphiggurus villosus*) is a solitary, nocturnal and arboreal animal, endemic to the Atlantic forest habitat, occurring in southeastern and southern Brazil (Lange & Schmidt, 2014; Oliveira & Bonvicino, 2006). Although occur in primary Atlantic Forest, they may be commonly found on forest borders and, occasionally, near urban areas where human (Jorge et al., 2016) and domestic dogs (Lange & Schmidt, 2014) injuries caused by its spines may occur. Additionally, porcupines are amongst the most frequently road-killed animals in Brazil (Coelho, Kindel, & Coelho, 2008).

Haemotropic mycoplasmas (haemoplasmas) are epicellular bacteria that attach to erythrocyte's surface of a wide range of mammalian hosts (Messick, 2004), including human beings (Hattori et al., 2020). Two haemotropic *Mycoplasma* species have been reported in

rodents, *Mycoplasma coccoides* (Neimark, Peters, Robinson, & Stewart, 2005) and *Mycoplasma haemomuris* (Neimark, Johansson, Rikihisa, & Tully, 2001), being the second separated in '*Candidatus* M. haemomuris *subsp. musculi*' and '*Candidatus* M. haemomuris *subsp. ratti*' (Harasawa, Fujita, Kadosaka, Ando, & Rikihisa, 2015). In Brazil, a potentially novel haemoplasma species has been found in capybaras (*Hydrochaeris hydrochaeris*) (Gonçalves et al., 2020; Vieira et al., 2009), and other potentially novel haemotropic *Mycoplasma* spp. have been described in wild rodents from different Brazilian biomes (de Sousa et al., 2017; Gonçalves et al., 2015, 2020).

Porcupines are frequently infested by ticks, with *Amblyomma longirostre* and *Amblyomma parkeri* commonly associated with porcupines of the Erethizontidae family (Labruna et al., 2009; Luz et al., 2018; Martins et al., 2013). Due to the proximity of urban areas and human-animal interactions, monitoring ticks and the health status of porcupines may be of public health concern. Therefore, the aims of this study were (a) to screen porcupines for TBD pathogens and haemoplasmas, and (b) to identify the tick species parasitizing these rodents in Paraná State, southern Brazil.

2 | MATERIAL AND METHODS

A total of nine orange-spined hairy dwarf porcupines were referred to the Veterinary Teaching Hospital, Universidade Federal do Paraná, Parana State, southern Brazil, between April 2018 and October 2019. Porcupines were identified at species level based on morphological and phenotypical characteristics (Woods & Kilpatrick, 2005). Clinical signs/history and clinical outcome were recorded. Blood samples were collected by venipuncture of ventral caudal vein, placed into tubes containing EDTA (BD Vacutainer®) for PCR analysis and kept at −20°C until testing. Fragments of spleen samples were collected from three animals that died. Ticks parasitizing animals were collected using a commercial hook (O'TOM®/Tick Twister®) and kept in absolute ethanol for further classification according to morphological taxonomic keys (Barros-Battesti, Arzua, & Bechara, 2006; Labruna et al., 2009; Martins, Onofrio, Barros-Battesti, & Labruna, 2010; Martins et al., 2013).

DNA was extracted from blood and spleen samples using commercially available kits (QIAamp™ DNA Blood Mini Kit and QIAamp™ DNA Micro Kit, Qiagen, respectively), according to the manufacturer's instructions. Ultrapure water was used as a negative control in parallel to monitor for cross-contamination.

A PCR for the mammal endogenous gene glyceraldehyde-3-phosphate dehydrogenase (*gapdh*) was performed in all samples, to monitor DNA extraction (Birkenheuer, Levy, & Breitschwerdt, 2003). Thereafter, DNA samples were screened for haemotropic mycoplasmas using a PCR assay targeting a fragment (~900 bp) of the 16S rRNA gene of haemoplasmas (Hoelzle et al., 2011; Machado et al., 2017). Porcupine DNA samples that tested positive in the PCR assay based on the 16S rRNA gene were subjected to a genus-specific PCR assay targeting a fragment (800 pb) of the 23S rRNA gene of haemoplasmas (Mongruel et al., 2020). *Mycoplasma ovis* DNA obtained from a naturally infected goat (Machado et al., 2017) and nuclease-free water were used as positive and negative controls, respectively.

Additionally, DNA samples were also tested by PCR assays targeting a fragment (551 bp) of the 18S rRNA gene of *Theileria/Babesia* spp. (Almeida et al., 2012) and a fragment (349 bp) of 16S rRNA gene of *Ehrlichia/Anaplasma* spp. (Parola et al., 2000). *Babesia vogeli* and *Ehrlichia canis* DNA obtained from naturally infected dogs were used as positive controls. Nuclease-free water was used as negative control.

Amplicons (~900 bp) obtained from two haemotropic *Mycoplasma* sp.-positive samples were sequenced in both directions by Sanger method, with nucleotide sequences of the 16S rRNA and 23S rRNA genes of haemotropic *Mycoplasma* sp. submitted to GenBank® database (accession nos. MN164483, MN860071, and MN164485, MN692881, respectively).

The partial sequences of 16S and 23S rRNA genes of haemotropic *Mycoplasma* spp. were aligned using MAFFT 7.110 (Katoh & Standley, 2013) on the Guidance 2 server (Sela, Ashkenazy, Katoh, & Pupko, 2015) for each gene. Phylogenetic analysis of each gene were based on Bayesian Inference (BI) using Beast 1.8.0 package (Drummond, Suchard, Xie, & Rambaut, 2012). Three independent runs of 100,000,000 generations of Monte Carlo Markov Chain (MCMC) were performed with one sampling per 10,000 generations and a 10% burn-in. The substitution models were estimated as GTR + G to 16S rRNA gene and GTR + I+G to 23S rRNA gene, based on Akaike information criterion (AIC) using jModeltest 2.1.10 (Darriba, Tab oada, Doallo, & Posada, 2012). Reconstructions were visualized with FigTree 1.4.4 software (Rambaut, 2014). The 16S and 23S rRNA trees were rooted with *Mycoplasma pneumoniae* (NZ_CP008895). Moreover, a haplotype network for each fragment was estimated in the PopArt (Leigh & Bryant, 2015) using the median-joining method (Bandelt, Forster, & Röhl, 1999).

3 | RESULTS AND DISCUSSION

Five porcupines presented variable clinical signs such as skin lesions and pneumothorax. A total of 275 ticks (34 males, 11 females, 7 nymphs and 223 larvae) were collected from eight out of nine (89%; 95% CI: 52%–99%) porcupines. Ticks were identified as *A. longirostre* (n = 26M, 6F, 4N), *A. parkeri* (n = 4M, 3F, 3N) and *Amblyomma* spp. (223L). Clinical signs/history and outcome recorded are presented on Table 1.

For all samples, the mammalian-endogenous *gapdh* gene was consistently amplified. Two out of nine (22%; 95% CI: 3%–60%) porcupines were positive for haemotropic *Mycoplasma* spp. by PCR. Both haemoplasma-positive animals were parasitized by ticks (Table 1). All samples tested negative for *Theileria/Babesia* spp. and *Ehrlichia/Anaplasma* spp. by PCR.

Sequencing of the 16S rRNA gene fragments from two haemotropic *Mycoplasma* sp.-positive samples showed 97.01% identity with multiple *Mycoplasma* sp. detected in crab-eating fox (*Cerdocyon*

TABLE 1 Clinical data, outcome and molecular diagnosis of haemoplasmas in orange-spined hairy dwarf porcupines (*S. villosus*) parasitized by ticks in Paraná State, southern Brazil

Animal identification	Sample	Haemoplasmas (PCR)	Ticks	Stages	Clinical signs/history	Outcome	GeneBank *n.* access
1	Spleen	(-)	*A. longirostre* *A. parkeri*	5M 2M, 1F	Road-killed	Died	-
2	Blood Spleen	(-) (-)	*A. longirostre* *A. parkeri* *Amblyomma* spp.	1M 1M, 1N 222L	Lesions on the face and nose; tumour mass in the perianal region	Euthanized	-
3	Blood	(-)	-	-	Found in a human dwelling	Released	-
4	Blood	(+)	*A. longirostre* *Amblyomma* spp.	1M 1L	Pneumothorax; suspected of being hit by a car	Treated	MN164483 (16S rRNA) MN164485 (23S rRNA)
5	Blood	(-)	*A. parkeri*	2F, 2N	Carpal bone luxation; circling behaviour	No information	-
6	Blood	(-)	*A. longirostre*	1M, 1F	Pneumothorax; suspected of being hit by a car	Died	-
7	Blood	(+)	*A. longirostre* *A. parkeri*	1F 1M	Found in a human dwelling	Released	MN860071 (16S rRNA) MN692881 (23S rRNA)
8	Blood Spleen	(-) (-)	*A. longirostre*	16M, 2F, 3N	Bitten by a dog	Died	-
9	Blood	(-)	*A. longirostre*	2M, 2F, 1N	No information	No information	-
Total		2/9 (22% CI 95%: 3%–60%)		275 (34M, 11F, 7N, 223L) ticks			

Abbreviations: -, negative; +, positive; F, female; L, larvae; M, male; N, nymph.

thous) (KY002676) and coatis (*Nasua nasua*) (KY002651, KY002656, KY002658, KY002660, KY002663, KY002668) from the central region of the Pantanal, state of Mato Grosso do Sul, central-western Brazil. Sequencing of the 23S rRNA gene fragments from two haemotropic *Mycoplasma* sp.-positive samples showed 82.72% identity with *Mycoplasma haemocanis* strain Illinois (CP003199) and 82.35% identity with *M. haemofelis* strain Ohio2 (CP002808).

Phylogenetic 16S rRNA gene fragment analysis confirmed the close relationship of the porcupine haemoplasma haplotype with *Mycoplasma* sp. detected in crab-eating fox, coatis and capybaras (*Hydrochaeris hydrochaeris*) from Brazil. Moreover, the haemotropic *Mycoplasma* sp. detected herein formed a strongly supported branch with the haemotropic *Mycoplasma* sp. detected in rodents from Brazil and Hungary (Figure 1). Phylogenetic 23S rRNA gene fragment analysis of the porcupine haemoplasma detected herein formed a strong supported branch and clustered together with those of the *M. haemofelis* group (Figure 2). The haplotype networks support these results (Figure 3). Our sequences were assigned in the *M. haemofelis* group as isolated haplotypes, with high number of mutations to the hypothetical haplotypes that link these sequences with the sequences of the other species (13 and 79 mutations in the 16S and 23S networks, respectively).

In the present study, we first reported a potentially novel haemoplasma species in porcupines from Paraná State, southern of Brazil, based on 16S and 23S rRNA genes sequencing, phylogenetic and haplotype analysis. The 16S rRNA sequence from the novel haemoplasma of the porcupine was closely related to *Mycoplasma* sp. detected in crab-eating fox and coatis from the central region of the Pantanal, state of Mato Grosso do Sul, central-western Brazil, but with only a 97% identity score and high branch support values among them. According to Drancourt and Raoult (2005), '*two bacterial isolates would belong to different species if the similarity in the 16S rRNA gene sequence between them were less than 97%*'. Despite the 16S rRNA gene has been widely used for assigning uncultivable

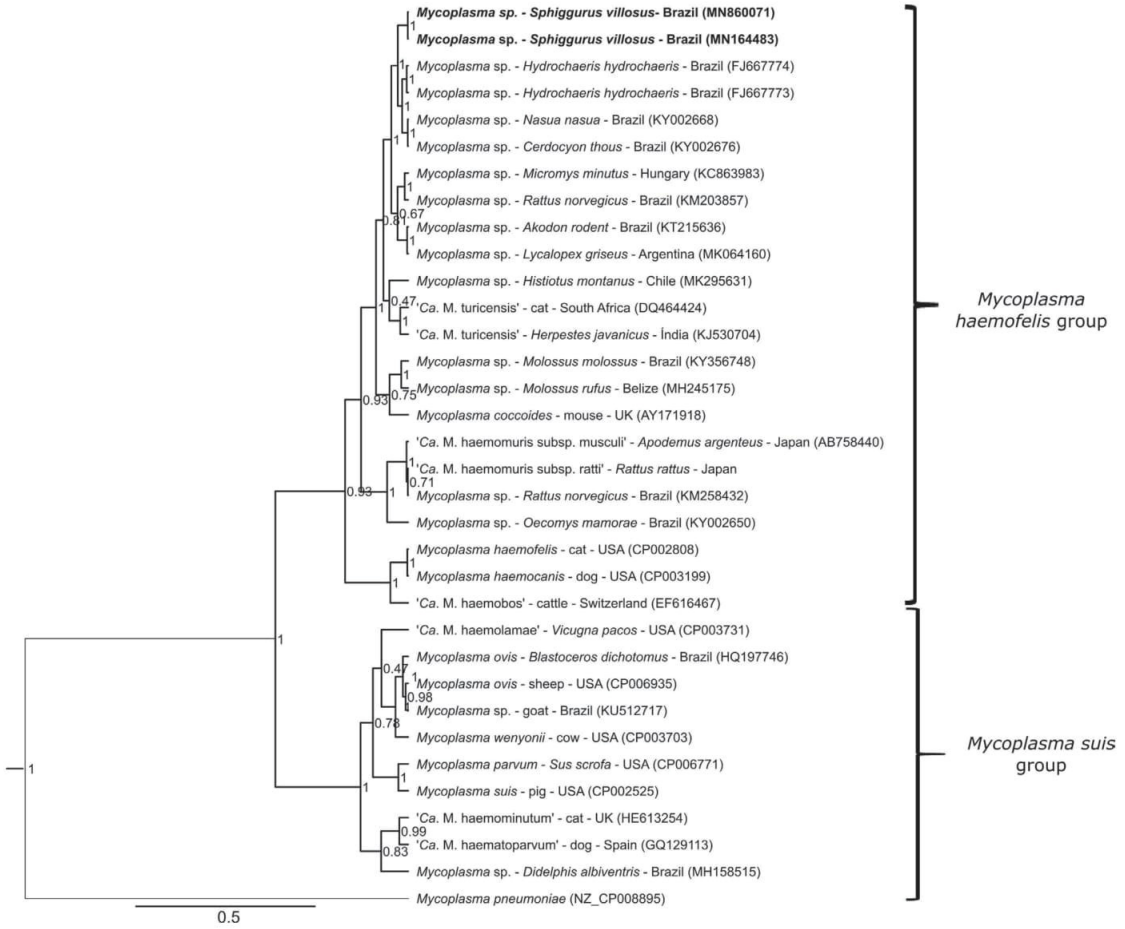

FIGURE 1 Phylogenetic relationships within the *Mycoplasma* genus based on fragments of ~800 bp of the 16S rRNA gene. The phylogenetic tree was inferred by using the Bayesian Inference (BI). Sequences detected in the present study are highlighted in bold. *Mycoplasma pneumoniae* was used as outgroup. Branch lengths represent units of substitutions per site

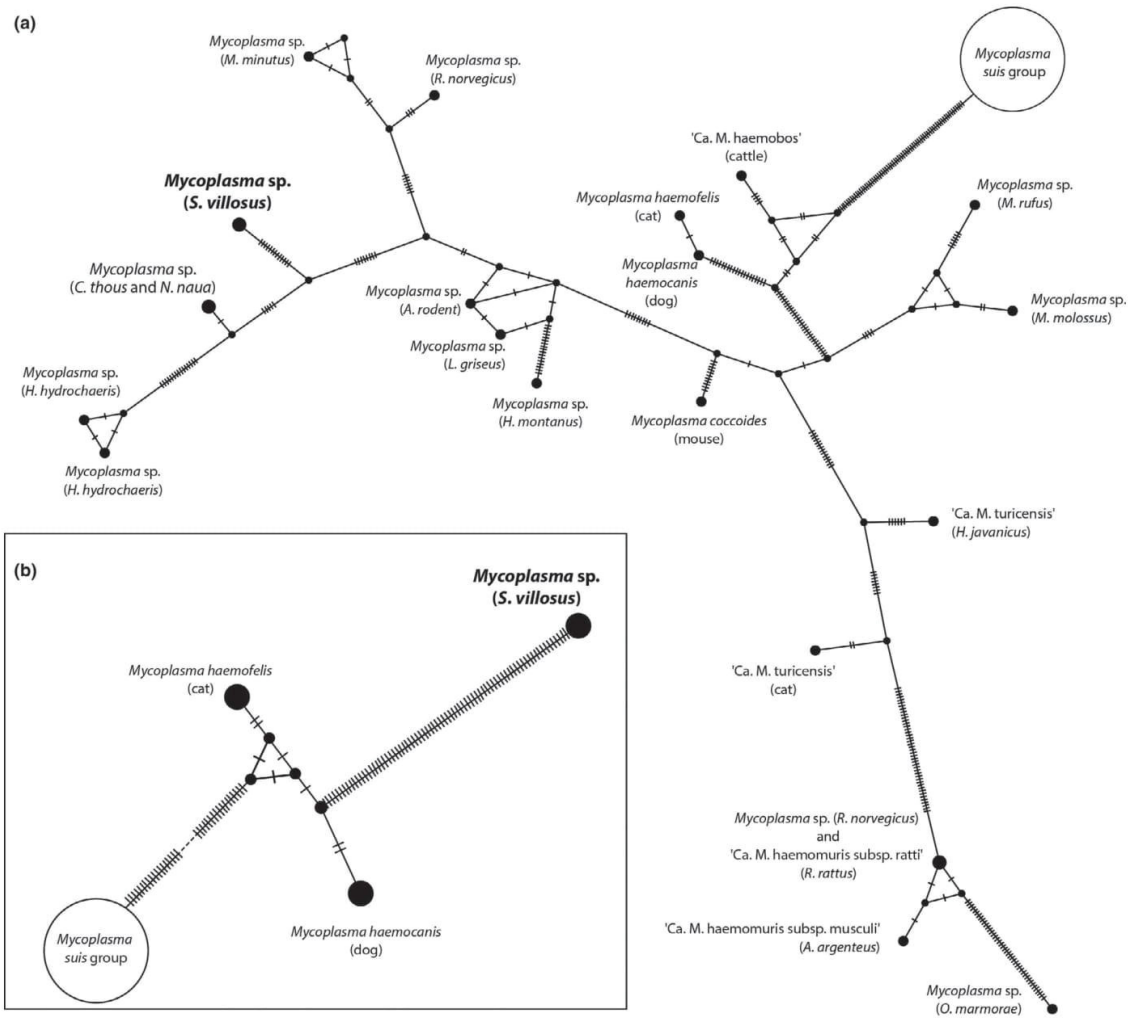

FIGURE 3 Haplotype network of the sampled *Mycoplasma* species based on 16S (a) and 23S (b) rRNA genes. Sequences detected in the present study are highlighted in bold. Only the *M. haemofelis* group species is presented. Small circles represent hypothetical haplotypes, lines represent links between the haplotypes and crossing lines represent mutations

species by this tick species does not occur in field conditions (Aktas & Ozubek, 2017).

In conclusion, a potentially novel haemotropic *Mycoplasma* sp. has been identified by 16S and 23S rRNA gene sequence analysis in orange-spined hairy dwarf porcupines in Paraná state, southern of Brazil. The name '*Candidatus* Mycoplasma haemosphiggurus' is proposed for this novel organism that should be further fully characterized.

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CONFLICT OF INTEREST

The authors declared no conflict of interest.

ETHICAL APPROVAL

Animals were referred to the Veterinary Teaching Hospital—UFPR and screened for infectious diseases before releasing.

DATA AVAILABILITY STATEMENT

Raw data were generated at VBDL—UFPR. Sequences were deposited in GenBank® database. Derived data supporting the findings of

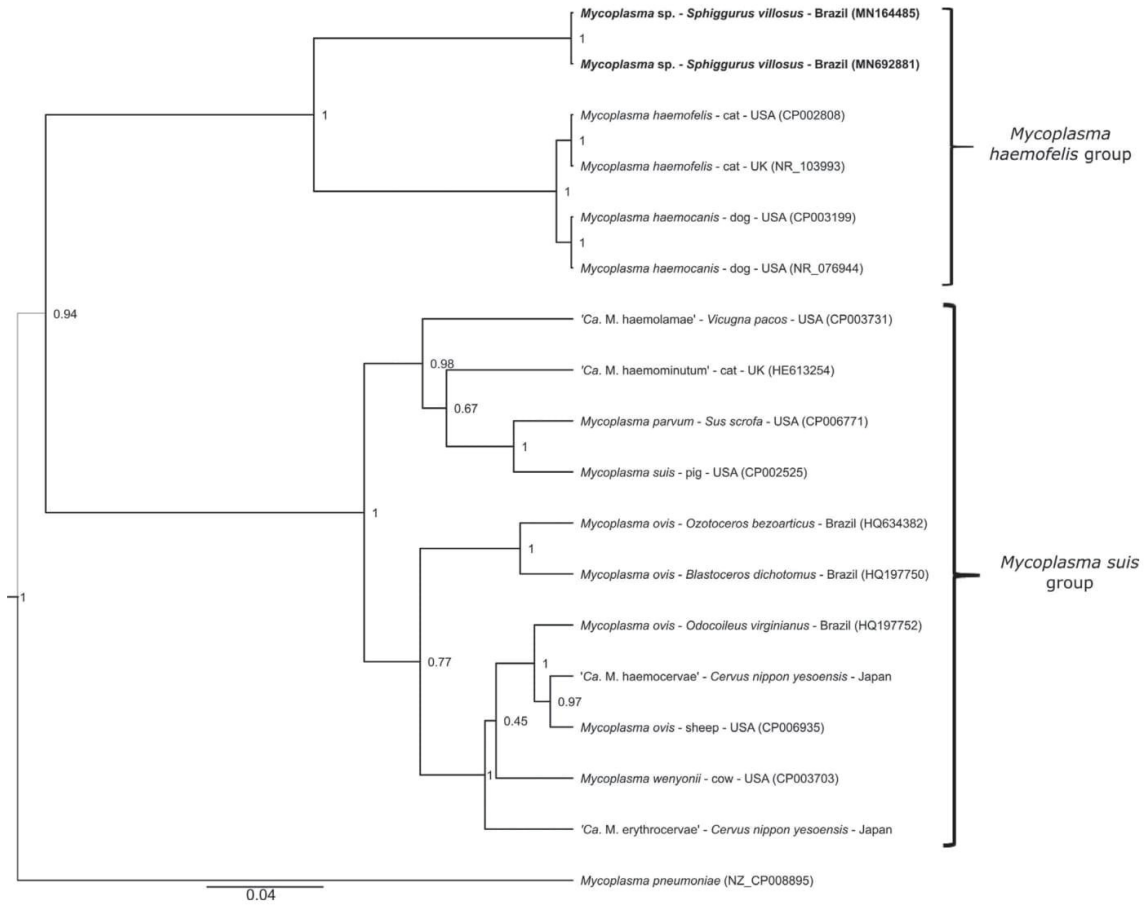

FIGURE 2 Phylogenetic relationships within the *Mycoplasma* genus based on a fragment of ~900 bp of the 23S rRNA gene. The phylogenetic tree was inferred by using the Bayesian Inference (BI). Sequences detected in the present study are highlighted in bold. *Mycoplasma pneumoniae* was used as outgroup. Branch lengths represent units of substitutions per site

organisms as new species, the use of a single gene has major drawbacks as there may be too few informative nucleotide sites and homologous recombination to differentiate very similar species (Hanage, Fraser, & Spratt, 2006). The 23S rRNA gene sequence from the novel haemoplasma of the porcupine was more closely related to *M. haemocanis*, but with only an 82.72% identity score. Accordingly, based on phylogenetic and network analysis of the 16S rRNA and 23S rRNA genes, the name '*Candidatus* Mycoplasma haemosphiggurus' is proposed for this novel organism that should be further fully characterized.

Herein, the haemotropic mycoplasma detected in porcupines was phylogenetically distant from others murine haemoplasmas. A previous study has suggested that haemoplasmas from synanthropic rodents (*Rattus rattus*, *Rattus norvegicus* and *Mus musculus*) are restrict to synanthropic rodents or show a low occurrence among wild rodents in Brazil (Gonçalves et al., 2015). Curiously, our sequences were also distant from haemoplasmas detected in wild rodents from all Brazilian biomes (<96% identity score) (Gonçalves et al., 2015). In fact, the natural environment in which wild rodents are found present practicalities for many animal groups or species. New World porcupines show arboreal behaviour and inhabit forest formations of the Brazilian Amazon, Atlantic Forest and Cerrado biomes (Bonvicino, de Oliveira, & D'Andrea, 2008), different from the other wild rodents found infected by haemotropic *Mycoplasma* sp. in Brazil. This fact may have reduced the contact and the direct transmission of haemoplasmas through aggressive interaction between synanthropic rodents as well as wild rodents (Cohen et al., 2018).

In the present study, 89% of orange-spined hairy dwarf porcupines were parasitized by ticks, the majority *A. longirostre*. To date, there has not been a robust evidence to support the transmission of haemotropic mycoplasmas by ixodid ticks. Although the experimental transmission of *M. haemocanis* by *Rhipicephalus sanguineus* sensu *lato* (s.l.) ticks has been reported in dogs (Seneviratna, Weerasinghe, & Ariyadasa, 1973), a previous study has failed in detect haemotropic mycoplasmas in *R. sanguineus* s.l. ticks in an animal shelter and suggested that trans-stadial transmission of canine haemoplasma

this study are available from the corresponding author [RFCV] on request.

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3 ARTIGO PARA SUBMISSÃO (*SHORT COMMUNICATION*)

Título: *Anaplasma* sp. in collared anteater (*Tamandua tetradactyla*) from Paraná state, Southern Brazil

3.1 ABSTRACT

Anteaters (Pilosa: Myrmecophagidae) are neotropical mammals with a diet based on termites and/or ants. In Brazil, the collared anteater (*Tamandua tetradactyla*) is widely distributed, and this species may be found through all Brazilian biomes. Anteaters are frequently exposed to ticks, being *Amblyomma calcaratum, Amblyomma goeldii* and *Amblyomma nodosum* are the main tick species found parasitizing collared anteaters. The aim of this study was to screen collared anteaters from Paraná State, southern Brazil, for hemotropic mycoplasmas, *Ehrlichia/Anaplasma* spp., and piroplasms infections by PCR. Blood or spleen samples were collected from four collared anteaters referred to the Veterinary Teaching Hospital, Universidade Federal do Paraná, Parana State, southern Brazil. One of four (25%) collared anteater sample was PCR-positive for *Anaplasma* sp. Two out of four anteaters were infested by *A. calcaratum* ticks. In conclusion, we firstly report *Anaplasma* sp. in collared anteater from Paraná state Southern, Brazil. The phylogenetic analysis showed our sequence positioned close to sequences of *Anaplasma* spp. of anteaters from São Paulo. Also, *A. calcaratum* adult ticks were found infesting two collared anteaters.

Key-words: Xenarthra, Anaplasmatacea, ticks, *A. calcaratum*.

3.2 INTRODUCTION

Anteaters (Pilosa: Myrmecophagidae) are neotropical mammals with a diet based on termites and/or ants. In Brazil, the giant anteater (*Myrmecophaga tridactyla*) and the collared anteater (*T. tetradactyla*) are widely distributed, and these species may be found in all Brazilian biomes (Medri et al., 2006). In Brazil, collared anteaters are recurrently found at anthropogenic sites and they are among the most frequently road-killed animals (Freitas et al., 2014). Anteaters are also frequently exposed to ticks, being *Amblyomma calcaratum, Amblyomma goeldii* and *Amblyomma nodosum* the main tick species affecting anteaters (Szabó et al., 2019). Although anteaters were determined as natural reservoirs of *Leishmania* spp. and *Rickettsia* spp. (Richini-

Pereira et al., 2014), the potential role of anteater ticks as vectors of other tick-borne pathogens remains to be better investigated.

Wild animals are reservoirs of pathogens that may cause diseases in animals and humans, and favor the spread of these agents (Doudier et al., 2010; Dumler et al., 2001; Parola et al., 2005). In Brazil, genotypes and potential novel species of Anaplasmatacea family bacteria have been detected on wild animals, including deer (Machado et al., 2006; Mongruel et al., 2017; Sacchi et al., 2012; Silveira et al., 2014, 2013), canids (Almeida et al., 2013; André et al., 2012; Sousa et al., 2017), felids (André et al., 2012, 2010; Widmer et al., 2011), coatis (Sousa et al., 2017), suids (Soares et al., 2015), opposums (Guimarães et al., 2019; Lopes et al., 2018) and rodents (Benevenute et al., 2017; Braga et al., 2018; Sousa et al., 2017). Recently, *Anaplasma* spp. and *Ehrlichia* spp. were detected in mammals of Xenarthra superorder (Calchi et al., 2020). Therefore, the aim of this study was to screen collared anteaters from Paraná State, southern Brazil, for hemotropic mycoplasmas, *Ehrlichia/Anaplasma* spp., and piroplasms infections.

3.3 MATERIAL AND METHODS

This study was approved by the Ethics Committee for Animal Experimentation and Animal Welfare at the Universidade Federal do Paraná, Brazil (protocol number 044/2020). Animal and laboratory procedures were approved and performed under regulations of the Chico Mendes Institute for Biodiversity Conservation (ICMBio, protocol number 76984-1).

Four free-ranging collared anteaters were referred to the Veterinary Teaching Hospital, Universidade Federal do Paraná, Parana State, southern Brazil. Blood samples of two collared anteaters were collected by venipuncture of ventral caudal vein, placed into tubes containing EDTA (BD Vacutainer®, Franklin Lakes, NJ, EUA) for PCR analysis and kept at -20 °C until testing. Fragments of spleen were collected from two other animals that died. Ticks parasitizing animals were collected using a commercial hook (O'TOM®/Tick Twister®, Lavancia, FRA), and kept in absolute ethanol for further classification according to morphological taxonomic keys (Barros-Battesti et al., 2006). DNA was extracted from blood and spleen samples using commercially available kits (QIAamp™ DNA Blood Mini Kit and QIAamp™ DNA Micro Kit, Qiagen,

Hilden, Germany, respectively), according to the manufacturer's instructions. Ultrapure water was used as a negative control in parallel to monitor for cross-contamination.

A conventional PCR (cPCR) for the mammal endogenous gene glyceraldehyde-3-phosphate dehydrogenase (*gapdh*) was performed in all samples, to monitor DNA extraction (Birkenheuer et al., 2003). Thereafter, DNA samples were further screened by cPCR assays targeting two complementary fragments (349 bp and 421 bp) of the 16S rRNA gene of *Anaplasma/Ehrlichia* spp. (Parola et al., 2000; Stuen et al., 2003). Additionally, DNA samples were tested by cPCR assays targeting a fragment (551 bp) of the 18S rRNA gene of *Theileria*/*Babesia* spp. (Almeida et al., 2012), and fragment (~900 bp) of the 16S rRNA gene of hemoplasmas (Hoelzle et al., 2011).

Amplicons obtained from one *Ehrlichia/Anaplasma* sp.- positive sample were sequenced in both directions by Sanger method. Concatenate nucleotide sequence (771 bp) of the 16S rRNA gene of *Ehrlichia/Anaplasma* sp. was subjected to Blast® analysis and submitted to the GenBank® database (accession no. MW555173).

Phylogenetic analysis of 16S rRNA gene was based on Bayesian Inference (BI) using Beast 1.8.0 package (Drummond et al., 2012). Three independent runs of 100,000,000 generations of Monte Carlo Markov Chain (MCMC) were performed with one sampling per 10,000 generations and a 10% burn-in. The substitution model was estimated as GTR+G+I, based on Akaike Information Criterion (AIC) using jModel test 2.1.10 (Darriba et al., 2012). Reconstructions were visualized with FigTree 1.4.4 software (Rambaut, 2014). The 16S rRNA tree was rooted with *Ehrlichia canis* (EF195135) sequence.

3.4 RESULTS AND DISCUSSION

All samples consistently amplified the anteater *gapdh* gene. One of four (25%; CI 95%: 0.6-80%) collared anteater sample (blood) was PCR-positive for *Anaplasma/Ehrlichia* sp. The concatenate sequence of the 16S rRNA gene fragment (770 bp) showed 98.19% identity with *Anaplasma platys* detected in *Canis lupus familiaris* from Saint Kitts and Nevis (CP046391), and South Africa (MK814419). Two out of four (50%; CI 95%: 6-93%) anteaters were infested by ticks (four males, and two females) identified as *A. calcaratum* (Table 1).

This is the first report of Anaplasmatacea agent in collared anteater (*T. tetradactyla*) from Paraná state, Southern Brazil. Previous studies of detection of Anaplasmataceae agents in Xenarthra are scarce. In Pará state, genotypes of

Ehrlichia spp., and *Anaplasma* spp. were detected in a three toed sloth (*Bradypus tridactylus*) (Soares et al., 2015). A recent study detected genotypes of *Ehrlichia* and *Anaplasma* spp. in Xenarthra mammals from four Brazilian states Mato Grosso do Sul, São Paulo, Pará, and Rondônia (Calchi et al., 2020). The phylogenetic analysis of 16S rRNA positioned the sequences obtained in Xernathra (*Bradypus* spp. and *Choloepus* spp.) from Rondônia and Pará states in a single clade phylogenetically closer to *Anaplasma* spp. genotypes from rodents in Brazil. In the same study, the sequences obtained from anteaters of São Paulo state were allocated to a different clade closer to sequences of *Anaplasma* spp. detected in ocelots (*Leopardus pardalis*), coatis (*Nasua nasua*), and crab-eating foxes (*Cerdocyon thous*) from the Pantanal natural region in southern Brazil (Calchi et al., 2020). Despite forming a single clade, the obtained sequence of our study showed greater proximity to the clade of *Anaplasma* spp. found in anteaters (*T. tetradactyla*) from São Paulo, Brazil (MT199830 and MT199830), probably due the geographical closety between São Paulo e Paraná state, and the same Xernathra mammal species.

Two out of four anteaters were infested by *A. calcaratum* ticks. Anteaters are the principal hosts for adults of *A. calcaratum* ticks, whereas immature stages of these species rather feed on passerine birds (Nava et al., 2017). Tick species collected from collared anteaters has been recently found as carriers of *Rickettsia* spp. (Szabó et al., 2019). Moreover, a study reported *A. calcaratum* nymphs infected with a rickettsial bacterium (*Rickettsia parkeri*-like agent) (Ogrzewalska et al., 2013). Birds are an important host to spread immature stages of ticks, so the importance of *A. calcaratum* ticks, especially immature stages, should be better investigated.

3.5 CONCLUSION

In conclusion, we firstly report *Anaplasma* sp. in collared anteater from Paraná state Southern, Brazil. The phylogenetic analysis showed our sequenced positioned close to sequences of *Anaplasma* spp. of anteaters from São Paulo. Also, *A. calcaratum* adult ticks were found infesting two collared anteaters.

Conflict of interests

The authors declared no conflict of interest.

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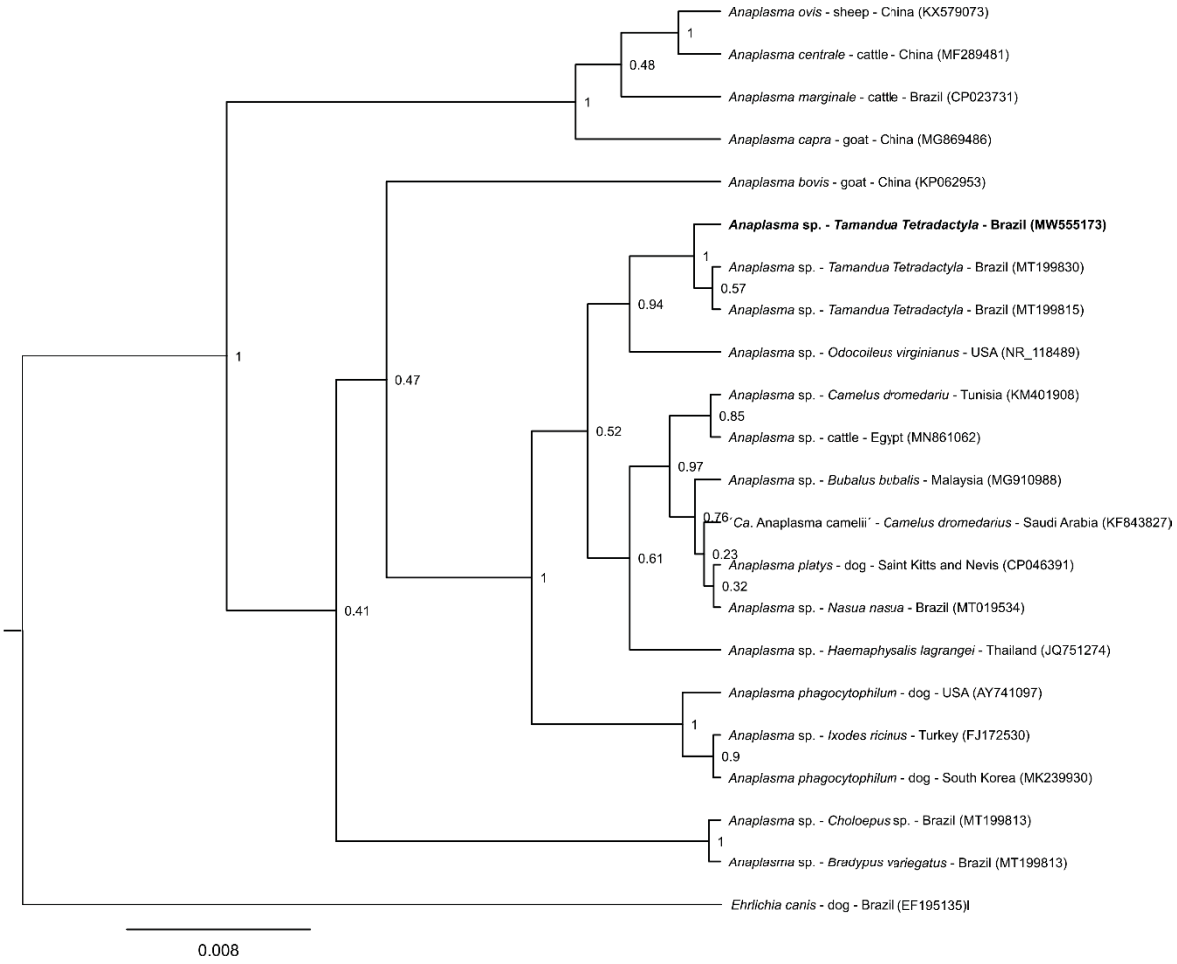

Figure 1. Phylogenetic relationships within the *Anaplasma* genus based on fragments of ~771 bp of the 16S rRNA gene. The phylogenetic tree was inferred by using the Bayesian Inference (BI). Sequences detected in the present study are highlighted in bold. *Ehrlichia canis* was used as outgroup. Branch lengths represent units of substitutions per site.

Table 1. Molecular diagnosis of Anaplasmatacea agents in collared anteaters (*Tamandua tetradactyla*) parasitized by ticks in Paraná State, southern Brazil.

Animal identification	**Sample**	**Hemoplasmas (PCR)**	**Ticks**	**Stages**	**Clinical signs/history**	**Outcome**	**GeneBank n. access**
1	Blood	(-)	*A. calcaratum*	3M, 2F	-	-	-
2	Blood	**(+)**	*A. calcaratum*	1M	Lesions on the face and nose; skin excoriations	Released	**MW555173 (16S rRNA)**
3	Spleen	(-)	-	-	Road-killed	Died	-
4	Spleen	(-)	-	-	Road-killed	Died	-
Total		2/4 (50%)		6 (4M, 2F) ticks			

M male; F female; N nymph; L larvae; (-) negative; (+) positive.

4 CONSIDERAÇÕES FINAIS

Um potencial novo *Mycoplasma* hemotrópico foi identificado infectando ouriços-cacheiro do estado do Paraná, Sul do Brasil, por meio de análise filogenética do gene 16S e 23S rRNA. O nome '*Candidatus* Mycoplasma haemosphiggurus' é proposto para esse novo organismo, que deve ser totalmente caracterizado. Além disso, foi relatada a detecção de *Anaplasma* sp. em uma amostra de sangue de tamanduá-mirim pela primeira vez no estado do Paraná, Brasil. Por fim, foi relatado o parasitismo de ouriços-cacheiro por carrapatos *Amblyomma longirostre* e *Amblyomma parkeri*, e parasitismo de tamanduás-mirim por carrapatos *A. calcaratum*. Conclui-se que a pesquisa envolvendo animais silvestres, principalmente os animais atropelados em rodovias, representa uma importante ferramenta de pesquisa para detecção de agentes etiológicos de doenças transmitidas por vetores, uma vez que o acesso a muitas espécies desses animais é limitado.

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5 APÊNDICE 1 – ARTIGO PUBLICADO

Estudo paralelo relacionado à tese.

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Original article

Records of ticks (Acari: Ixodidae) on humans and distribution of spotted-fever cases and its tick vectors in Paraná State, southern Brazil

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ABSTRACT

Brazilian spotted fever (BSF) is the deadliest rickettsiosis in the world. Although the epidemiology of the disease has been established in Brazil, there are still limited data available on distribution of tick vectors and tick species parasitizing humans in the country, particularly in Paraná State. The State of Paraná is located in the southern region of the country and is covered by two biomes: Atlantic rainforest and Cerrado. Thus, the aims of this study were i) to map the distribution of SF tick vectors, ii) to describe and map the distribution of human parasitism by ticks, and iii) to map the distribution of fatal and non-fatal spotted fever (SF) cases in Paraná State, southern Brazil. Data were reviewed and compiled from previous published reports, and also from two scientific collections of Paraná State. SF cases were retrieved from the Brazilian Notifiable Diseases Information System. A total of 50 cases of human parasitism by ticks were recorded, with a total of 64 (22 males, 12 females, 30 nymphs) ticks collected. The following 12 tick species were identified: *Amblyomma aureolatum, Amblyomma brasiliense, Amblyomma calcaratum, Amblyomma dubitatum, Amblyomma incisum, Amblyomma longirostre, Amblyomma ovale, Amblyomma parkeri, Amblyomma scalpturatum, Amblyomma sculptum, Haemaphysalis juxtakochi* and *Rhipicephalus sanguineus* sensu lato (s.l.). The most prevalent tick species associated to cases of human parasitism were *A. sculptum* (13/50; 26 %), *A. aureolatum* (10/50; 20 %), *A. brasiliense* (5/50; 10 %), *A. ovale* (5/50; 10 %) and *A. parkeri* (4/50; 8%). A total of 51 non-fatal and five fatal SF cases were recorded. Data from this study highlights the need for monitoring ticks parasitizing humans aiming early detection of tick-borne diseases cases, particularly BSF in Paraná State, southern Brazil.

1. Introduction

Spotted-fever group (SFG) rickettsiae are transmitted by an array of tick species and may cause mild to severe human infectious disease (Szabó et al., 2013a). In Brazil, at least eight rickettsial agents have been recognized; however only two, *Rickettsia rickettsii* and *Rickettsia parkeri* strain Atlantic rainforest, have been detected infecting humans (Luz et al., 2017a; Nieri-Bastos et al., 2014; Parola et al., 2013).

Epidemiology of the rickettsioses is determined by specific tick vector geographic and micro-environmental distribution (Szabó et al., 2013a). Brazilian spotted fever (BSF), caused by the SFG agent *R. rickettsii,* is considered the main human tick-borne disease occurring in Brazil and the deadliest rickettsiosis in the world (Labruna, 2009). Main vectors of *R. rickettsii* in Brazil are the ticks *A. sculptum* and *A. aureolatum* (Szabó et al., 2013a). Human cases of a milder SFG rickettsiosis, caused by *R. parkeri* strain Atlantic rainforest, have been associated with the transmission by *A. ovale* ticks in Brazil (Sevá et al., 2019).

In the last years, cases of SFG rickettsioses, including BSF, have been increasing in Brazil (Oliveira et al., 2016a), particularly in Paraná State. Although BSF has been classified as a disease of compulsory notification since 2001, few Brazilian municipalities officially record human parasitism by ticks. Thus, there are still limited data available on tick species

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Table 1
Records of human parasitism by ticks in Paraná State, southern Brazil (1988–2019).

Tick species	Municipality	Year	Cases	Tick stages	Collection accession No.	Reference
Amblyomma aureolatum	Almirante Tamandaré	1995	1	1 (1 M)	MHNCI - 1350	Arzua et al., 2005
	São José dos Pinhais	1993	1	1 (1 M)	MHNCI - 1343	Arzua et al., 2005
	Curitiba	2003	1	1 (1 F)	MHNCI - 1354	Arzua et al., 2005
	São José dos Pinhais	2017	1	1 (1 M)	SESA - 013/2018	this study
	Tijucas do Sul	2017	1	1 (1 F)	SESA - 015/2018	this study
	São Mateus do Sul	2017	1	1 (1 F)	SESA - 014/2018	this study
	Mandirituba	2018	1	1 (1 M)	SESA - 053/2018	this study
	São José dos Pinhais	2018	1	1 (1 F)	SESA - 057/2018	this study
	Paulo Frontin	2018	1	1 (1 N)	SESA - 085/2018	this study
	Campo Largo	2018	1	1 (1 M)	SESA - 056/2019	this study
		Subtotal	10 (20 %)	10 (16 %)		
Amblyomma brasiliense	Guaraqueçaba	1994	1	1 (1 N)	MHNCI - 124	this study
	Colombo	2000	1	1 (1 N)	MHNCI - 1348	this study
	Adrianópolis	2000	1	1 (1 M)	MHNCI - 1353	Arzua et al., 2005
	Campina Grande do Sul	2000	1	1 (1 N)	MHNCI - 1382	this study
	Londrina	2004	1	2 (1 M, 1 F)	–	Guglielmone et al., 2006
		Subtotal	5 (10 %)	6 (9%)		
Amblyomma calcaratum	Guaraqueçaba	1994	1	1 (1 N)	MHNCI - 1347	this study
		Subtotal	1 (2%)	1 (2%)		
Amblyomma dubitatum	Pinhais	2017	1	1 (1 N)	VBDL - 165	this study
	Rio Bom	2018	1	1 (1 N)	SESA - 087/2018	this study
		Subtotal	2 (4%)	2 (3%)		
Amblyomma incisum	Pinhão	1991	1	2 (2 N)	MHNCI - 90	Arzua et al., 2005
	Ponta Grossa	1999	1	1 (1 N)	MHNCI - 1344	this study
	Fazenda Rio Grande	2000	1	1 (1 N)	MHNCI - 1351	this study
		Subtotal	3 (6%)	4 (6%)		
Amblyomma longirostre	Fênix	1988	1	1 (1 N)	MHNCI - 436	Arzua et al., 2005
	Almirante Tamandaré	2002	1	1 (1 N)	MHNCI - 1359	this study
	Porto Vitória	2018	1	1 (1 N)	SESA - 035/2018	this study
		Subtotal	3 (6%)	3 (5%)		
Amblyomma ovale	Morretes	1994	1	1 (1 F)	MHNCI - 1349	Arzua et al., 2005
	Morretes	2006	1	1 (1 F)	MHNCI - 1681	this study
	Antonina	2019	1	3 (2 M, 1 F)	SESA - 073/2019	this study
	Morretes	2019	1	1 (1 M)	SESA - 087/2019	this study
	Porto Barrreiro	2019	1	1 (1 M)	SESA - 162/2019	this study
		Subtotal	5 (10 %)	7 (11 %)		
Amblyomma parkeri	Curitiba	2006	1	1 (1 N)	MHNCI - 1859	this study
	São José dos Pinhais	2017	1	2 (2 N)	SESA - 013/2018	this study
	Lapa	2018	1	1 (1 N)	SESA - 052/2018	this study
	Campo Largo	2019	1	1 (1 N)	SESA - 111/2019	this study
		Subtotal	4 (8%)	5 (8%)		
Amblyomma scalpturatum	Londrina	2010	1	1 (1 M)	–	Onofrio et al., 2010
		Subtotal	1 (2%)	1 (2%)		
Amblyomma sculptum	Adrianópolis	1992	1	5 (4 M,1 F)	MHNCI - 1342	Arzua et al., 2005
	Adrianópolis	1992	1	5 (4 M,1 F)	MHNCI - 99	Arzua et al., 2005
	Adrianópolis	1993	1	1 (1 N)	MHNCI - 1524	Arzua et al., 2005
	Adrianópolis	1993	1	1 (1 N)	MHNCI - 1525	Arzua et al., 2005
	Guaraqueçaba	1994	1	1 (1 F)	MHNCI - 1345	Arzua et al., 2005
	Paranaguá	2018	1	1 (1 N)	SESA - 083/2018	this study
	Rio Bom	2018	1	2 (2 N)	SESA - 056/2018	this study
	Paulo Frontin	2019	1	1 (1 N)	SESA - 112/2019	this study
	Rio Bom	2019	1	1 (1 N)	SESA - 159/2019	this study
	Paranaguá	2019	1	1 (1 N)	VBDL - 449	this study
	Paranaguá	2019	1	1 (1 N)	SESA	this study
	Paranaguá	2019	1	1 (1 N)	SESA	this study
	Paranaguá	2019	1	1 (1 N)	SESA	this study
		Subtotal	13 (26 %)	22 (34 %)		
Haemaphysalis juxtakochi	Curitiba	1992	1	1 (1 M)	MHNCI - 1390	Arzua et al., 2005
	Curitiba	1996	1	1 (1 F)	MHNCI - 1394	Arzua et al., 2005
		Subtotal	2 (4%)	2 (3%)		
Rhipicephalus sanguineus sensu lato	Pinhais	2018	1	1 (1 M)	SESA - 012/2018	this study
		Subtotal	1 (2%)	1 (2%)		
		Total	50 (100 %)	64 (100 %)		

VBDL, Vector-Borne Diseases Laboratory; MHNCI, Capão da Imbuia Museum of Natural History; SESA, State Health Department of Paraná (*Secretaria Estadual de Saúde*); M, male; F, female; N, nymph.

parasitizing humans in the country (Dantas-Torres et al., 2006; Oliveira et al., 2018; Labruna et al., 2007a; Reck et al., 2018; Serra-Freire et al., 2011; Serra-Freire, 2010), particularly in Paraná State (Arzua et al., 2005; Guglielmone et al., 2006; Onofrio et al., 2010). Accordingly, the aims of this study were i) to map the distribution of known tick vectors of SFG rickettsiae, ii) to describe and map the distribution of human parasitism by ticks, and iii) to map the distribution of non-fatal and fatal cases of SFG rickettsioses in Paraná State, southern Brazil.

2. Materials and methods

Paraná State is divided into geographical regions following the criterion adopted by the Paranaense Institute for Economic and Social Development (Ipardes, 2012), which subdivides the state into ten mesoregions: Curitiba Metropolitan (CM), East Central (EC), North Pioneering (NP), North Central (NC), Northwest (NW), West (W), West Central (WC), Southwest (SW), South Central (SC), and Southeast (SE). The State of Paraná is predominantly located in the Atlantic rainforest biome, with solely the EC mesoregion in the Cerrado biome (Brasil, 2018). The climate across Paraná State presents great variability. According to Köppen's classification, the central and southern regions present predominantly a temperate climate (Cfb), with average temperatures between 10 − 15 °C in the winter and 17 − 22 °C in the summer. However, the northern, western, southern and coastal regions present subtropical climate (Cfa), characterized by average temperatures between 15 − 21 °C in the winter and 22 − 27 °C in the summer (Iapar, 2019).

The geographical distribution of SFG rickettsia vectors (*A. sculptum, A. aureolatum* and *A. ovale*) in Paraná State was performed using unpublished data from active surveillance studies performed by the State Health Department of Paraná (*Secretaria Estadual de Saúde* – SESA), and records of ticks deposited in the following scientific collections: "Coleção de Ectoparasitos" at the Capão da Imbuia Museum of Natural History (MHNCI) and "Coleção Científica de Carrapatos" at the Vector-Borne Diseases Laboratory (VBDL), Universidade Federal do Paraná. Additionally, we reviewed and compiled tick records from previously published studies (Arzua et al., 2005, 2003; Batista et al., 2010; Blanco et al., 2017; Fortes et al., 2011; de O. Freitas et al., 2010; Gonçalves et al., 2013, 2011; Labruna et al., 2001; Luz et al., 2017b; Magalhães-Matos et al., 2017; Martins et al., 2016; Nascimento et al., 2016; Nava et al., 2010; Nieri-Bastos et al., 2016; Pacheco et al., 2012; Ribeiro et al., 2017; da Silva et al., 2017; Tamekuni et al., 2011, 2010; Toledo et al., 2008, 2011a; Toledo et al., 2011b; Vieira et al., 2016, 2013; Massini et al., 2019). The review of published articles was conducted through a computerized search in the PubMed (http://www.ncbi.nlm.nih.gov/pubmed) and SciELO (http://www.scielo.org/) electronic databases, using the following general descriptors (keywords): ticks, tick-borne diseases, vector-borne diseases, *Amblyomma*, Ixodidae, Brazilian Spotted Fever, *Rickettsia*, *Theileria*, *Anaplasma, Ehrlichia* and *Babesia*. The same descriptors in English were also searched for in the SciELO database, with additional Portuguese translations as keywords. Since the predominance of *A. dubitatum* over *A. sculptum* may also have direct implications on *R. rickettsii* occurrence, particularly in BSF non-endemic areas (Luz et al., 2019), the geographical distribution of *A. dubitatum* in Paraná State was also performed. The tick collection methods were classified in host, actively (cloth dragging or human bait) and passively (CO_2 traps) (Mayo et al., 2015; SUCEN, 2004) when this information was available. All data of SFG rickettsia vectors are presented in Table S1.

We reviewed and compiled tick records on humans from previous studies (Arzua et al., 2005; Guglielmone et al., 2006; Onofrio et al., 2010), and unpublished records of ticks parasitizing humans from 25 municipalities of Paraná State, southern Brazil, between 1988 and 2019, provided by the SESA and those deposited in the MHNCI and VBDL scientific collections. Tick specimens collected from humans were kept in absolute ethanol-labeled tubes at MHNCI or VBDL scientific collections, and identified by morphologic dichotomous keys (Barros-Battesti et al., 2006; Martins et al., 2010). The scientific collections were visited during 2019, and all the nymphs compiled in this study were reviewed and identified at the species level according to criteria established by Martins et al. (2010). All records of human parasitism by ticks in Praná State are presented in Table 1.

Non-fatal and fatal cases of SFG rickettsioses in Paraná State, between 2007 and 2017, were retrieved from the Notifiable Diseases Information System (SINAN) (Brasil, 2019). SINAM is a platform created by the Brazilian Ministry of Health which aims to collect, gather and disseminate data on this disease group (Brasil, 2016). Additionally, records of SFG rickettsioses that occurred between 2018 and September 2019 were provided by the SESA. SFG rickettsioses were confirmed when signs, symptoms and epidemiological history matched the suspected case definition and when infection with a SFG *Rickettsia* species was laboratory testing confirmed (Brasil, 2014). The laboratory testing recommended for SF by the Brazilian Ministry of Health consists of a fourfold change in immunoglobulin G (IgG)-specific antibody titers reactive to *R. rickettsia* SF group antigens by indirect immunofluorescence assay (IFA), between paired serum samples (one in the first week of illness and a second 2–4 weeks later). Moreover, it is also recommended the detection of SF group *Rickettsia* DNA in a clinical sample by PCR assay, demonstration of SF group antigens in a biopsy/autopsy sample by immunohistochemistry, or isolation of SF group *Rickettsia* from a clinical sample in cell culture (Brasil, 2014; Oliveira et al., 2016a).

Average coefficients of incidence of SF were calculated for municipalities of Paraná State (cases/100,000 inhabitants per year) (IBGE, 2019). The locations of cases of human parasitism by ticks, the distribution of tick vectors of SFG rickettsiae, average coefficients of incidence and cases of SFG rickettsioses were plotted using the geographical information system software Quantum GIS 2.18.19 (GNU, Boston, MA, USA). The kernel analysis was used to convert point data into continuous surfaces ("kernel density themes") expressing the intensity per square km of the occurrence of tick bites. The kernel density themes were estimated using a bandwidth of 20 km.

3. Results

The geographical distribution of tick vectors of SFG rickettsiae (*A. sculptum*, *A. aureolatum* and *A. ovale*) and *A. dubitatum* is shown in Fig. 1. Overall, we obtained 84/514 (16 %) records for *A. sculptum*, 266/514 (52 %) for *A. aureolatum*, 65/514 (13 %) for *A. ovale*, and 99/514 (19 %) *A. dubitatum*. Detailed data (collection accession number or reference, host or environment, tick stage, year, municipality, and mean altitude) for these four tick species are shown in Table S1.

Fifty cases of human parasitism by ticks were recorded, with a total of 64 (22 males, 12 females, 30 nymphs) tick specimens collected. The following 12 tick species were identified: *A. aureolatum, A. brasiliense, A. calcaratum, A. dubitatum, A. incisum, A. longirostre, A. ovale, A. parkeri, A. scalpturatum, A. sculptum, H. juxtakochi,* and *R. sanguineus* (s.l.). The most prevalent tick species associated to cases of human parasitism were *A. sculptum*, with 22/64 (34 %; CI 95 %: 23–47 %) ticks collected from 13/50 (26 %; CI 95 %: 15–40 %) human cases, and *A. aureolatum*, with 10/64 (16 %; CI 95 %: 8–26 %) ticks collected from 10/50 (20 %; CI 95 %: 10–34 %) human cases. Tick specimens parasitizing humans were collected at the municipalities of Adrianópolis, Almirante Tamandaré, Antonina, Campina Grande do Sul, Campo Largo, Colombo, Curitiba, Fazenda Rio Grande, Fênix, Guaraqueçaba, Lapa, Londrina, Mandirituba, Morretes, Paranaguá, Paulo Frontin, Pinhais, Pinhão, Ponta Grossa, Porto Barrreiro, Porto Vitória, Rio Bom, São José dos Pinhais, São Mateus do Sul, and Tijucas do Sul. An overview of the spatial distribution of cases of human parasitism by ticks in Paraná State is shown in Fig. 2. Detailed information for each of the 50 cases are shown in Table 1.

A total of 51 non-fatal and five fatal cases of SFG rickettsioses were recorded. The majority of cases were concentrated in the CM mesoregion (n = 24), followed by W (n = 10) and NP (n = 8) mesoregions. All five fatal cases occurred in the NP mesoregion of the State. In this regard, it is important to note that the fatal case from Ribeirão Claro was initially registered in the SINAN database as from the municipality of São Carlos do Ivaí (NW mesoregion); however, a prospective epidemiological investigation on this case concluded that it was acquired in Ribeirão Claro, as detailed by de Oliveira et al. (2016b). The municipalities of Paranaguá (6/51; 12 %, 95 % CI: 4–24 %) and Guaratuba (5/

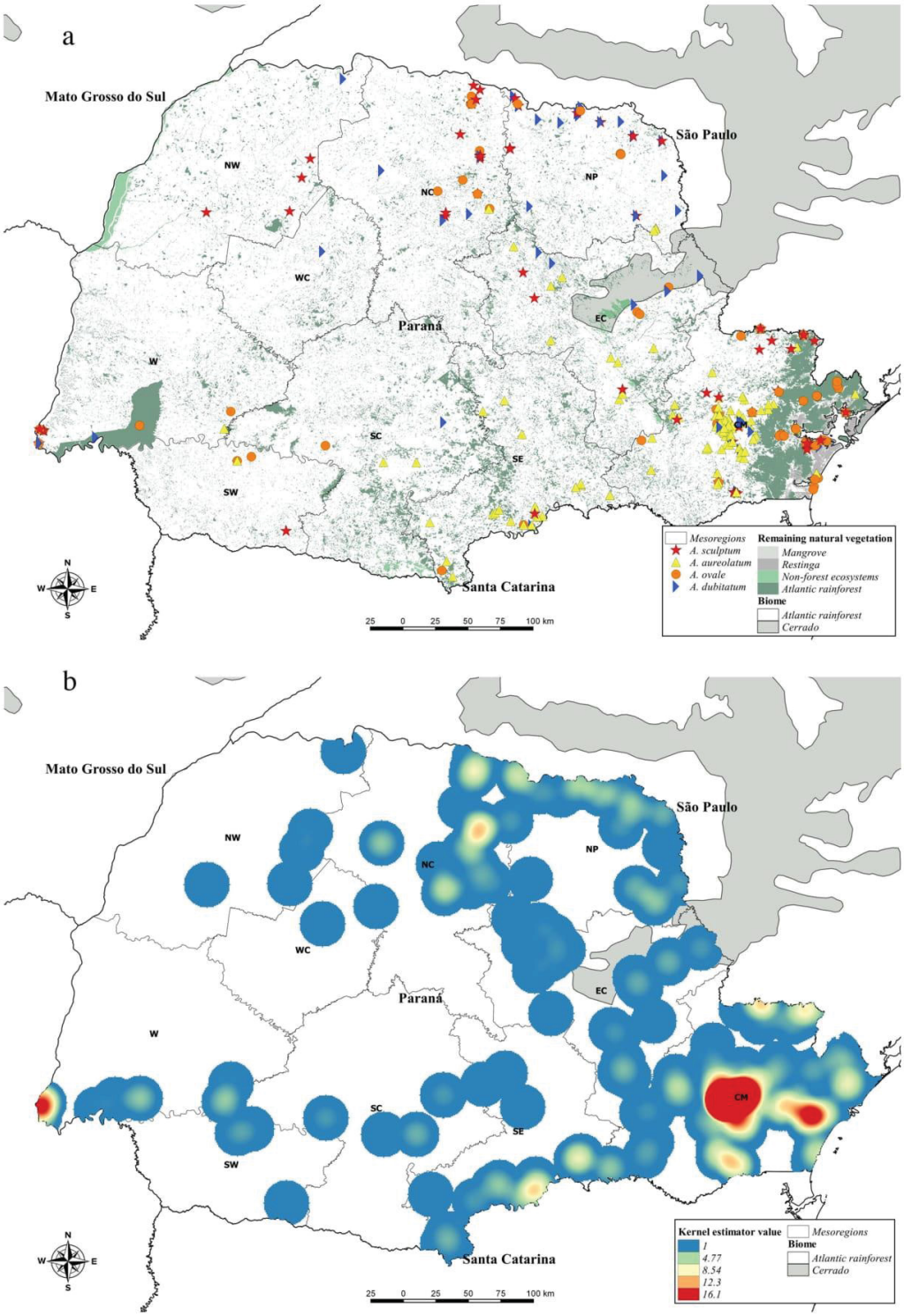

Fig. 1. a Geographical distribution of tick vectors of spotted fever group rickettsiae in Paraná state, southern Brazil. b Kernel density of the proportion of tick vectors of spotted fever group rickettsiae in Paraná state, southern Brazil.

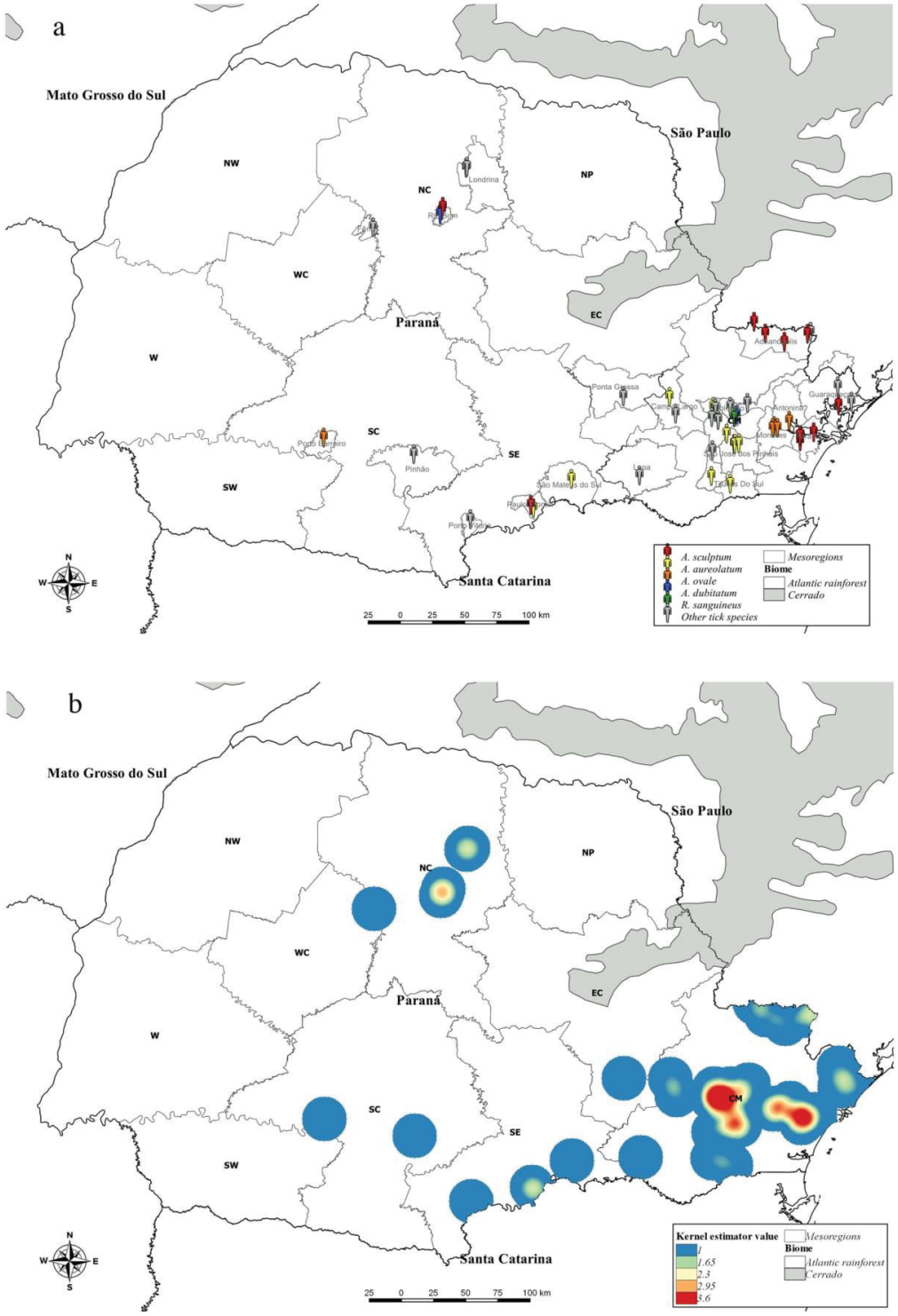

Fig. 2. a Geographical distribution of human parasitism by ticks in Paraná state, southern Brazil. b Kernel density of the proportion of human parasitism by ticks in Paraná state, southern Brazil.

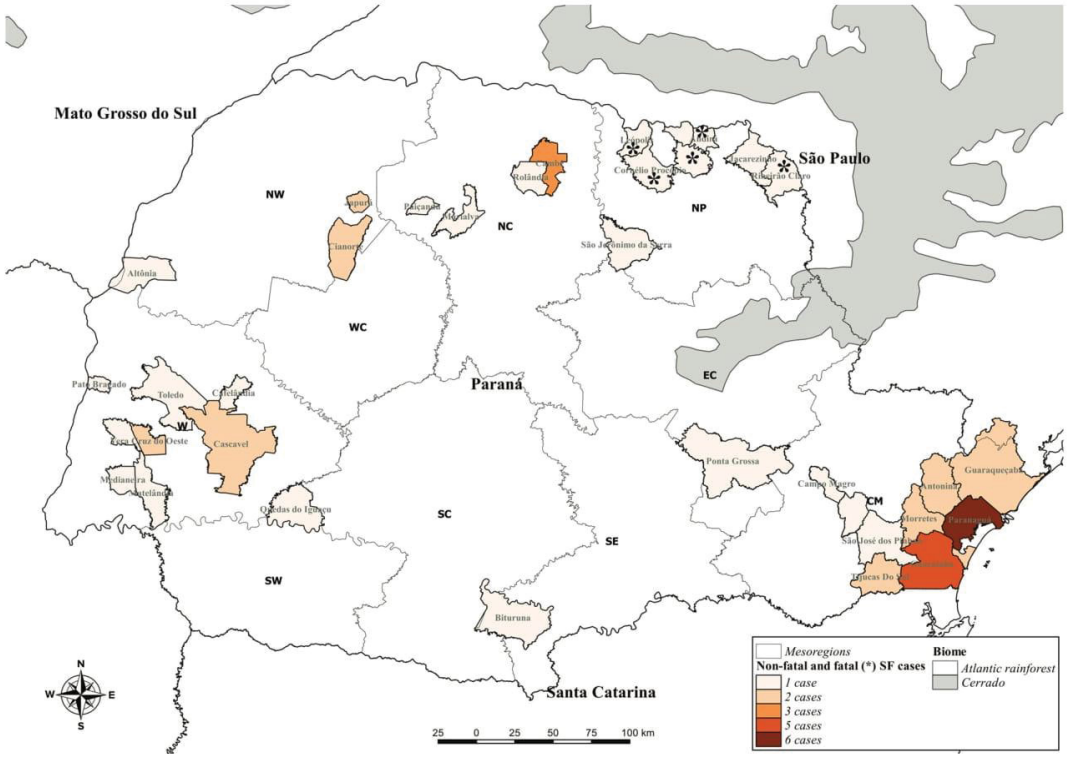

Fig. 3. Geographical distribution of non-fatal and fatal cases of spotted fever group rickettsiosis in Paraná state, southern Brazil.

51; 10 %, 95 % CI: 3–21 %), both located in the CM mesoregion, registered the majority of non-fatal cases. The geographical distribution of non-fatal and fatal cases of SFG rickettioses is shown in Fig. 3. Detailed information for the cases are shown in Table 2. The geographical distribution of the incidence rate of SFG rickettsiosis is shown in Fig. 4.

4. Discussion

In the present study, we evaluated the geographical distribution of tick vectors (*A. sculptum*, *A. aureolatum* and *A. ovale*) of SFG rickettsiae and *A. dubitatum* in Paraná State. Based on the assessed data, *A. aureolatum* and *A. ovale* were found widespread across the State (Fig. 1a); however, with *A. aureolatum* mainly at municipalities with elevation > 700 m in the CM and SE mesoregions, and *A. ovale* mainly in the coastal region and in NC and SW mesoregions (< 300 m) of the State (Fig. 1a). This distribution pattern is in agreement with a previous studies in the state of São Paulo (the northern neighboring state to Paraná), where the odds of finding *A. aureolatum* was higher in municipalities > 700 m above the sea level, while *A. ovale* had its odds ratio diminishing at higher altitudes (Barbieri et al., 2015). On the other hand, there were several locations where both *A. aureolatum* and *A. ovale* were found occurring sympatrically (Fig. 1a), as previously reported in the state of Santa Catarina, the southern neighboring state to Paraná (Medeiros et al., 2011). However, it is important to emphasize that there is a lack of surveillance studies in the areas where the presence of ticks is not reported in the map.

Overall, 20 % and 10 % of the cases of human parasitism in Paraná State were by *A. aureolatum* and *A. ovale* ticks, respectively. Cases of human parasitism by these tick species were concentrated in the municipalities of the CM mesoregion (Fig. 2a), following the geographical distribution of these two tick species (Fig. 1a). Kernel analysis (Fig. 2b) shown that hot spots comprised the municipalities of the CM mesoregion. Considering that municipalities among this mesoregion have easier access to health care facilities and reference laboratories, the identification of cases of human parasitism by ticks may have been facilitated, as previously described for other metropolitan areas (Reck et al., 2018).

Amblyomma sculptum was the most common tick species parasitizing humans in Paraná State, particularly in Paranaguá and Adrianópolis municipalities, both located at the CM mesoregion (Fig. 2a). In the present study, this tick species was mainly found in the NP mesoregion and also in the municipalities bordering São Paulo State (Fig. 1a). In natural conditions, *A. sculptum* is widely distributed across the Cerrado and Pantanal biome (Martins et al., 2016), since the high humidity of rainforests seems to be a detrimental condition to this tick species (Labruna, 2018; Szabó et al., 2007). The occurrence of *A. sculptum* in the Atlantic rainforest biome is restricted to areas where the natural vegetation cover has been replaced by secondary vegetation (Martins et al., 2016), such as the Paranaguá municipality where the majority of cases of human parasitism by this tick species were recorded (Table 2).

In the Southern region of Brazil, cases of SFG rickettsioses have been attributed mostly to *R. parkeri* strain Atlantic rainforest (Oliveira et al., 2016a; Krawczak et al., 2016), which is transmitted by *A. ovale* ticks, and is characterized as a milder SF (Sevá et al., 2019; Spolidorio et al., 2010). In Paraná State, 43 % of the cases have occurred in the CM mesoregion, particularly in the coastal municipalities (Fig. 3). In this region, *A. ovale* has been the main tick species found (Fig. 1a), which may explain the absence of fatal cases. However, it is important to consider that Paranaguá municipality has registered the majority of cases of human parasitism by *A. sculptum*, the vector of *R. rickettsii*, and thus further studies should be performed to determine the *Rickettsia* species infecting human-biting ticks occurring in that area. Furthermore, access to healthcare facilities in more rural locations may impact the reporting of human cases as well as the reporting of human

Table 2
Records of non-fatal and fatal cases of spotted fever group-rickettsioses in Paraná State, Brazil (2007–2019).

		Non-fatal and fatal (*) cases per year													
Mesoregion	Municipality	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
Curitiba Metropolitan (CM)	Antonina	–	–	–	–	–	–	–	–	–	–	–	–	2	2
	Paranaguá	–	–	–	–	–	1	–	–	–	–	2	–	3	6
	Guaratuba	1	–	–	–	–	–	–	–	–	–	–	1	3	5
	Guaraqueçaba	–	–	–	1	–	–	–	–	–	–	–	–	1	2
	Matinhos	–	1	–	–	1	–	–	–	–	–	–	–	–	2
	Tijucas do Sul	–	–	–	–	–	–	–	2	–	–	–	–	–	2
	Campo Magro	–	–	–	–	–	–	1	–	–	–	–	–	–	1
	Curitiba	–	–	–	–	–	–	–	–	–	–	1	–	–	1
	Morretes	–	–	–	–	–	–	–	–	–	–	–	–	2	2
	São José dos Pinhais	–	–	–	–	–	–	–	–	–	–	1	–	–	1
	Subtotal														24 (43 %)
West (W)	Cascavel	–	–	–	–	–	–	–	–	1	–	–	–	1	2
	Vera Cruz do Oeste	–	1	–	–	–	–	–	–	–	–	–	1	–	2
	Diamante D'Oeste	1	–	–	–	–	–	–	–	–	–	–	–	–	1
	Matelândia									–	–	–	–	1	1
	Medianeira	–	–	–	–	–	1	–	–	–	–	–	–	–	1
	Pato Bragado	–	–	–	–	–	–	–	–	1	–	–	–	–	1
	Toledo	–	–	–	–	–	–	–	–	1	–	–	–	–	1
	Cafelândia	–	–	–	–	–	–	–	–	–	–	–	–	1	1
	Subtotal														10 (18 %)
North Pioneering (NP)	Andirá	–	–	1*	–	–	–	–	–	–	–	–	–	–	1
	Bandeirantes	–	–	–	–	–	–	–	–	1*	–	–	–	–	1
	Cornélio Procópio	–	–	–	–	–	–	–	–	–	–	1*	–	–	1
	Itambaracá	–	–	–	–	–	–	–	–	–	1	–	–	–	1
	Jacarezinho	–	–	–	–	1	–	–	–	–	–	–	–	–	1
	Leópolis	–	–	–	1*	–	–	–	–	–	–	–	–	–	1
	São Jerônimo da Serra	–	–	–	–	–	–	–	1	–	–	–	–	–	1
	Ribeirão Claro (registered in São Carlos do Ivaí)	–	–	–	–	–	–	–	–	1*	–	–	–	–	1
	Subtotal														8 (14 %)
Northwest (NW)	Cianorte	–	–	–	–	–	–	1	–	–	1	–	–	–	2
	Japurá	–	–	–	–	–	–	–	–	–	–	2	–	–	2
	Altônia	–	–	–	–	–	–	–	–	1	–	–	–	–	1
	Subtotal														5 (9%)
North Central (NC)	Cambé	–	–	–	–	–	1	–	–	–	–	–	–	2	3
	Marialva	–	–	–	1	–	–	–	–	–	–	–	–	–	1
	Paiçandu	–	–	–	–	–	–	–	–	–	–	1	–	–	1
	Rolândia	–	–	–	–	–	–	–	–	–	–	1	–	–	1
	Subtotal														6 (11 %)
East Central (EC)	Ponta Grossa	–	–	–	–	–	–	–	–	–	1	–	–	–	1
	Subtotal														1 (2%)
South Central (SC)	Quedas do Iguaçu	–	–	–	–	–	–	–	–	–	–	1	–	–	1
	Subtotal														1 (2%)
Southeast (SE)	Bituruna	–	–	–	–	–	1	–	–	–	–	–	–	–	1
	Subtotal														1 (2%)
	Total	2	2	1	3	2	4	2	3	6	3	10	2	16	56 (100 %)

parasitism by ticks.

The NP mesoregion of Paraná State has concentrated 100 % of the fatal cases of SFG rickettsiosis (Fig. 3). In fact, *A. sculptum* was the most prevalent tick species in the municipalities bordering São Paulo State (Fig. 1a). A recent study demonstrated that at least one of these cases, the one from Ribeirão Claro municipality, was caused by *R. rickettsii,* the agent of BSF (de Oliveira et al., 2016b). Therefore, we can assume that the remaining fatal cases of the NP mesoregion were caused by *R. rickettsii,* which is so far the only SFG agent known to cause fatalities in Brazil (Oliveira et al., 2016a). In Brazil, BSF frequently goes unrecognized as a diagnostic hypothesis and is frequently confused with more prevalent illnesses, such as dengue fever, which was first suspected in at least one of the SFG fatal case in Paraná State (de Oliveira et al., 2016b). Thus, considering the importance of introducing early adequate antibiotic treatment, the fatal cases occurred in this region may be associated with the low rate of suspicion of SFG rickettsiosis by the health care professionals (de Oliveira et al., 2016b). Additionally, there is a lack of information regarding the tick species parasitizing humans from the NP mesoregion, which we attributed to the absence of more healthcare facilities in that region.

Amblyomma dubitatum ticks were mainly found in the North region of Paraná State, particularly in the NP mesoregion (Fig. 1a). Herein, we report the first case of human parasitism by this tick species in Paraná State. The high occurrence of capybaras in the CM mesoregion, particularly at public parks of Curitiba City and surroundings, associated to the high infestation of *A. dubitatum* ticks may explain the spontaneous parasitism of this tick species on humans. A previous case of human parasitism by *A. dubitatum* has been reported in a researcher in São Paulo State while he was working with dry ice traps in the field, which may have caused an excitatory effect on ticks (Labruna et al., 2007a). The importance of *A. dubitatum* as a vector of pathogens to humans is still unknown. While laboratory studies have demonstrated vector competence of *A. dubitatum* for *R. rickettsii* (Sakai et al., 2014), this tick species has never been found naturally infected by this rickettsial agent. In fact, this ticks is usually found naturally infected at high infection rates by the non-pathogenic agent *Rickettsia bellii* (Pacheco et al., 2009) and field studies have indicated that the abundance of this tick species is associated with absence of BSF cases in a given area (Luz et al., 2019).

Amblyomma parkeri adult ticks are commonly found on porcupines (*Sphiggurus spinosus,* and *Sphiggurus villosus*), while immatures stages

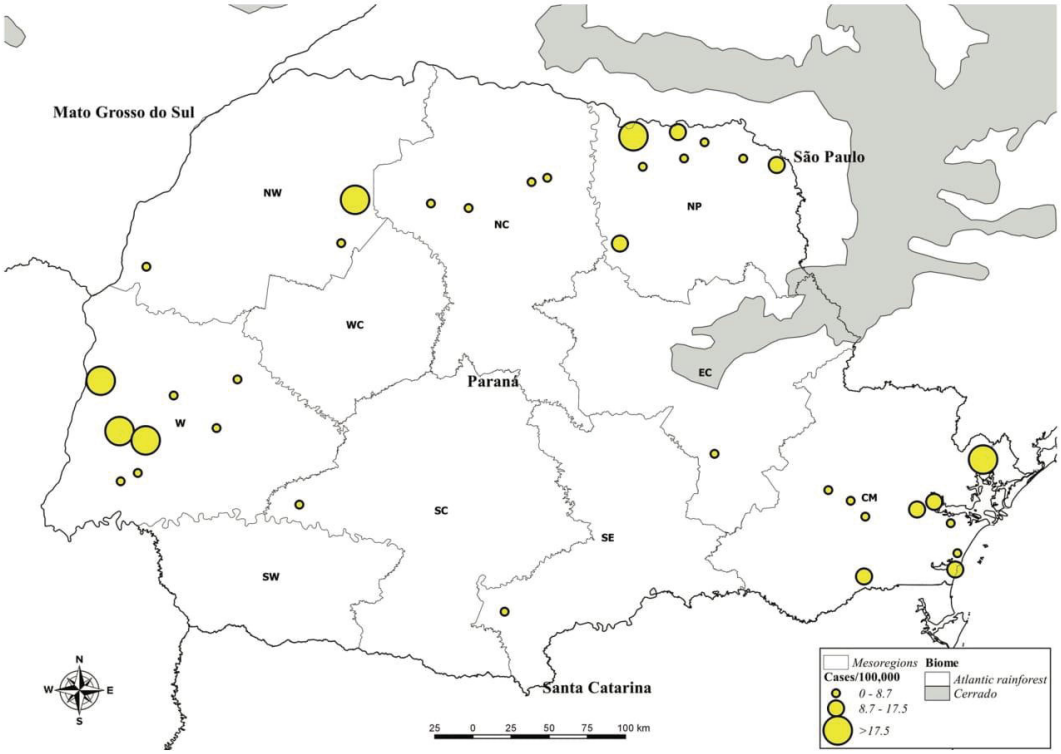

Fig. 4. Geographical distribution of the incidence rate of spotted fever group rickettsiosis in Paraná state, southern Brazil.

appear parasitizing birds (Guglielmone et al., 2014). In the present study, 8% of the human cases of tick parasitism were attributed to *A. parkeri* nymphs. Cases of human parasitism by *A. parkeri* nymphs have also been registered in São Paulo (Martins et al., 2013). Moreover, in Rio Grande do Sul, the southernmost state of Brazil, *A. parkeri* was the most prevalent tick species parasitizing humans, and all were associated to nymphs (Reck et al., 2018). Therefore, considering that a taxonomic key to identify *Amblyomma* spp. nymphs from Brazil has only became recently available (Martins et al., 2010), cases of human parasitism by *A. parkeri* may have been underreported.

A new rickettsial strain, '*Candidatus* Rickettsia paranaensis', has been detected infecting *A. parkeri* ticks collected from wild birds from Paraná (Pacheco et al., 2012) and Rio de Janeiro State (Luz et al., 2017a). Additionally, 9/12 (75 %) *A. parkeri* nymphs parasitizing humans from Paraná, Santa Catarina and Rio Grande do Sul States, all located in southern Brazil, were infected by '*Candidatus* R. paranaensis' (Borsoi et al., 2019). Since '*Ca.* R. paranaensis' is phylogenetically closest related to *Rickettsia sibirica* and *Rickettsia africae,* agents of non-fatal SFG rickettsiosis in the Old World (Peckle et al., 2019), further studies are needed to investigate the role of *A. parkeri* in transmitting '*Ca.* R. paranaensis' to humans, and if some of the non-fatal cases of SFG rickettsioses in southern Brazil were caused by this novel agent.

Amblyomma brasiliense and *A. incisum* comprised 10 % and 6%, respectively, of the human cases of tick parasitism. Previous reports of human infestation by these two tick species referred mostly to immature stages (Szabó et al., 2006), similarly to the present study. In the present study, 3/4 cases of human parasitism by *A. brasiliense* occurred in the CM mesoregion. However, the role of this tick species in SF cases is unknown since previous studies have not detected rickettsial agents infecting *A. brasiliense* (Luz et al., 2018; Sabatini et al., 2010; Szabó et al., 2013b).

We report the first case of human parasitism by *R. sanguineus* s.l. in Paraná Sate. The potential of this tick species as a vector is still underestimated among Brazilian scientists and health authorities (Reck et al., 2018). In Rio Grande do Sul State, this tick species is the second most prevalent tick on humans (Reck et al., 2018). Moreover, human parasitism by *R. sanguineus* s.l. was also reported in São Paulo (Guglielmone et al., 2006), Rio de Janeiro (Serra-Freire et al., 2011), Mato Grosso do Sul (Acosta et al., 2017) and Pernambuco States (Dantas-Torres et al., 2006). Lineages of *R. sanguineus* s.l. are reported to have a latitude related geographical pattern (tropical and temperate) (Hornok et al., 2017; Moraes-Filho et al., 2015). *R. sanguineus* from Rio Grande do Sul State (temperate) is a different lineage from elsewhere in Brazil (tropical). Thus, anthropophilic behavior of those described by Reck et al. (2018) – second most prevalent tick biting humans – probably differ from elsewhere in the country. The vector competence of *R. sanguineus* s.l. to transmit *R. rickettsii* and the role of dogs, the main host, as an amplifier of *R. rickettsii* has been experimentally demonstrated in Brazil (Piranda et al., 2011). In addition, there have been several reports of *R. sanguineus* naturally infected by *R. rickettsii* in Brazil (Moraes-Filho et al., 2009; Ogrzewalska et al., 2012; Pacheco et al., 2011). Thus, the epidemiological significance of *R. sanguineus* s.l. in the transmission of *R. rickettsii* to humans in BSF-endemic areas should be further investigated, since this tick species is the primary vector of this rickettsial agent in parts of Mexico and the United States (Álvarez-Hernández et al., 2017; Demma et al., 2005).

Other tick species that were found parasitizing humans in Paraná State at low rates, such as *A. longirostre, A. calcaratum, A. scalpturatum* and *H. juxtakochi.* While some of these tick species have been found infected by different SFG rickettsial agents of unknown pathogenicity to humans – *Rickettsia amblyommatis* (de Abreu et al., 2019) and *Rickettsia rhipicephali* (Labruna et al., 2007b) – their role as vectors of disease agents to humans remain unknown.

5. Conclusion

The geographical distribution of tick vectors of SFG agents shows that *A. aureolatum* and *A. ovale* are widespread across Paraná State. *A. sculptum* and *A. aureolatum* were most prevalent tick species associated to cases of human parasitism. The NP mesoregion has concentrated 100 % of the fatal cases of SFG rickettisosis, while the non-fatal cases have occurred mainly in the CM mesoregion of Paraná State. This is the first report of human parasitism by *A. dubitatum* and *R. sanguineus* s.l. ticks in Paraná State. These are preliminary results relating to the distribution of tick vectors responsible for the transmission of SFG rickettsiae in Paraná state. Further evaluations such as the testing of tick samples and thorough conducting of active surveillance are needed to complete any gaps.

CRediT authorship contribution statement

Jessica D.M. Valente: Data curation, Formal analysis, Methodology, Writing - original draft, Writing - review & editing. **Patrícia W. Silva:** Data curation, Methodology, Resources. **Márcia Arzua:** Data curation, Methodology, Resources. **Darci M. Barros-Battesti:** Data curation, Methodology, Resources. **Thiago F. Martins:** Formal analysis, Methodology, Writing - review & editing. **Aparecida M. Silva:** Data curation, Methodology. **Thállitha S.W.J. Vieira:** Conceptualization, Methodology, Supervision. **Marcelo B. Labruna:** Conceptualization, Writing - review & editing. **Rafael F.C. Vieira:** Conceptualization, Project administration, Resources, Supervision, Writing - original draft, Writing - review & editing.

Declaration of Competing Interest

The authors declared no conflict of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.ttbdis.2020.101510.

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5. Conclusion

The geographical distribution of tick vectors of SFG agents shows that *A. aureolatum* and *A. ovale* are widespread across Paraná State. *A. sculptum* and *A. aureolatum* were most prevalent tick species associated to cases of human parasitism. The NP mesoregion has concentrated 100 % of the fatal cases of SFG rickettisosis, while the non-fatal cases have occurred mainly in the CM mesoregion of Paraná State. This is the first report of human parasitism by *A. dubitatum* and *R. sanguineus* s.l. ticks in Paraná State. These are preliminary results relating to the distribution of tick vectors responsible for the transmission of SFG rickettsiae in Paraná state. Further evaluations such as the testing of tick samples and thorough conducting of active surveillance are needed to complete any gaps.

CRediT authorship contribution statement

Jessica D.M. Valente: Data curation, Formal analysis, Methodology, Writing - original draft, Writing - review & editing. **Patrícia W. Silva:** Data curation, Methodology, Resources. **Márcia Arzua:** Data curation, Methodology, Resources. **Darci M. Barros-Battesti:** Data curation, Methodology, Resources. **Thiago F. Martins:** Formal analysis, Methodology, Writing - review & editing. **Aparecida M. Silva:** Data curation, Methodology. **Thállitha S.W.J. Vieira:** Conceptualization, Methodology, Supervision. **Marcelo B. Labruna:** Conceptualization, Writing - review & editing. **Rafael F.C. Vieira:** Conceptualization, Project administration, Resources, Supervision, Writing - original draft, Writing - review & editing.

Declaration of Competing Interest

The authors declared no conflict of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.ttbdis.2020.101510.

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6 APÊNDICE 2 – ARTIGO SUBMETIDO

Estudo paralelo relacionado à tese.

Título: Retrospective and new records of hard ticks (Acari: Ixodidae) on wild animals from Paraná State, southern of Brazil

6.1 ABSTRACT

Ticks are distributed worldwide, and in South America, Brazil possesses the largest diversity of them. They are responsible for transmitting a wide range of pathogens to animals and accidentally to humans. The available data on tick species parasitizing wild animals in Paraná State are limited to few reports. Accordingly, the aims of this study were to describe and map the distribution of ticks parasitizing wild animals in Paraná State, southern Brazil, based on unpublished data from records of ticks deposited in two scientific collections, and tick records from previously published studies. Overall, we obtained 976 records of parasitism by ticks from 173 different species of free-ranging wild animals: 2/173 (1.2%) amphibians, 2/173 (1.2%) reptiles, 119/173 (68.8%) birds, 3/173 (1.7%) canids, 2/173 (1.2%) deer, 6/173 (3.5%) felids, 7/173 (4.0%) marsupials, 3/173 (1.7%) mustelid, 2/173 (1.2%) non-human primates, 2/173 (1.2%) procionid, 19/173 (11.0%) rodents, 2/173 (1.2%) Suine, 1/173 (0.6%) tapir, and 3/173 (1.7%) Xenarthra. A total of 6,794 ticks (1,163 males, 749 females, 428 adults of non-defined sex, 1,824 nymphs, 2,370 larvae, and 260 not identified stages) were recorded. The following tick species were recorded: *Amblyomma aureolatum*, *Amblyomma brasiliense*, *Amblyomma calcaratum*, *Amblyomma coelebs*, *Amblyomma dissimile*, *Amblyomma dubitatum*, *Amblyomma fuscum*, *Amblyomma geayi*, *Amblyomma incisum*, *Amblyomma longirostre*, *Amblyomma nodosum*, *Amblyomma ovale*, *Amblyomma parkeri* (some published as *A. geayi)*, *Amblyomma parvum*, *Amblyomma pseudoconcolor, Amblyomma rotundatum*, *Amblyomma sculptum* (some published as *Amblyomma cajennense* senso lato), *Amblyomma tigrinum*, *Amblyomma triste*, *Amblyomma* sp., *Haemaphysalis juxtakochi*, *Haemaphysalis* sp., *Ixodes auritulus*, *Ixodes fuscipes* (some published as *Ixodes aragaoi*), *Ixodes loricatus*, *Ixodes paranaensis*, *Ixodes schulzei*, *Ixodes* sp., and *Rhipicephalus microplus. Amblyomma aureolatum* and *A. longirostre* were highly prevalent on wild hosts. Ring-tailed coati (*Nasua nasua*) was the host species with the highest tick richness in Paraná State, Brazil. Also, we provide the first record of the tick-host association *A. fuscum* on felid (*Leopardus guttulus*), and *R. microplus* on

rodent (*Sphiggurus villosus*).

Keywords: *Amblyomma*, *Haemaphysalis*, *Ixodes*, *Rhipicephalus*, wild hosts**.**

6.2 INTRODUCTION

Ticks are distributed worldwide and are responsible for transmitting a wide range of pathogens to animals and accidentally to human beings. These ectoparasites may act as mechanical or biological vectors for viruses, bacteria, protozoa and helminths, representing an One Health issue (Otranto *et al*. 2013; Parola *et al*. 2013; Westblade *et al.* 2017; Ličková *et al.* 2020). Brazil has the largest diversity of ticks in South America, currently composed by 51 species classified into the Ixodidae family (Michel *et al.* 2017; Dantas-Torres *et al.* 2019; Martins *et al.* 2019; Labruna *et al.* 2020; Onofrio *et al.* 2020). The genus *Amblyomma* is the most important and representative taxon in the medical and veterinary field, with 33 species currently reported in Brazil (Nava *et al.* 2017; Gianizella *et al.* 2018; Martins *et al.* 2019, 2021).

The Atlantic Forest is one of the 34 global "hotspots" of biodiversity, is the second largest tropical forest in the Americas, and originally extended continuously along the Brazilian coast, to eastern Paraguay and northeastern Argentina (Lautert *et al.* 2015). The State of Paraná, southern Brazil, concentrates one of the largest continuous forest remnants of Atlantic Forest in the country, however only 12.4% of the all original forest remains (SOS Mata Atlântica 2021). In recent years, the incidence and diversity of tick-borne infections has increased. This may be attributed, among other factors, to changes in the environment associated with the anthropization of natural areas, which have led to increased densities of ticks and potential reservoir hosts (Yabsley & Shock, 2013).

The available data on tick species parasitizing wild animals in Paraná State are limited to few reports. Accordingly, the aims of this study were to report and map the distribution of ticks parasitizing wild animals in Paraná State, southern Brazil.

6.3 MATERIAL AND METHODS

The State of Paraná comprises about 199,000 km², divided into 399 municipalities, distributed into ten mesoregions: Curitiba Metropolitan (CM), East Central (EC), North Pioneering (NP), North Central (NC), Northwest (NW), West (W), West Central (WC), Southwest (SW), South Central (SC), and Southeast (SE),

following the criterion adopted by the Paraná Institute for Economic and Social Development (Ipardes 2012). Paraná State is predominantly located in the Atlantic Forest biome, except for the EC mesoregion, which is in the Cerrado biome (Brasil, 2018). The climate along the State is variable, where the central and southern regions have a predominantly temperate climate – Cfb (average temperatures between 10−15 °C in the winter and 17−22 °C in the summer). The northern, western, southern and coastal regions have a subtropical climate – Cfa (average temperatures between 15−21 °C in the winter and 22−27 °C in the summer), according to Köppen's classification (IAPAR 2019).

The geographical distribution of ticks in wild animals from Paraná State was performed using unpublished data from records of ticks deposited in the following scientific collections: “Coleção de Ectoparasitos” at the Capão da Imbuia Museum of Natural History (MHNCI) and “Coleção Científica de Carrapatos” at the Vector-Borne Diseases Laboratory (VBDL), Universidade Federal do Paraná. Additionally, tick records from previously published studies were reviewed and compiled (Antonucci *et al*. 2011; Arzua *et al.* 1994, 2003, 2005; Arzua & Barros-Battesti 1999; Barros-Battesti 2008; Barros-Battesti *et al.* 2003; Barros & Baggio 1992; Blanco *et al.* 2017; Fonseca 1933; Fortes *et al*. 2011; Guglielmone *et al.* 2003; Kmetiuk *et al.* 2019; Labruna *et al*. 2005, 2009, 2020; Luz *et al.* 2017; Magalhães-Matos *et al*. 2017; Martins *et al*. 2021; Massini *et al*. 2019; Mongruel *et al*. 2017; Nava *et al.* 2010, 2014; Onofrio *et al.* 2013; Pacheco *et al.* 2012; Seki *et al.* 2013; Serra-Freire & Peralta 1993; Sinkoc *et al.* 1998; Toledo *et al.* 2011; Valente *et al.* 2020a). The review of published articles was conducted through a computerized search in the PubMed (http://www.ncbi.nlm.nih.gov/pubmed) and SciELO (http://www.scielo.org/) electronic databases, using the following general descriptors (keywords): ticks, tick-borne diseases, vector-borne diseases, wild animals, *Amblyomma*, *Haemaphysalis*, *Ixodes*, *Rhipicephalus*, Ixodidae, Brazilian Spotted Fever, *Rickettsia*, *Theileria*, *Anaplasma*, *Ehrlichia*, *Babesia, Hepatozoon, Rangelia,* and hemoplasmas. The same descriptors in English were also searched for in the SciELO database, with additional Portuguese translations as keywords. The reference list of every selected manuscript was also considered for our literature survey.

Tick specimens collected and deposited in the MHNCI and VBDL scientific collections from wild animals were kept in absolute ethanol-labeled tubes and all the adults identified by morphologic dichotomous keys (Barros-Battesti *et al.* 2006). The

scientific collections were visited during 2015 and 2019, and all the nymphs compiled in this study were reviewed and identified at the species level according to criteria previously established (Martins *et al.* 2010, 2013). All records of parasitism by ticks on wild animals in Paraná State are presented in Supplementary Table S1.

The locations of wild animals parasitized by ticks were plotted using the geographical information system software Quantum GIS 2.18.19 (GNU, Boston, MA, USA).

6.4 RESULTS

Overall, we obtained 976 records of parasitism by ticks from 173 different species of free-ranging wild animals: 2/173 (1.2%) amphibians, 2/173 (1.2%) reptiles, 119/173 (68.8%) birds, 3/173 (1.7%) canids, 2/173 (1.2%) deer, 6/173 (3.5%) felids, 7/173 (4.0%) marsupials, 3/173 (1.7%) mustelid, 2/173 (1.2%) non-human primates, 2/173 (1.2%) procionid, 19/173 (11.0%) rodents, 2/173 (1.2%) Suine, 1/173 (0.6%) tapir, and 3/173 (1.7%) Xenarthra. Detailed data of parasitism by ticks in wild animals are shown in Supplementary Table S1.

A total of 6,794 ticks of 30 different species were collected, being, 1,163/6,794 (17.12%) males (M), 749/6,794 (11.02%) females (F), 428/6,794 (6.3%) adults of non-defined sex (A), 1,824/6,794 (26.8%) nymphs (N), 2,370/6,794 (34.88%) larvae (L), and 260/6,794 (3.83%) not identified stages according to published data.

From 976 records of parasitism by ticks in wild animals, the tick species found were *Amblyomma aureolatum*, *Amblyomma brasiliense*, *Amblyomma calcaratum*, *Amblyomma coelebs*, *Amblyomma dissimile*, *Amblyomma dubitatum*, *Amblyomma fuscum*, *Amblyomma geayi*, *Amblyomma incisum*, *Amblyomma longirostre*, *Amblyomma nodosum*, *Amblyomma ovale*, *Amblyomma parkeri* (some published as *A. geayi)*, *Amblyomma parvum, Amblyomma pseudoconcolor, Amblyomma rotundatum*, *Amblyomma sculptum* (some published as *Amblyomma cajennense* senso lato), *Amblyomma tigrinum*, *Amblyomma triste*, *Amblyomma* sp., *Haemaphysalis juxtakochi*, *Haemaphysalis* sp., *Ixodes auritulus*, *Ixodes fuscipes* (some published as *Ixodes aragaoi*), *Ixodes loricatus*, *Ixodes paranaensis*, *Ixodes schulzei*, *Ixodes* sp., and *Rhipicephalus microplus.*

The most prevalent tick species related in this study were: *A. aureolatum*, with 1,636/6,794 (24.08%) ticks collected from 192/976 (19.69%) cases; *A. longirostre*, with 364/6,794 (5.36%) ticks collected from 167/976 (17.13%) cases; *I. auritulus*, with

228/6,794 (3.36%) ticks collected from 97/976 (9.95%) cases; *A. calcaratum*, with 154/6,794 (2.27%) ticks collected from 54/976 (5.54%) cases; and *A. ovale*, with 396/6,794 (5.83%) ticks collected from 38/976 (3.90%) cases.

Birds were mostly infested by larvae (2,085/3,188; 65.40%), and nymphs (901/3,188; 28.26%). Only 1/3,188 (0.03%) and 71/3,188 (2.23%) of the bird-infesting ticks were male and female, respectively.

Amblyomma longirostre was found infesting the most diversity of wild animal species, including 61 bird, one felid and two rodent species (porcupines). The host species with the highest tick richness in this study were, *Nasua nasua*, found infested by *A. aureolatum*, *A. brasiliense*, *A. coelebs*, *A. dubitatum*, *A. incisum*, *A. ovale*, *H. juxtakochi*, *I. loricatus*, and *Tamandua tetradactyla*, found infested by *A. aureolatum*, *A. brasiliense*, *A. calcaratum*, *A. dubitatum*, *A. nodosum, A. pseudoconcolor.* The geographical distribution of tick parasitism on wild hosts is shown in Fig. 1 and Fig. 2.

6.5 DISCUSSION

In the present study, we provide information of tick species infesting wildlife from the State of Paraná, southern Brazil. *Amblyomma aureolatum* was the most common tick species found parasitizing wild animals. Ring-tailed coatis comprised the host species with the highest tick richness in Paraná State, Brazil. All tick species reported in this study were previously described in Paraná State; however, unusual tick-host association to *A. fuscum* and *R. microplus* was observed.

Overall, the tick-host general associations found herein have been previously reported, as *A. aureolatum* on birds, canids, procionids, felids, and marsupials, mustelid, non-humans primates, procionid, xenarthras (Arzua *et al.* 2003, 2005; Barros & Baggio 1992; Guglielmone *et al.* 2003; Martins *et al.* 2021), *A. brasiliense* on anteaters, ring-tailed coati, marsupials, tapir, Suine, and xenarthras (Arzua et al. 2005; Kmetiuk *et al.* 2019; Luz *et al.* 2018a; Magalhães-Matos *et al.* 2017; Nava *et al.* 2017), *A. calcaratum* on xenarthras, and birds (Martins et al. 2014; Szabó et al. 2019), *A. coelebs* on procionids, and tapir (Arzua *et al.* 2005; Magalhães-Matos *et al.* 2017), *A. dubitatum* on birds, procionids, deer, marsupials, rodents, Suine, and xenarthras (Barros & Baggio 1992; Blanco *et al.* 2017; Massini *et al.* 2019; Nava *et al.* 2010, 2017; Szabó *et al.* 2019; Teixeira *et al.* 2020), *A. fuscum* on reptiles (Dantas-Torres *et al.* 2008), *A. incisum* on birds, procionids, and tapirs (Márcia Arzua et al. 2005; Barros & Baggio 1992; Ogrzewalska *et al.* 2009), *A. longirostre* on birds, felids, and rodents

(Barros & Baggio 1992; Blanco *et al.* 2017; Martins *et al.* 2014), *A. nodosum* on birds, and xenarthras (Robayo-Sánchez *et al.* 2020; Teixeira *et al.* 2020; Fecchio *et al.* 2020), *A. ovale* on birds, canids, procionids, felids, marsupials, mustelid, non-human primates, procionid, rodents, and Suine (Arzua *et al*. 2005; Barros-Battesti 2008; Barros & Baggio 1992; Magalhães-Matos *et al.* 2017; Martins *et al.* 2016; Sinkoc *et al.* 1998; Teixeira *et al.* 2020), *A. parkeri* on birds, rodents and non-human primates (Arzua *et al.* 2005; Martins *et al.* 2021; Teixeira *et al.* 2020; Valente *et al.* 2020a), *A. parvum* on deer (Guglielmone & Nava, 2006), *A. rotundatum* on amphibians (Antonucci *et al.* 2011), *A. sculptum* on birds, felids, rodents, Suine, and tapir (Luz *et al.* 2016; Nava *et al.* 2014; Witter *et al.* 2016), *A. tigrinum* on canids (Barros & Baggio 1992; Cardoso *et al.* 2008), *A. triste* on deer, and rodents (Bastos, 2012; Martins *et al.* 2010; Sinkoc *et al.* 1998), *H. juxtakochi* on birds, canids, procionids, deer, and tapir (Barros-Battesti 2008; Barros & Baggio 1992; Magalhães-Matos *et al.* 2017; Seki *et al.* 2013; Souza *et al.* 2018), *I. auritulus* on birds (Arzua *et al*. 2003), *I. fuscipes* on birds, deer and marsupials (Arzua *et al*. 2005; Labruna *et al.* 2020), *I. loricatus* on marsupials and procionids *(*Barros & Baggio *1992; Blanco et al.* 2017), *I. paranaensis* on birds (Arzua *et al.* 2005; Barros-Battesti *et al.* 2003), *I. schulzei* on rodents (Barros-Battesti 2008; Onofrio *et al.* 2013), and *R. microplus* on deer (Nelson *et al.* 2017); However, new tick-host associations were recorded.

Considering the review of previous reports to complaining the data of this study, we found two reposts of *A. geayi* (Barros & Baggio 1992; Labruna *et al*. 2009) and one report of *A. dissimile* on reptile (Serra-Freire & Peralta 1993) in Paraná state. Previous reports of *A. geayi* included mostly areas within the northern half of South America, especially the Amazonian region (Guglielmone *et al.* 2003). A record of an *A. geayi* male (MHNCI – 15) collected on a sloth in the Curitiba zoo for the state of Paraná, southern Brazil (Barros & Baggio 1992; Arzua *et al.* 2005), certainly represents an infestation acquired in an area northern to Paraná State, before the sloth was taken to the Curitiba zoo. Besides, most of these *A. geayi* collected from porcupines were reidentified as *A. parkeri*, it seems that the distribution of *A. geayi* tend to be restricted to the northern half of South America (Labruna *et al*. 2009).

A report of *A. dissimile* on reptiles (*Caiman crocodilus*) has been previously described in the state of Paraná (Serra-Freire & Peralta 1993). The distribution of the *Caiman crocodilus* occurs from southern Mexico to Brazil, in the Amazon River basins, in the complex of the Atlantic coastal basins (Barreto-Lima et al. 2020). Furthermore,

the distribution of the current potential of *A. dissimile* was restricted to tropical regions with constant climatic conditions throughout the year such as the Amazon and Pantanal (Polo, 2021). Therefore, it is suggested that this animal came to the Curitiba zoo already parasitized, and this report is considered an exotic tick only registered in Paraná.

Barros & Baggio (1992) listed *A. naponense* occurrence in Paraná state. However, when these specimens were reviewed by Arzua *et al.* (2005), it was verified that the material belongs to three different species: one female of *A. brasiliense*, 11 females of *A. coelebs* and one female of *A. incisum* (MHNCI: 55-A, 55-B, 55-C). Therefore, considering the absence of another report, we may provisionally consider that Paraná state is not included in the range of occurrence of *A. naponense* in Brazil. Arzua *et al.* 2005 also identified a specimen of *A. oblongoguttatum* collected from a human from Paraná State. This tick was subsequently determined as *A. scalpturatum* by Onofrio et al. (2010). The presence of *A. oblongoguttatum* in Paraná state was based on this record; consequently, Paraná state is not included in the range of this tick.

To our knowledge, we provide the first record of the tick-host association *A. fuscum* on felid (*Leopardus guttulus*), and *R. microplus* on rodent (*Sphiggurus villosus*). Also, we firstly record *A. fuscum* occurrence in Paraná state. *Amblyomma fuscum* has been described to preferentially parasitize reptiles, however, mammals such as *Cerdocyon thous*, *Didelphis aurita,* and *Dasypus septemcinctus* have been found infested by this tick species (Barros-Battesti *et al.* 2005; Brum *et al.* 2003). *Rhipicephalus microplus* is the most economically important cattle tick in Brazil, where deer have been also found infested (Cançado *et al.* 2009). The occurrence of ticks shared by cattle and wild animals may play a role in the epidemiology of tick-borne diseases (Cançado *et al.* 2009). Considering other wild hosts of *R. microplus*, relates of this tick species on rodents are rare, being described only on capybaras (Nava *et al.* 2017). In this study, we relate firstly the occurrence of *A. fuscum* on felid (*L. guttulus*), and *R. microplus* on orange-spined hairy dwarf porcupines (*S. villosus*), whose role of this finding in the epidemiology these tick species should be better investigated.

In the present study, 1,824 nymphs were recorded, being 901/1,824 (38.02%) found infesting birds. Birds represent an important host and dispersers for ticks, mainly immature stages (Norte *et al.* 2020; Teixeira *et al.* 2020). In contrast to mammals, birds

may play a role in the ecology of tick-borne diseases, as the ability to fly and migrate over long distances may allow avian hosts to disperse infected ticks across large areas (Norte *et al.* 2020). Depending on their specific biology, birds may cover longer distances, for example, a long-distance migratory bird of up to 1,600 Km uninterrupted across the Sahara (Klaus *et al.* 2016). In Brazil, 198/1,919 (10.3%) bird species exhibit migratory behavior (Somenzari *et al.* 2018). However, even the non-migratory (resident) bird species show greater movement when compared to mammals. In addition, comparing bird populations from different Brazilian biomes, those from the Atlantic Forest have shown highest prevalence of tick infestation (Fecchio *et al.* 2020). Annual precipitation of the sampling area was positively associated with a high probability bird infestation by ticks (Fecchio *et al.* 2020), fact that may also explain the bird infestation found in the present study.

Amblyomma aureolatum was the most prevalent tick species found herein. The distribution of this tick species is limited to South America. Adult ticks are frequently found infesting carnivores, while birds and rodents are commonly hosts of immature tick stages (Guglielmone *et al.* 2003). On the other hand, *A. longirostre* was found infesting the most diversity of wild animal species, including 61 bird, one felid and two rodent species. The adult stage of *A. longirostre* has been recorded mainly on neotropical porcupines of the Erethizontidae family (Guglielmone *et al.* 2014; Nava *et al.* 2017), while larval and nymphal stages have been found parasitizing mainly wild birds of the order Passeriformes (Luz *et al.* 2018b), similarly to immature stages of *A. aureolatum*. In that study, it was evidenced the role of birds in spread immature stages of ticks, once 93.2% and 57.4% of the collected *A. aureolatum* and *A. longirostre* ticks, respectively, were larvae and/or nymphs. Additionally, it is important to note that both tick species have been reported accidentally parasitizing humans in Paraná State (Valente *et al.* 2020b).

Moreover, we report six different tick species parasitizing ring-tailed coatis, which was the host species with the highest tick richness in the present study. Ring-tailed coatis are carnivores widely distributed throughout South America, being one of the species with the highest synanthropy, mainly in visitation areas, for example, near the Iguaçu Falls viewpoint, Paraná State (Magalhães-Matos *et al.* 2017). This anthropogenic behavior may represent a risk of human bites by ticks, since five of six tick species found infesting ring-tailed coatis were also found parasitizing humans in Paraná State (Valente *et al.* 2020b). Indeed, such tick richness may be related to the

co-occurrence of species hosting those ticks and may also be related to the movement along larger sized areas, enhancing the chances of getting into contact with different tick species.

6.6 CONCLUSION

A total of 25 tick species – 18 *Amblyomma,* 5 *Ixodes,* 1 *Haemaphysalis* and 1 *Rhipicephalus* – are reported on wild animals from Paraná State, southern of Brazil. To our knowledge, we provide the first records of the tick-host association *A. fuscum* on felid (*L. guttulus*), and *R. microplus* on rodents (*S. villosus*). *Amblyomma aureolatum* and *A. longirostre* were highly prevalent on wild hosts, mostly immature stages on birds. Ring-tailed coati (*N. nasua*) was the host species with the highest tick richness in Paraná State, Brazil. Additionally, different tick-vectors of zoonotic pathogens were found on wild animals. Further studies should focus to evaluate the interactions between wild animals, ticks, and pathogens for public health.

Conflict of interests

The authors declared no conflict of interest.

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Table S1. Records of ticks on wild animals in Paraná State, southern Brazil (1983–2020): **ANEXO 6**

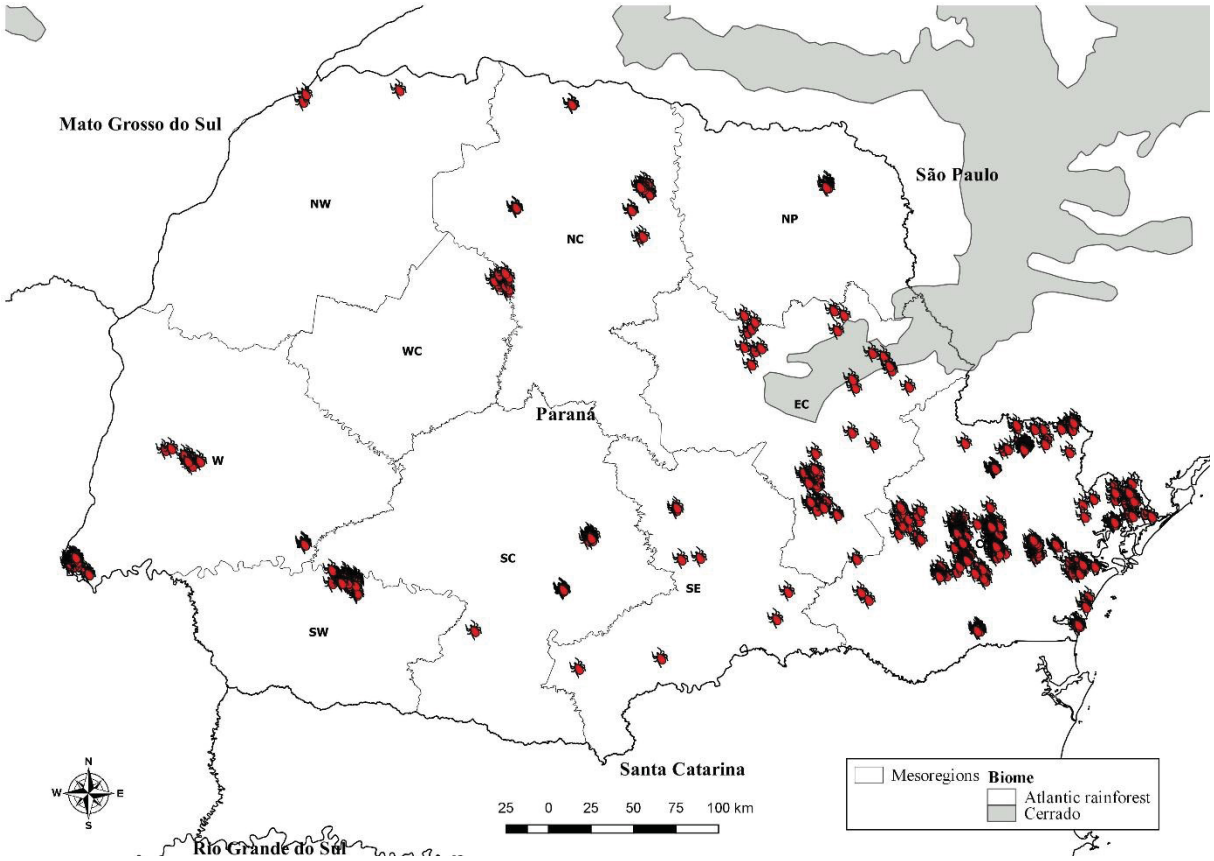

Figure 1. Geographical distribution of ticks from wild animals in Paraná state, southern Brazil – biomes.

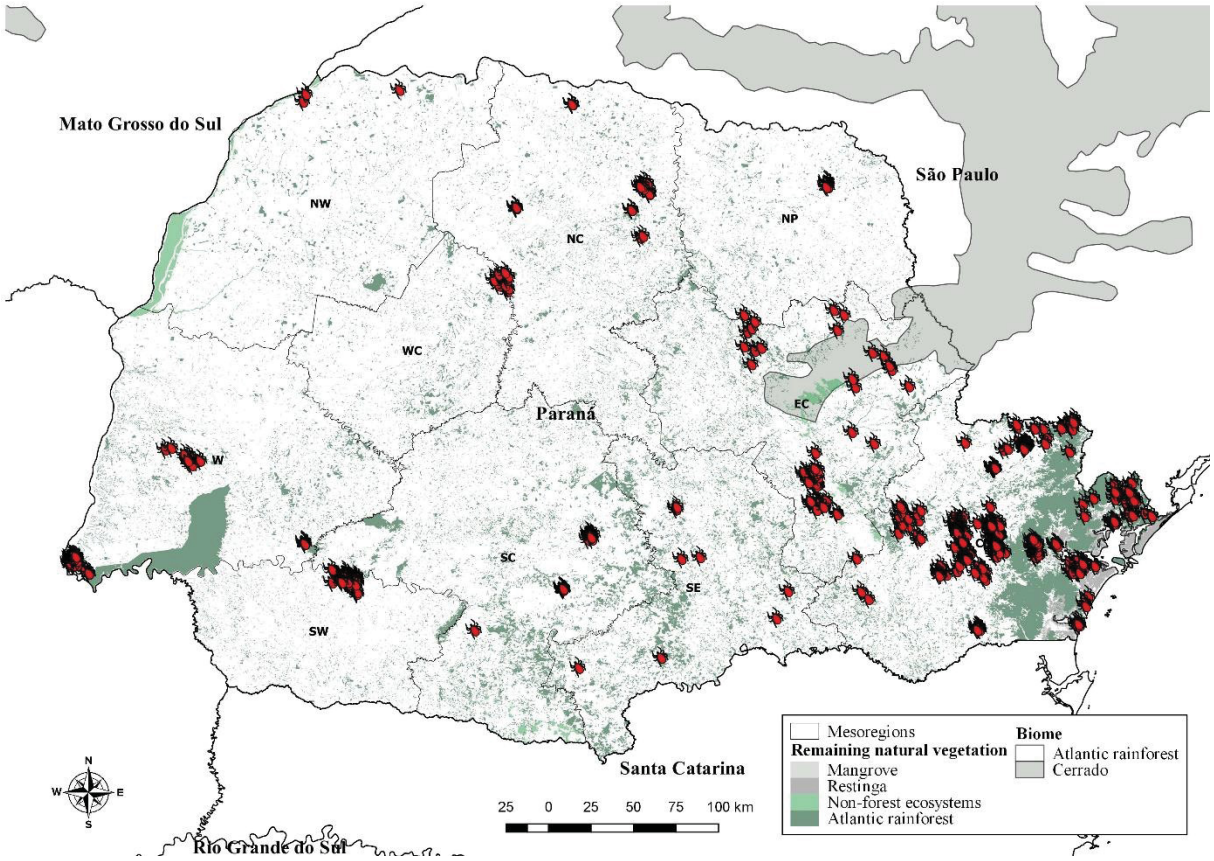

Figure 2. Geographical distribution of ticks from wild animals in Paraná state, southern Brazil – remaining natural vegetation.

ANEXO 1 – APROVAÇÃO CEUA - UFPR

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SETOR DE CIÊNCIAS AGRÁRIAS
COMISSÃO DE ÉTICA NO USO DE ANIMAIS

CERTIFICADO

Certificamos que o protocolo número 044/2020, referente ao projeto de pesquisa **"Levantamento sanitário de mastofauna em Curitiba e região metropolitana"**, sob a responsabilidade de **Rafael Felipe da Costa Vieira** – que envolve a produção, manutenção e/ou utilização de animais pertencentes ao filo Chordata, subfilo Vertebrata (exceto o homem), para fins de pesquisa científica ou ensino – encontra-se de acordo com os preceitos da Lei nº 11.794, de 8 de Outubro de 2008, do Decreto nº 6.899, de 15 de julho de 2009, e com as normas editadas pelo Conselho Nacional de Controle da Experimentação Animal (CONCEA), e foi aprovado pela COMISSÃO DE ÉTICA NO USO DE ANIMAIS (CEUA) DO SETOR DE CIÊNCIAS AGRÁRIAS DA UNIVERSIDADE FEDERAL DO PARANÁ - BRASIL, com grau 2 de invasividade, em 02/10/2020.

Finalidade	Pesquisa
Vigência da autorização	Novembro/2020 até Novembro/2025
Espécie/Linhagem	Diversas
Número de animais	Dependente da ocorrência em zonas urbanas e rodovias
Peso/Idade	Variável/Variável
Sexo	Macho e fêmea
Origem	Animais de vida livre sob responsabilidade do ICMBio.

*A autorização para início da pesquisa se torna válida a partir da data de emissão deste certificado.

CERTIFICATE

We certify that the protocol number 044/2020, regarding the research project **"Health survey of mastofauna in Curitiba and metropolitan region"** under **Rafael Felipe da Costa Vieira** – which includes the production, maintenance and/or utilization of animals from Chordata phylum, Vertebrata subphylum (except Humans), for scientific or teaching purposes – is in accordance with the precepts of Law nº 11.794, of 8 October 2008, of Decree nº 6.899, of 15 July 2009, and with the edited rules from Conselho Nacional de Controle da Experimentação Animal (CONCEA), and it was approved by the ANIMAL USE ETHICS COMMITTEE OF THE AGRICULTURAL SCIENCES CAMPUS OF THE UNIVERSIDADE FEDERAL DO PARANÁ (Federal University of Paraná, Brazil), with degree 2 of invasiveness, in session of 10/02/2020.

Purpose	Research
Validity	November/2020 until November/2025
Specie/Line	Various
Number of animals	Dependent on occurrence in urban areas and highways
Weight/Age	Variable/Variable
Sex	Male and female
Origin	Wild animals under responsibility of ICMBio.

*The authorization to start the research becomes valid from the date of issue of this certificate.

Curitiba, 20 de outubro de 2020

Simone Tostes de Oliveira Stedile
Coordenadora CEUA-SCA

ANEXO 2 – APROVAÇÃO ICMBio

Ministério do Meio Ambiente - MMA
Instituto Chico Mendes de Conservação da Biodiversidade - ICMBio
Sistema de Autorização e Informação em Biodiversidade - SISBIO

Autorização para atividades com finalidade científica

Número: 76984-1	Data da Emissão: 23/02/2021 20:40:20	Data da Revalidação*: 23/02/2022
De acordo com o art. 28 da IN 03/2014, esta autorização tem prazo de validade equivalente ao previsto no cronograma de atividades do projeto, mas deverá ser revalidada anualmente mediante a apresentação do relatório de atividades a ser enviado por meio do Sisbio no prazo de até 30 dias a contar da data do aniversário de sua emissão.		

Dados do titular

Nome: RAFAEL F C VIEIRA	CPF: 041.694.404-39
Título do Projeto: Levantamento sanitário de mastofauna em Curitiba e região metropolitana	
Nome da Instituição: Universidade Federal do Paraná	CNPJ: 75.095.679/0001-49

Cronograma de atividades

#	Descrição da atividade	Início (mês/ano)	Fim (mês/ano)
1	Coleta de amostras insitu	01/2021	12/2023
2	Processamento de amostras	01/2021	12/2024
3	Recebimento de carcaças	01/2021	01/2023

Equipe

#	Nome	Função	CPF	Nacionalidade
1	Andre Saldanha Ferreira	Manejo dos animais, coleta e processamento das amostras	102.517.026-18	Brasileira
2	Renato Silva de Sousa	Necropsias e coleta de amostras	893.025.839-53	Brasileira
3	Thallitha Samih Wischral Jayme Vieira	Coleta e processamento de amostras	042.856.639-10	Brasileira
4	Flávia Carolina Meira Collere	Coleta e processamento das amostras	081.430.749-35	Brasileira
5	Leonardo Pereira dos Santos	Manejo dos animais e coleta de amostras	020.163.289-67	Brasileira
6	Larissa Dantas Roeder Ferrari	Manejo dos animais, coleta e processamento de amostras	039.167.539-75	Brasileira
7	Eloisa Muehlbauer	Manejo e anestesia dos animais	079.230.609-08	Brasileira

ANEXO 3 – TABELA SUPLEMENTAR - PUBLICAÇÃO ARTIGO

Table S1. Records of spotted fever (SF) tick vectors in Paraná State, southern Brazil (1953–2019).

Record number	Year	Municipality	Mean altitude (m)	Stage	Host/environment	Collection methods: host, actively or passively	Collection accession No.	Reference
	Amblyomma aureolatum							
1	1953	São Mateus do Sul	780	1F	*Cerdocyon thous*	host	MHNCI - 146	Arzua et al. 2005
2-3	1992	Almirante Tamandaré	965	2F	*Canis familiaris*	host	MHNCI – 1376, 1520	Arzua et al. 2005
4	1992	Antonina	9	1F	*C. familiaris*	host	MHNCI - 1399	Arzua et al. 2005
5	1992	Curitiba	900	1F	*C. familiaris*	host	MHNCI - 1361	Arzua et al. 2005
6	1992	Curitiba	900	1F	*Felis catus*	host	MHNCI - 1395	Arzua et al. 2005
7	1993	Piraquara	915	11M, 6F	*C. thous*	host	MHNCI - 107	Arzua et al. 2005
8	1993	São José dos Pinhais	902	1M	*Homo sapiens*	host	MHNCI - 1343	Arzua et al. 2005
9	1993	Ponta Grossa	930	1M	*Lutreolina crassicaudata*	host	MHNCI - 148	Arzua et al. 2005
10	1993	Campina Grande do Sul	905	3M, 4F	*Procyon cancrivorus*	host	MHNCI - 113	Arzua et al. 2005
11	1993	Curitiba	900	24M, 14F, 1N	*Puma concolor*	host	MHNCI - 118	Arzua et al. 2005
12-13	1994	Mandirituba	918	13M, 5F	*C. familiaris*	host	MHNCI – 1366, 1370	Arzua et al. 2005

14-15	1995	Curitiba	900	4M	*C. thous*	host	MHNCI – 135, 160	Arzua et al. 2005
16	1995	Almirante Tamandaré	965	1M	*H. sapiens*	host	MHNCI - 1350	Arzua et al. 2005
17	1995	Carambeí	1030	1M, 4F	*P. concolor*	host	MHNCI - 173	Arzua et al. 2005
18	1996	Curitiba	900	1F	*C. familiaris*	host	MHNCI - 1521	Arzua et al. 2005
19	1998	Bocaiúva do Sul	995	1F	*C. familiaris*	host	MHNCI - 416	Arzua et al. 2005
20	1998	Campina Grande do Sul	905	1F	*C. familiaris*	host	MHNCI - 1378	Arzua et al. 2005
21-24	1999	Curitiba	900	4N, 1L	*Basileuterus leucoblepharus*	host	MHNCI – 952, 963, 966, 969	Arzua et al. 2005
25	1999	Curitiba	900	2N, 1L	*Conopophaga lineata*	host	MHNCI - 935	Arzua et al. 2005
26-27	1999	Curitiba	900	1N, 3L	*Cranioleuca obsoleta*	host	MHNCI – 907, 920	Arzua et al. 2005
28-30	1999	Curitiba	900	4L	*Cranioleuca pallida*	host	MHNCI – 904, 905, 906	Arzua et al. 2005
31	1999	Curitiba	900	1N, 2L	*Furnarius rufus*	host	MHNCI - 853	Arzua et al. 2005
32-33	1999	Curitiba	900	3N	*Poospiza lateralis*	host	MHNCI – 953, 954	Arzua et al. 2005
34	1999	Curitiba	900	1N, 1L	*Saltator similis*	host	MHNCI - 923	Arzua et al. 2005
35	1999	Curitiba	900	1L	*Tachyphonus coronatus*	host	MHNCI - 911	Arzua et al. 2005
36	1999	Curitiba	900	2N, 37L	*Thamnophilus caerulescens*	host	MHNCI - 898	Arzua et al. 2005
37	1999	Curitiba	900	21L	*Thamnophilus ruficapillus*	host	MHNCI - 895	Arzua et al. 2005

38-42	1999	Curitiba	900	11N, 156L	*Troglodytes aedon*	host	MHNCI – 858, 896, 897, 899, 965	Arzua et al. 2005
43-45	1999	Curitiba	900	2N, 9L	*Turdus albicollis*	host	MHNCI – 910, 913, 917	Arzua et al. 2005
46-47	1999	Curitiba	900	2N	*Turdus amaurochalinus*	host	MHNCI – 946, 956	Arzua et al. 2005
48-103	1999	Curitiba	900	1M, 82N, 155L	*Turdus rufiventris*	host	MHNCI – 852, 854-857, 894, 900, 901, 908, 912, 914, 915A, 916, 918A, 919-922A, 924-934, 936-942, 944, 945, 947-951, 955, 957-962, 964, 967-973	Arzua et al. 2005
104-105	1999	Curitiba	900	1M, 2F	*C. familiaris*	host	MHNCI – 492, 1522	Arzua et al. 2005
106	1999	Piraquara	915	2M	*C. familiaris*	host	MHNCI - 432-B	Arzua et al. 2005
107	1999	Curitiba	900	1N	*T. rufiventris*	host	MHNCI - 937-A	This study
108-110	2000	Curitiba	900	3L	*B. leucoblepharus*	host	MHNCI – 985, 991, 993	Arzua et al. 2005
111-112	2000	Curitiba	900	1N, 9L	*C. obsoleta*	host	MHNCI – 998, 1001	Arzua et al. 2005
113-115	2000	Curitiba	900	1N, 7L	*S. similis*	host	MHNCI – 974, 977, 1002	Arzua et al. 2005

116	2000	Curitiba	900	4N, 1L	*Synallaxis cinerascens*	host	MHNCI - 1017	Arzua et al. 2005
117-119	2000	Curitiba	900	2N, 15L	*T. caerulescens*	host	MHNCI – 979, 1000, 1006	Arzua et al. 2005
120-121	2000	Curitiba	900	3N, 30L	*T. aedon*	host	MHNCI – 984, 1005	Arzua et al. 2005
122	2000	Curitiba	900	8N	*T. amaurochalinus*	host	MHNCI - 1018	Arzua et al. 2005
123-159	2000	Curitiba	900	77N, 33L	*T. rufiventris*	host	MHNCI – 975, 978, 980-983, 986, 987, 990, 992, 994, 996, 997, 999, 1003, 1007-A, 1009-1016, 1019-1026, 1027A, 1028-1031	Arzua et al. 2005
160	2000	Curitiba	900	1N	*Zonotrichia capensis*	host	MHNCI - 1004	Arzua et al. 2005
161	2000	Campina Grande do Sul	905	1F	*C. familiaris*	host	MHNCI - 1401	Arzua et al. 2005
162	2000	Curitiba	900	1F	*C. familiaris*	host	MHNCI - 1393	Arzua et al. 2005
163	2000	São José dos Pinhais	902	1F	*C. thous*	host	MHNCI - 1239	Arzua et al. 2005
164	2000	Adrianópolis	280	2F	*F. catus*	host	MHNCI - 1398	Arzua et al. 2005
165	2000	Pinhão	1045	1M	*Nasua nasua*	host	MHNCI - 1242	Arzua et al. 2005
166	2000	Prudentópolis	788	5M, 3F	*P. cancrivorus*	host	MHNCI - 423	Arzua et al. 2005

167	2001	Tamarana	770	5M, 6F	*C. familiaris*	host	-	Labruna et al. 2001
168	2001	Campina Grande do Sul	905	1M	*C. familiaris*	host	MHNCI - 1381	Arzua et al. 2005
169-172	2001	Curitiba	900	1M, 5F	*C. familiaris*	host	MHNCI – 422, 988, 1456, 1458	Arzua et al. 2005
173	2001	Guaraqueçaba	170	1F	*C. familiaris*	host	MHNCI - 425	Arzua et al. 2005
174	2001	Rio Branco do Sul	890	1M, 1F	*C. familiaris*	host	MHNCI - 1462	Arzua et al. 2005
175-176	2001	Wenceslau Braz	820	2M	*C. familiaris*	host	MHNCI – 426, 1460	Arzua et al. 2005
177	2001	Curitiba	900	1M	*F. catus*	host	MHNCI - 1241	Arzua et al. 2005
178	2002	Colombo	1000	3M, 2F	*C. familiaris*	host	MHNCI - 1369	Arzua et al. 2005
179	2002	Araucária	903	2M, 1F	*C. thous*	host	MHNCI - 1375	Arzua et al. 2005
180	2002	Colombo	1000	3M, 2F	*C. thous*	host	MHNCI - 1369	Arzua et al. 2005
181	2002	Curitiba	900	1F	*F. catus*	host	MHNCI - 1374	Arzua et al. 2005
182	2002	Telêmaco Borba	760	1F	*Tamandua tetradactyla*	host	MHNCI - 1404	Arzua et al. 2005
183	2003	Curitiba	900	217N, 487L	birds	host	-	Arzua et al. 2003
184-185	2003	Piraquara	915	4F	*C. familiaris*	host	MHNCI – 1371, 1373	Arzua et al. 2005
186	2003	Curitiba	900	1F	*H. sapiens*	host	MHNCI - 1354	Arzua et al. 2005

187	2004	Ortigueira	760	1F	*C. familiaris*	host	MHNCI - 1683A	This study
188	2010	Almirante Tamandaré	965	-	*C. familiaris*	host	-	Batista et al. 2010
189	2012	São Jorge do Oeste	470	1N	birds	host	-	Pacheco et al. 2012
190	2013	Curitiba	900	1F	*C. familiaris*	host	VBDL - 100	This study
191-200	2014	Curitiba	900	3M, 11F	*C. familiaris*	host	VBDL – 49, 65, 69, 70, 72, 73, 82, 84, 85, 105	This study
201	2015	Irati	845	-	-	-	SESA	This study
202	2017	Campina Grande do Sul	905	-	*C. familiaris*	host	-	Silva et al. 2017
203	2017	Campo Largo	960	-	*C. familiaris*	host	-	Silva et al. 2017
204	2017	Curitiba	900	-	*C. familiaris*	host	-	Silva et al. 2017
205	2017	Matinhos	15	-	*C. familiaris*	host	-	Silva et al. 2017
206	2017	Paranaguá	10	-	*C. familiaris*	host	-	Silva et al. 2017
207	2017	São José dos Pinhais	902	-	*C. familiaris*	host	-	Silva et al. 2017
208	2017	Carambeí	1030	-	*C. familiaris*	host	-	Silva et al. 2017
209	2017	Castro	1000	-	*C. familiaris*	host	-	Silva et al. 2017
210	2017	Ponta Grossa	930	-	*C. familiaris*	host	-	Silva et al. 2017
211	2017	Três Barras do Paraná	530	8N	birds	host	-	Luz et al. 2017b
212	2017	Araucária	903	1	*C. familiaris*	host	SESA - 086/2017	This study
213	2017	Lapa	910	1	-	-	SESA - 091/2017	This study
214-215	2017	Tijucas do Sul	915	8	*C. familiaris*	host	SESA - 096/2017, 097/2017	This study

216	2017	Porto Amazonas	820	1	environment (cloth dragging)	actively	SESA - 113/2017	This study
217	2017	Bituruna	860	1	*F. catus*	host	SESA - 087/2017	This study
218	2017	Paula Freitas	780	3	*C. familiaris*	host	SESA - 093/2017	This study
219-220	2017	Paulo Frontin	780	2	*C. familiaris*	host	SESA - 094/2017, 107/2017	This study
221-222	2017	General Carneiro	915	5	*C. familiaris*	host	SESA - 101/2017, 104/2017	This study
223	2017	São Mateus do Sul	780	1	*C. familiaris*	host	SESA - 109/2017	This study
224	2017	União da Vitória	770	2	-	-	SESA - 112/2017	This study
225	2017	Curitiba	900	1M	human dwelling	passively	VBDL - 127	This study
226	2018	Almirante Tamandaré	965	1	*C. familiaris*	host	SESA - 009/2018	This study
227	2018	Campo Largo	960		-	-	SESA - 030/2018	This study
228	2018	Mandirituba	918	1M	*H. sapiens*	host	SESA - 053/2018	This study
229	2018	Pinhais	895	1	-		SESA - 012/2018	This study
230-231	2018	São José dos Pinhais	902	1M, 1F	*H. sapiens*	host	SESA - 013/2018, 057/2018	This study
232	2018	Tijucas do Sul	915	1F	*H. sapiens*	host	SESA - 015/2018	This study
233	2018	Paula Freitas	780	4	-	-	SESA - 011/2018	This study

234	2018	Paula Freitas	780	1	environment (cloth dragging)	actively	SESA - 054/2018	This study
235	2018	Paulo Frontin	780	1	*H. sapiens*	host	SESA - 085/2018	This study
236	2018	Paulo Frontin	780	1	*C. familiaris*	host	SESA - 085/2018	This study
237	2018	São Mateus do Sul	780	2	*H. sapiens*	host	SESA - 014/2018	This study
238	2018	São Mateus do Sul	780	1	environment (cloth dragging)	actively	SESA - 058/2018	This study
239	2018	São Mateus do Sul	780	1	*F. catus*	host	SESA - 088/2018	This study
240	2018	União da Vitória	770	1	-	-	SESA - 016/2018	This study
241	2018	Curitiba	900	2F	*C. familiaris*	host	VBDL - 209	This study
242	2018	Colombo	1000	1F	*C. familiaris*	host	VBDL - 253	This study
243	2018	Colombo	1000	1N	environment (cloth dragging)	actively	VBDL - 259	This study
244	2018	Quatro Barras	930	1F	*C. familiaris*	host	VBDL - 327	This study
245	2019	Campo Largo	960	1	*H. sapiens*	host	SESA - 56/2019	This study
246-247	2019	Antônio Olinto	815	11	*C. familiaris*	host	SESA - 85/2019, 110/2019	This study
248	2019	Antônio Olinto	815	1	*Alouatta sp.*	host	SESA - 164/2019	This study
249	2019	Antônio Olinto	815	3	*C. familiaris*	host	SESA - 164/2019	This study
250	2019	General Carneiro	915	4	*C. familiaris*	host	SESA - 86/2019	This study

251-252	2019	Paulo Frontin	780	3	*C. familiaris*	host	SESA - 91/2019, 112/2019	This study
253	2019	Paula Freitas	780	1	*C. familiaris*	host	SESA - 166/2019	This study
254	2019	São Mateus do Sul	780	1	*C. familiaris*	host	SESA - 58/2019	This study
255	2019	União da Vitória	770	1	*C. familiaris*	host	SESA - 92/2019	This study
256	2019	União da Vitória	770	1	environment (cloth dragging)	actively	SESA - 167/2019	This study
257	2019	Tibagi	720	1	*C. familiaris*	host	SESA - 114/2019	This study
258	2019	Pinhais	895	1F	*C. familiaris*	host	VBDL - 347	This study
259	2019	São José dos Pinhais	902	1F, 2N	*Alouatta guariba*	host	VBDL - 381	This study
260	2019	São José dos Pinhais	902	1F	*C. familiaris*	host	VBDL - 382	This study
261	-	Almirante Tamandaré	965	1M	*C. familiaris*	host	VBDL - 34	This study
262-266	-	Curitiba	900	2M, 6F	*C. familiaris*	host	VBDL – 83, 101, 136, 137, 161	This study
Subtotal	266/514 (52%)							
Amblyomma dubitatum								
267	1998	Curitiba	900	23M, 1F, 2L	*Hydrochoerus hydrochaeris*	host	433	Arzua et al. 2005
268	2008	Londrina	570	1738	environment	-	-	Toledo et al. 2008
269	2008	Telêmaco Borba	760	2N	*T. tetradactyla*		MHNCI - 1863E	This study
270	2010	Curitiba	900	1M, 1F	*H. hydrochaeris*	host	-	Nava et al. 2010

271	2010	Guarapuava	1085	1F	*Tayassu pecari*	host	-	Nava et al. 2010
272	2010	Foz de Iguaçu	180	1M, 1F, 1N	*H. hydrochaeris*	host	-	Nava et al. 2010
273	2011	Foz do Iguaçu	180	48M, 92F	*H. hydrochaeris*	host	-	Fortes et al. 2011
274	2011	Londrina	570	735	environment	-	-	Toledo et al. 2011a
275	2011	Londrina	570	40	*H. hydrochaeris*	host	-	Toledo et al. 2011a
276	2012	Paranaguá	10	4M, 2F	*H. hydrochaeris*	host	MHNCI - 1786	This study
277	2013	Andirá	480	-	-	-	SESA	This study
278	2013	Leópolis	470	-	-	-	SESA	This study
279	2013	Sertaneja	430	-	-	-	SESA	This study
280	2013	Cambará	450	-	-	-	SESA	This study
281	2014	Jaguariaíva	840	-	-	-	SESA	This study
282	2014	Sengés	610	-	-	-	SESA	This study
283	2014	Campo Mourão	585	-	-	-	SESA	This study
284	2014	Inajá	400	-	-	-	SESA	This study
285	2014	Andirá	480	-	-	-	SESA	This study
286	2014	Leópolis	470	-	-	-	SESA	This study
287	2014	Sertaneja	430	-	-	-	SESA	This study
288	2014	Cambará	450	-	-	-	SESA	This study
289	2014	Jacarezinho	520	-	-	-	SESA	This study
290	2014	Ribeirão Claro	640	-	-	-	SESA	This study
291	2014	Santana do Itararé	550	-	-	-	SESA	This study
292	2014	Tomazina	510	-	-	-	SESA	This study
293	2015	São José dos Pinhais	902	-	-	-	SESA	This study
294	2015	Jaguariaíva	840	-	-	-	SESA	This study
295	2015	Piraí do Sul	1040	-	-	-	SESA	This study
296	2015	Sengés	610	-	-	-	SESA	This study

297	2015	Itambaracá	410	-	-	-	SESA	This study
298	2015	Santa Mariana	470	-	-	-	SESA	This study
299	2015	São Jerônimo da Serra	920	-	-	-	SESA	This study
300	2015	Carlópolis	535	-	-	-	SESA	This study
301	2015	Jacarezinho	520	-	-	-	SESA	This study
302	2015	Ribeirão Claro	640	-	-	-	SESA	This study
303	2015	Santana do Itararé	550	-	-	-	SESA	This study
304	2015	Tomazina	510	-	-	-	SESA	This study
305	2017	Itambaracá	410	4N	marsupials	host	-	Blanco et al. 2017
306	2017	Tijucas do Sul	915	108	*C. familiaris*	host	SESA - 097/2017	This study
307	2017	Paula Freitas	780	1	*C. familiaris*	host	SESA - 093/2017	This study
308	2017	Itambaracá	410	83	environment (cloth dragging)	actively	SESA - 089/2017	This study
309	2017	Sertaneja	430	364	*C. familiaris*	host	SESA - 110/2017	This study
310	2017	Pinhais	895	1N	*H. sapiens*	host	VBDL - 165	This study
311	2017	Curitiba	900	1M	environment (CO2 trap)	passively	VBDL - 321	This study
312	2018	Marilândia do Sul	740	1	-	-	SESA - 025/2018	This study
313	2018	Rio Bom	650	1N	*H. sapiens*	host	SESA - 087/2018	This study
314	2018	Pinhais	895	5M, 1F, 4N	*H. hydrochaeris*	host	VBDL - 163	This study
315-330	2018	Colombo	1000	3M, 100N,	environment (CO2 trap)	passively	VBDL – 212, 213, 218-220, 222, 223, 239-247	This study

331-335	2018	Colombo	1000	7N	environment (cloth dragging)	actively	VBDL – 215, 216, 234, 237	This study
336-337	2018	Colombo	1000	4N	*H. sapiens* *not fixed	actively	VBDL – 249, 250	This study
338-340	2018	Colombo	1000	1M, 3F, 41N	environment (CO2 trap)	passively	VBDL – 277, 301, 307	This study
341-357	2018	Pinhais	895	26M, 23F, 109N	*H. hydrochaeris*	host	VBDL – 329-345	This study
358-361	2018	Maringá	520	7N	*Didelphis albiventris*	host	VBDL – 201-204	Massini et al. 2019
362	2019	Telêmaco Borba	760	1	environment (cloth dragging)	actively	SESA - 160/2019	This study
363	2019	Piraquara	915	1M, 2N	*H. hydrochaeris*	host	VBDL - 349	This study
364-365	2019	Colombo	1000	1M, 1F	environment (CO2 trap)	passively	VBDL – 359, 378	This study
Subtotal	99/514 (19%)							
Amblyomma ovale								
366	1984	Matinhos	15	5M, 3F	*P. cancrivorus*	host	MHNCI - 83	Arzua et al. 2005
367	1986	Paranaguá	10	1M, 1F	*Galictis cuja*	host	MHNCI - 5	Arzua et al. 2005
368	1988	Foz do Iguaçu	180	1F	*Cebus apella*	host	MHNCI - 53	Arzua et al. 2005
369	1988	Foz do Iguaçu	180	13N, 4F	*N. nasua*	host	MHNCI - 13	Arzua et al. 2005
370	1988	Matinhos	15	7M, 3F	*P. cancrivorus*	host	MHNCI - 82	Arzua et al. 2005
371	1989	Almirante Tamandaré	965	1F	*Herpailurus yagouaroundi*	host	MHNCI - 46	Arzua et al. 2005
372	1990	Piraí do Sul	1040	5M, 1F	*C. thous*	host	MHNCI - 30	Arzua et al. 2005

373	1990	Matinhos	15	68M, 34F	*Lontra longicaudis*	host	MHNCI - 20	Arzua et al. 2005
374	1990	Campina Grande do Sul	905	1M	*Sphiggurus villosus*	host	MHNCI - 52C	Arzua et al. 2005
375	1990	Pirai do Sul	1040	5M, 1F	*C. thous*	host	MHNCI - 30	This study
376-378	1992	Adrianópolis	280	4M, 3F	*C. familiaris*	host	MHNCI – 1396, 1238, 1358	Arzua et al. 2005
379	1992	Adrianópolis	280	1M, 3F	*P. cancrivorus*	host	MHNCI - 1387	Arzua et al. 2005
380	1993	Adrianópolis	280	1M, 1F	*P. cancrivorus*	host	MHNCI - 114	Arzua et al. 2005
381	1994	Morretes	10	1F	*H. sapiens*	host	MHNCI - 1349	Arzua et al. 2005
382	1998	Guaratuba	10	37M, 24F	*Eira barbara*	host	MHNCI - 1334	Arzua et al. 2005
383	2001	Apucarana	820	4M, 5F	*C. familiaris*	host	-	Labruna et al. 2001
384	2001	Londrina	570	4M, 5F	*C. familiaris*	host	-	Labruna et al. 2001
385	2001	Tamarana	770	4M, 5F	*C. familiaris*	host	-	Labruna et al. 2001
386-389	2001	Guaraqueçaba	170	5M, 2F, 2N	*C. familiaris*	host	MHNCI – 1453, 1459, 1372, 137	Arzua et al. 2005
390	2001	Guaraqueçaba	170	2M	*C. familiaris*	host	MHNCI - 1377	This study
391	2002	Santo Antonio da Platina	520	2M, 6F, 1N	*P. concolor*	host	MHNCI - 1391	Arzua et al. 2005
392-393	2002	Paranaguá	10	2M, 2F	environment	-	MHNCI – 1442, 1443	Arzua et al. 2005
394	2003	Morretes	10	1M, 2F	*C. familiaris*	host	MHNCI - 1637	Arzua et al. 2005

395	2004	Guaraqueçaba	170	5M, 4F, 2N	*C. thous*	host	MHNCI - 1682	This study
396	2004	São Jorge D´Oeste	470	16L	*Passerina brissonii*	host	MHNCI - 1726	This study
397	2006	Morretes	10	1F	*H. sapiens*	host	MHNCI - 1681	This study
398	2006	Guaraqueçaba	170	1M	*C. familiaris*	host	MHNCI - 1684 A	This study
399	2011	Alvorada do Sul	360	21	*C. familiariss*	host	-	Tamekuni et al. 2011
400	2011	Arapongas	790	19	*C. familiariss*	host	-	Tamekuni et al. 2011
401	2012	Londrina	570	1N	birds	host	-	Pacheco et al. 2012
402	2012	São Jorge do Oeste	470	2N	birds	host	-	Pacheco et al. 2012
403	2013	Alvorada do Sul	360	21	*C. familiaris*	host	-	Vieira et al. 2013
404-405	2014	Curitiba	900	2M, 2F	*C. familiaris*	host	VBDL – 56, 61	This study
406	2015	Porto Amazonas	820		-	-	SESA	This study
407	2016	Adrianópolis	280	7M, 10F	*C. familiaris*	host	-	Nieri-Bastos et al. 2016
408	2016	Alvorada do Sul	360	21	*C. familiaris*	host	-	Nascimento et al. 2016
409	2017	Antonina	9		*C. familiaris*	host	-	Silva et al. 2017
410	2017	Foz do Iguaçu	180	46A	*N. nasua*	host	-	Magalhães-Matos et al. 2017
411	2017	Três Barras do Paraná	530	2N	birds	host	-	Luz et al. 2017
412	2017	Paranaguá	10	10N, 1L	rodents	host	-	Blanco et al. 2017
413	2017	Jaguariaíva	840	19N	rodents	host	-	Blanco et al. 2017

414	2017	Itambaracá	410	1	environment (cloth dragging)	actively	SESA - 089/2017	This study
415	2017	Sertaneja	430	1	*C. familiaris*	host	SESA - 110/2017	This study
416	2017	Foz do Iguaçu	180	-	environment (cloth dragging)	actively	VBDL - 8	This study
417	2018	Paranaguá	10	3	-	-	SESA - 033/2018	This study
418	2018	Paula Freitas	780	1	-	-	SESA - 011/2018	This study
419	2018	Londrina	570	1F	*Sus scrofa*	host	VBDL - 328	This study
420	2019	Antonina	9	2M, 1F	*H. sapiens*	host	SESA - 73/2019	This study
421	2019	Morretes	10	13	*C. familiaris*	host	SESA - 75/2019	This study
422	2019	Morretes	10	1M	*H. sapiens*	host	SESA - 87/2019	This study
423	2019	Paranaguá	10	3	*C. familiaris*	host	SESA - 89/2019	This study
424	2019	Porto Barrreira	780	1M	*H. sapiens*	host	SESA - 162/2019	This study
425	2019	General Carneiro	915	1	*C. familiaris*	host	SESA - 74/2019	This study
426-430	2019	Paranaguá	10	4F, 5M	*C. familiaris*	host	VBDL – 419, 420, 422, 425, 429	This study
Subtotal	65/514 (13%)							
Amblyomma sculptum								
431	1990	Tijucas do Sul	915	42L	*Cichlocolaptes leucophrus*	host	MHNCI - 1243	Arzua et al. 2005
432	1990	Tijucas do Sul	915	5L	*C. lineata*	host	MHNCI - 1246	Arzua et al. 2005

433	1990	Tijucas do Sul	915	3L	*Pyrrhocoma ruficeps*	host	MHNCI - 1367	Arzua et al. 2005
434	1990	Tijucas do Sul	915	4L	*Tachyphonus coronatus*	host	MHNCI - 1244	Arzua et al. 2005
435	1990	Campina Grande do Sul	905	1F	*S. villosus*	host	MHNCI - 52A	Arzua et al. 2005
436	1990	Tijucas do Sul	915	3L	*P. ruficeps*	host	MHNCI - 1367B	This study
437	1991	Pinhão	1045	2N	*H. sapiens*	host	MHNCI - 90	Arzua et al. 2005
438-439	1992	Adrianópolis	280	14M, 8F	*Equus caballus*	host	MHNCI – 1438, 1439	Arzua et al. 2005
440-441	1992	Adrianópolis	280	8M, 2F	*H. sapiens*	host	MHNCI – 99, 1342	Arzua et al. 2005
442-443	1993	Adrianópolis	280	2N	*H. sapiens*	host	MHNCI – 124, 1525	Arzua et al. 2005
444	1993	Adrianópolis	280	1N	*H. sapiens*	host	MHNCI - 1524	This study
445	1994	Guaraqueçaba	170	1F	*H. sapiens*	host	MHNCI - 1345	Arzua et al. 2005
446-449	1994	Foz do Iguaçu	180	6M, 3F, 6N, 1L	*T. pecari*	host	MHNCI - 119A, 121A-123A	Arzua et al. 2005
450	2003	Rio Branco do Sul	890	1M, 13N	*C. familiaris*	host	MHNCI - 1640	Arzua et al. 2005
451	2004	Ortigueira	760	1F, 4N	*C. familiaris*	host	MHNCI - 1683 B	This study
452	2008	Londrina	570	455A	environment	-	-	Toledo et al. 2008
453	2010	São José dos Pinhais	902	-	*E. caballus*	host	-	Freitas et al. 2010
454	2010	Londrina	570	-	*E. caballus*	host	-	Tamekuni et al. 2010

455	2010	Umuarama	450	1F	human dwelling	passively	MHNCI - 1779	This study
456	2011	Jataizinho	355	56A	*E. caballus*	host	-	Gonçalves et al. 2011
457	2011	Alvorada do Sul	360	1	*C. familiariss*	host	-	Tamekuni et al. 2011
458	2011	Alvorada do Sul	360	34	*E. caballus*	host	-	Tamekuni et al. 2011
459	2011	Arapongas	790	1	*E. caballus*	host	-	Tamekuni et al. 2011
460	2011	Londrina	570	390	environment	-	-	Toledo et al. 2011a
461	2011	Londrina	570	2	*H. hydrochaeris*	host	-	Toledo et al. 2011a
462	2011	Londrina	570	1A	*C. familiaris*	host	-	Toledo et al. 2011b
463	2011	Londrina	570	68A	*E. caballus*	host	-	Toledo et al. 2011b
464	2013	Jataizinho	355	56A	*E. caballus*	host	-	Gonçalves et al. 2013
465	2013	Londrina	570	1	*C. familiaris*	host	-	Vieira et al. 2013
466	2013	Alvorada do Sul	360	1	*C. familiaris*	host	-	Vieira et al. 2013
467	2013	Andirá	480	-	-		SESA	This study
468-469	2013	Sertaneja	430	-	-		SESA	This study
470	2014	Andirá	480	-	-		SESA	This study
471	2014	Tomazina	510	-	-		SESA	This study
472	2015	Ponta Grossa	930	-	-		SESA	This study
473	2015	São Carlos do Ivaí	370	-	-		SESA	This study
474	2015	Jacarezinho	520	-	-		SESA	This study
475	2015	Ribeirão Claro	640	-	-		SESA	This study
476	2015	Pinhais	895	1M	*E. caballus*	host	VBDL - 311	This study

477	2016	Alvorada do Sul	360	127	*E. caballus*	host	-	Vieira et al. 2016
478	2016	Alvorada do Sul	360	1M	*E. caballus*	host	-	Martins et al. 2016
479	2016	Alvorada do Sul	360	1	*C. familiaris*	host	-	Nascimento et al. 2016
480	2016	Alvorada do Sul	360	34	*E. caballus*	host	-	Nascimento et al. 2016
481	2016	Curitiba	900	-	-	-	SESA	This study
482	2017	Pato Branco	800	-	*C. familiaris*	host	-	Ribeiro et al. 2017
483	2017	Tijucas do Sul	915	84	*C. familiaris*	host	SESA - 097/2017	This study
484	2017	Cianorte	520	3	*E. caballus*	host	SESA - 088/2017	This study
485	2017	Itambaracá	410	111	environment (cloth dragging)	actively	SESA - 089/2017	This study
486	2017	Sertaneja	430	15	environment (cloth dragging)	actively	SESA - 110/2017	This study
487	2017	Jacarezinho	520	1	environment (cloth dragging)	actively	SESA - 090/2017	This study
488-489	2017	Foz do Iguaçu	180	13M, 30F	environment (visual search)	passively	VBDL – 1, 4	This study
490	2017	Foz do Iguaçu	180	1M, 5F	environment (CO_2 trap)	passively	VBDL – 2	This study
491-492	2017	Foz do Iguaçu	180	5M, 6F	environment (cloth dragging)	actively	VBDL – 3, 5	This study
493	2017	Foz do Iguaçu	180	6M, 6F	*Tapirus terrestris*	host	VBDL - 6	This study
494-496	2017	Foz do Iguaçu	180	5M, 14F, 3N	environment (cloth dragging)	actively	VBDL – 7, 9, 10	This study
497-498	2017	Foz do Iguaçu	180	1M, 2F	environment (CO_2 trap)	passively	VBDL – 11-12	This study

499	2017	Foz do Iguaçu	180	1M, 7F	*H. sapiens* *not fixed	actively	VBDL - 23	This study
500	2018	Paranaguá	10	1	*H. sapiens*	host	SESA - 083/2018	This study
501	2018	Adrianópolis	280	1	environment (cloth dragging)	actively	SESA - 008/2018	This study
502	2018	Japurá	450	2	-	-	SESA - 031/2018	This study
503	2018	Rio Bom	650	2	*H. sapiens*	host	SESA - 056/2018	This study
504	2018	Londrina	570	1F	*S. scrofa*	host	VBDL - 328	This study
505	2019	Campo Largo	960	18	environment (cloth dragging)	actively	SESA - 56/2019	This study
506	2019	Paulo Frontin	780	1	*H. sapiens*	host	SESA - 112/2019	This study
507	2019	Rio Bom	650	1	*H. sapiens*	host	SESA - 159/2019	This study
508	2019	Imbau	890	3	environment (cloth dragging)	actively	SESA - 161/2019	This study
509-510	2019	Paranaguá	10	2F	*E. caballus*	host	VBDL – 427, 431	This study
511	2019	Paranaguá	10	1N	*H. sapiens*	host	VBDL - 449	This study
512-514	2019	Paranaguá	10	3N	*H. sapiens*	host	SESA	This study
Subtotal		84/514 (16%)						
Total		514 (100%)						

VBDL, Vector-Borne Diseases Laboratory; MHNCI, Capão da Imbuia Museum of Natural History; SESA, State Health Department of Paraná (*Secretaria Estadual de Saúde*); M, male; F, female; N, nymph; L, larvae; A, adult.

ANEXO 4 – TABELA SUPLEMENTAR - ARTIGO SUBMETIDO

Table S1. Records of ticks (M: males; F: females; N: nymphs; L: larvae) on wild animals in Paraná State, southern Brazil (1983–2020).

Record number	Year	Municipality	Stage	Host	group	Tick species	Collection accession No.	Collection	Reference
1	2005	São Pedro do Paraná	4F	*Rhinella icterica*	amphibians	*A. rotundatum*	1676	MHNCI	This study
2	2010	Terra Rica	130 MFN	*Rhinella schneideri*	amphibians	*A. rotundatum*	-	-	Antonucci *et al.* 2011
3	1999	Curitiba	1N	*Clibanornis dendrocolaptoides*	birds	*A. aureolatum*	647	MHNCI	This study
4	1999	Curitiba	2N	*Clibanornis dendrocolaptoides*	birds	*A. aureolatum*	935	MHNCI	Arzua *et al.* 2005
5	1999	Curitiba	1N	*Cranioleuca obsoleta*	birds	*A. aureolatum*	907	MHNCI	Arzua *et al.* 2005
6	2006	Curitiba	1N	*Cranioleuca obsoleta*	birds	*A. aureolatum*	1001	MHNCI	Arzua *et al.* 2005
7	1999	Curitiba	1N	*Furnarius rufus*	birds	*A. aureolatum*	853	MHNCI	Arzua *et al.* 2005
8	1993	Curitiba	1N	*Myiothlypis leucoblephara*	birds	*A. aureolatum*	966	MHNCI	Arzua *et al.* 2005
9	1999	Curitiba	1N	*Myiothlypis leucoblephara*	birds	*A. aureolatum*	952	MHNCI	Arzua *et al.* 2005
10	1999	Curitiba	1N	*Myiothlypis leucoblephara*	birds	*A. aureolatum*	963	MHNCI	Arzua *et al.* 2005
11	1999	Curitiba	1N	*Myiothlypis leucoblephara*	birds	*A. aureolatum*	969	MHNCI	Arzua *et al.* 2005
12	1993	Curitiba	1N	*Poospiza lateralis*	birds	*A. aureolatum*	542	MHNCI	This study
13	1999	Curitiba	1N	*Poospiza lateralis*	birds	*A. aureolatum*	953	MHNCI	Arzua *et al.* 2005

14	1999	Curitiba	2N	*Poospiza lateralis*	birds	*A. aureolatum*	954	MHNCI	Arzua *et al.* 2005
15	1999	Curitiba	1N	*Saltator similis*	birds	*A. aureolatum*	923	MHNCI	Arzua *et al.* 2005
16	2000	Curitiba	1N	*Saltator similis*	birds	*A. aureolatum*	974	MHNCI	Arzua *et al.* 2005
17	2000	Curitiba	3N	*Synallaxis cinerascens*	birds	*A. aureolatum*	1017	MHNCI	Arzua *et al.* 2005
18	2000	Curitiba	1N	*Synallaxis ruficapilla*	birds	*A. aureolatum*	639	MHNCI	This study
19	1999	Curitiba	2N	*Thamnophilus caerulescens*	birds	*A. aureolatum*	1000	MHNCI	Arzua *et al.* 2005
20	1999	Curitiba	2N	*Thamnophilus caerulescens*	birds	*A. aureolatum*	898	MHNCI	Arzua *et al.* 2005
21	1994	Curitiba	2N	*Troglodytes musculus*	birds	*A. aureolatum*	1005	MHNCI	Arzua *et al.* 2005
22	1999	Curitiba	4N	*Troglodytes musculus*	birds	*A. aureolatum*	897	MHNCI	Arzua *et al.* 2005
23	1999	Curitiba	1N	*Troglodytes musculus*	birds	*A. aureolatum*	965	MHNCI	Arzua *et al.* 2005
24	1999	Curitiba	1N	*Troglodytes musculus*	birds	*A. aureolatum*	858	MHNCI	Arzua *et al.* 2005
25	2000	Curitiba	1N	*Troglodytes musculus*	birds	*A. aureolatum*	899	MHNCI	Arzua *et al.* 2005
26	1999	Curitiba	1N	*Turdus albicollis*	birds	*A. aureolatum*	910	MHNCI	Arzua *et al.* 2005
27	1999	Curitiba	1N	*Turdus albicollis*	birds	*A. aureolatum*	913	MHNCI	Arzua *et al.* 2005
28	1994	Curitiba	1N	*Turdus amaurochalinus*	birds	*A. aureolatum*	638	MHNCI	This study
29	1999	Curitiba	1N	*Turdus amaurochalinus*	birds	*A. aureolatum*	946	MHNCI	Arzua *et al.* 2005

30	1999	Curitiba	1N	*Turdus amaurochalinus*	birds	*A. aureolatum*	956	MHNCI	Arzua *et al.* 2005
31	2000	Curitiba	7N	*Turdus amaurochalinus*	birds	*A. aureolatum*	1018	MHNCI	Arzua *et al.* 2005
32	1992	Quatro Barras	1N	*Turdus rufiventris*	birds	*A. aureolatum*	517	MHNCI	This study
33	1994	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	588B	MHNCI	This study
34	1995	Adrianópolis	1N	*Turdus rufiventris*	birds	*A. aureolatum*	645	MHNCI	This study
35	1998	Quatro Barras	1N	*Turdus rufiventris*	birds	*A. aureolatum*	1441	MHNCI	Arzua *et al.* 2005
36	1998	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	852	MHNCI	Arzua *et al.* 2005
37	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	854	MHNCI	Arzua *et al.* 2005
38	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	856	MHNCI	Arzua *et al.* 2005
39	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	857	MHNCI	Arzua *et al.* 2005
40	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	900	MHNCI	Arzua *et al.* 2005
41	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	912	MHNCI	Arzua *et al.* 2005
42	1999	Curitiba	2N	*Turdus rufiventris*	birds	*A. aureolatum*	915	MHNCI	Arzua *et al.* 2005
43	1999	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	918	MHNCI	Arzua *et al.* 2005
44	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	924	MHNCI	Arzua *et al.* 2005
45	1999	Curitiba	2N	*Turdus rufiventris*	birds	*A. aureolatum*	925	MHNCI	Arzua *et al.* 2005
46	1999	Curitiba	2N	*Turdus rufiventris*	birds	*A. aureolatum*	926	MHNCI	Arzua *et al.* 2005

47	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	927	MHNCI	Arzua *et al.* 2005
48	1999	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	928	MHNCI	Arzua *et al.* 2005
49	1999	Curitiba	2N	*Turdus rufiventris*	birds	*A. aureolatum*	929	MHNCI	Arzua *et al.* 2005
50	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	930	MHNCI	Arzua *et al.* 2005
51	1999	Curitiba	2N	*Turdus rufiventris*	birds	*A. aureolatum*	931	MHNCI	Arzua *et al.* 2005
52	1999	Curitiba	2N	*Turdus rufiventris*	birds	*A. aureolatum*	933	MHNCI	Arzua *et al.* 2005
53	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	934	MHNCI	Arzua *et al.* 2005
54	1999	Curitiba	6N	*Turdus rufiventris*	birds	*A. aureolatum*	936	MHNCI	Arzua *et al.* 2005
55	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	937A	MHNCI	Arzua *et al.* 2005
56	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	938	MHNCI	Arzua *et al.* 2005
57	1999	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	939	MHNCI	Arzua *et al.* 2005
58	1999	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	340	MHNCI	Arzua *et al.* 2005
59	1999	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	341	MHNCI	Arzua *et al.* 2005
60	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	342	MHNCI	Arzua *et al.* 2005
61	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	944	MHNCI	Arzua *et al.* 2005
62	1999	Curitiba	2N	*Turdus rufiventris*	birds	*A. aureolatum*	945	MHNCI	Arzua *et al.* 2005

63	1999	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	948	MHNCI	Arzua *et al.* 2005
64	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	949	MHNCI	Arzua *et al.* 2005
65	1999	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	950	MHNCI	Arzua *et al.* 2005
66	1999	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	951	MHNCI	Arzua *et al.* 2005
67	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	955	MHNCI	Arzua *et al.* 2005
68	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	957	MHNCI	Arzua *et al.* 2005
69	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	958	MHNCI	Arzua *et al.* 2005
70	1999	Curitiba	2N	*Turdus rufiventris*	birds	*A. aureolatum*	959	MHNCI	Arzua *et al.* 2005
71	1999	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	960	MHNCI	Arzua *et al.* 2005
72	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	961	MHNCI	Arzua *et al.* 2005
73	1999	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	962	MHNCI	Arzua *et al.* 2005
74	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	964	MHNCI	Arzua *et al.* 2005
75	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	967	MHNCI	Arzua *et al.* 2005
76	1999	Curitiba	5N	*Turdus rufiventris*	birds	*A. aureolatum*	968	MHNCI	Arzua *et al.* 2005
77	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	970	MHNCI	Arzua *et al.* 2005
78	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	971	MHNCI	Arzua *et al.* 2005

79	1999	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	972	MHNCI	Arzua *et al.* 2005
80	1999	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	973	MHNCI	Arzua *et al.* 2005
81	2000	Curitiba	2N	*Turdus rufiventris*	birds	*A. aureolatum*	975	MHNCI	Arzua *et al.* 2005
82	2000	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	982	MHNCI	Arzua *et al.* 2005
83	2000	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	983	MHNCI	Arzua *et al.* 2005
84	2000	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	986	MHNCI	Arzua *et al.* 2005
85	2000	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	990	MHNCI	Arzua *et al.* 2005
86	2000	Curitiba	4N	*Turdus rufiventris*	birds	*A. aureolatum*	996	MHNCI	Arzua *et al.* 2005
87	2000	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	997	MHNCI	Arzua *et al.* 2005
88	2000	Curitiba	2N	*Turdus rufiventris*	birds	*A. aureolatum*	999	MHNCI	Arzua *et al.* 2005
89	2000	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	1003	MHNCI	Arzua *et al.* 2005
90	2000	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	1007	MHNCI	Arzua *et al.* 2005
91	2000	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	1009	MHNCI	Arzua *et al.* 2005
92	2000	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	1010	MHNCI	Arzua *et al.* 2005
93	2000	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	1011	MHNCI	Arzua *et al.* 2005
94	2000	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	1013	MHNCI	Arzua *et al.* 2005

95	2000	Curitiba	2N	*Turdus rufiventris*	birds	*A. aureolatum*	1014	MHNCI	Arzua *et al.* 2005
96	2000	Curitiba	2N	*Turdus rufiventris*	birds	*A. aureolatum*	1015	MHNCI	Arzua *et al.* 2005
97	2000	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	1019	MHNCI	Arzua *et al.* 2005
98	2000	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	1020	MHNCI	Arzua *et al.* 2005
99	2000	Curitiba	2N	*Turdus rufiventris*	birds	*A. aureolatum*	1021	MHNCI	Arzua *et al.* 2005
100	2000	Curitiba	11N	*Turdus rufiventris*	birds	*A. aureolatum*	1022	MHNCI	Arzua *et al.* 2005
101	2000	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	1023	MHNCI	Arzua *et al.* 2005
102	2000	Curitiba	6N	*Turdus rufiventris*	birds	*A. aureolatum*	1027	MHNCI	Arzua *et al.* 2005
103	2000	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	1024	MHNCI	Arzua *et al.* 2005
104	2000	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	1025	MHNCI	Arzua *et al.* 2005
105	2000	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	1028	MHNCI	Arzua *et al.* 2005
106	2000	Curitiba	1N	*Zonotrichia capensis*	birds	*A. aureolatum*	1004	MHNCI	Arzua *et al.* 2005
107	2003	Curitiba	210N, 489L	birds	birds	*A. aureolatum*	-	-	Arzua *et al.* 2003
108	2012	São Jorge D´ Oeste	1N	birds	birds	*A. aureolatum*	-	-	Pacheco *et al.* 2012
109	1999	Curitiba	1N, 2L	*Furnarius rufus*	birds	*A. aureolatum*	853	MHNCI	Arzua *et al.* 2005
110	1999	Curitiba	2L	*Turdus rufiventris*	birds	*A. aureolatum*	855	MHNCI	Arzua *et al.* 2005

111	1999	Curitiba	3L	*Turdus rufiventris*	birds	*A. aureolatum*	894	MHNCI	Arzua *et al.* 2005
112	1999	Curitiba	21L	*Thamnophilus ruficapillus*	birds	*A. aureolatum*	895	MHNCI	Arzua *et al.* 2005
113	1999	Curitiba	4N, 87L	*Troglodytes aedon*	birds	*A. aureolatum*	896	MHNCI	Arzua *et al.* 2005
114	1999	Curitiba	1L	*Turdus rufiventris*	birds	*A. aureolatum*	901	MHNCI	Arzua *et al.* 2005
115	1999	Curitiba	1L	*Cranioleuca pallida*	birds	*A. aureolatum*	904	MHNCI	Arzua *et al.* 2005
116	1999	Curitiba	1L	*Cranioleuca pallida*	birds	*A. aureolatum*	905	MHNCI	Arzua *et al.* 2005
117	1999	Curitiba	2L	*Cranioleuca pallida*	birds	*A. aureolatum*	906	MHNCI	Arzua *et al.* 2005
118	1999	Curitiba	36L	*Turdus rufiventris*	birds	*A. aureolatum*	908	MHNCI	Arzua *et al.* 2005
119	1999	Curitiba	1L	*Tachyphonus coronatus*	birds	*A. aureolatum*	911	MHNCI	Arzua *et al.* 2005
120	1999	Curitiba	11L	*Turdus rufiventris*	birds	*A. aureolatum*	914	MHNCI	Arzua *et al.* 2005
121	1999	Curitiba	1L	*Turdus rufiventris*	birds	*A. aureolatum*	916	MHNCI	Arzua *et al.* 2005
122	1999	Curitiba	5L	*Turdus albicollis*	birds	*A. aureolatum*	917	MHNCI	Arzua *et al.* 2005
123	1999	Curitiba	1L	*Turdus rufiventris*	birds	*A. aureolatum*	919	MHNCI	Arzua *et al.* 2005
124	1999	Curitiba	3	*Cranioleuca obsoleta*	birds	*A. aureolatum*	920	MHNCI	Arzua *et al.* 2005
125	1999	Curitiba	2L	*Turdus rufiventris*	birds	*A. aureolatum*	921	MHNCI	Arzua *et al.* 2005
126	1999	Curitiba	2N	*Turdus rufiventris*	birds	*A. aureolatum*	929	MHNCI	Arzua *et al.* 2005

127	1999	Curitiba	6L	*Turdus rufiventris*	birds	*A. aureolatum*	932	MHNCI	Arzua *et al.* 2005
128	1999	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	940	MHNCI	Arzua *et al.* 2005
129	1999	Curitiba	3N	*Turdus rufiventris*	birds	*A. aureolatum*	941	MHNCI	Arzua *et al.* 2005
130	1999	Curitiba	1N	*Turdus rufiventris*	birds	*A. aureolatum*	942	MHNCI	Arzua *et al.* 2005
131	1999	Curitiba	3L	*Turdus rufiventris*	birds	*A. aureolatum*	947	MHNCI	Arzua *et al.* 2005
132	2000	Curitiba	1L	*Saltator similis*	birds	*A. aureolatum*	977	MHNCI	Arzua *et al.* 2005
133	2000	Curitiba	1L	*Turdus rufiventris*	birds	*A. aureolatum*	978	MHNCI	Arzua *et al.* 2005
134	2000	Curitiba	1L	*Thamnophilus caerulescens*	birds	*A. aureolatum*	979	MHNCI	Arzua *et al.* 2005
135	2000	Curitiba	1L	*Turdus rufiventris*	birds	*A. aureolatum*	980	MHNCI	Arzua *et al.* 2005
136	2000	Curitiba	2L	*Turdus rufiventris*	birds	*A. aureolatum*	981	MHNCI	Arzua *et al.* 2005
137	2000	Curitiba	1N, 3L	*Troglodytes aedon*	birds	*A. aureolatum*	984	MHNCI	Arzua *et al.* 2005
138	2000	Curitiba	1L	*Basileuterus leucoblepharus*	birds	*A. aureolatum*	985	MHNCI	Arzua *et al.* 2005
139	2000	Curitiba	1L	*Turdus rufiventris*	birds	*A. aureolatum*	987	MHNCI	Arzua *et al.* 2005
140	2000	Curitiba	1L	*Basileuterus leucoblepharus*	birds	*A. aureolatum*	991	MHNCI	Arzua *et al.* 2005
141	2000	Curitiba	1L	*Turdus rufiventris*	birds	*A. aureolatum*	992	MHNCI	Arzua *et al.* 2005
142	2000	Curitiba	1L	*Basileuterus leucoblepharus*	birds	*A. aureolatum*	993	MHNCI	Arzua *et al.* 2005

143	2000	Curitiba	1L	*Turdus rufiventris*	birds	*A. aureolatum*	994	MHNCI	Arzua *et al.* 2005
144	2000	Curitiba	7L	*Cranioleuca obsoleta*	birds	*A. aureolatum*	998	MHNCI	Arzua *et al.* 2005
145	2000	Curitiba	3L	*Saltator similis*	birds	*A. aureolatum*	1002	MHNCI	Barros & Baggio 1992; Arzua *et al.* 2005
146	2000	Curitiba	1L	*Thamnophilus caerulescens*	birds	*A. aureolatum*	1006	MHNCI	Arzua *et al.* 2005
147	2000	Curitiba	1L	*Turdus rufiventris*	birds	*A. aureolatum*	1012	MHNCI	Arzua *et al.* 2005
148	2000	Curitiba	2L	*Turdus rufiventris*	birds	*A. aureolatum*	1016	MHNCI	Arzua *et al.* 2005
149	2000	Curitiba	19N, 3L	*Turdus rufiventris*	birds	*A. aureolatum*	1026	MHNCI	Arzua *et al.* 2005
150	2000	Curitiba	4L	*Turdus rufiventris*	birds	*A. aureolatum*	1029	MHNCI	Arzua *et al.* 2005
151	2000	Curitiba	1L	*Turdus rufiventris*	birds	*A. aureolatum*	1030	MHNCI	Arzua *et al.* 2005
152	2000	Curitiba	6L	*Turdus rufiventris*	birds	*A. aureolatum*	1031	MHNCI	Arzua *et al.* 2005
153	2005	São Jorge D´ Oeste	1N	*Turdus leucomelas*	birds	*A. aureolatum*	1737	MHNCI	This study
154	2000	Curitiba	1N, 1L	*Turdus rufiventris*	birds	*A. aureolatum*	1007-A	MHNCI	Arzua *et al.* 2005
155	2000	Curitiba	6N	*Turdus rufiventris*	birds	*A. aureolatum*	1027-A	MHNCI	Arzua *et al.* 2005
156	1999	Curitiba	2N	*Turdus rufiventris*	birds	*A. aureolatum*	915-A	MHNCI	Arzua *et al.* 2005
157	1999	Curitiba	3N, 2L	*Turdus rufiventris*	birds	*A. aureolatum*	918-A	MHNCI	Arzua *et al.* 2005

158	1999	Curitiba	1L	*Turdus rufiventris*	birds	*A. aureolatum*	922 -A	MHNCI	Arzua *et al.* 2005
159	2008	São Jorge D´ Oeste	1N	*Turdus leucomelas*	birds	*A. aureolatum*	-	-	Barros-Battesti 2008
160	2003	Curitiba	2N,12L	*Cranioleuca obsoleta*	birds	*A. aureolatum*	-	-	Guglielmone *et al.* 2003
161	2003	Curitiba	4L	*Cranioleuca pallida*	birds	*A. aureolatum*	-	-	Guglielmone *et al.* 2003
162	2003	Curitiba	1N,2L	*Furnarius rufus*	birds	*A. aureolatum*	-	-	Guglielmone *et al.* 2003
163	2003	Curitiba	3N	*Poospiza lateralis*	birds	*A. aureolatum*	-	-	Guglielmone *et al.* 2003
164	2003	Curitiba	2N,8L	*Saltator similis*	birds	*A. aureolatum*	-	-	Guglielmone *et al.* 2003
165	2003	Curitiba	4N,1L	*Synallaxis cinerascens*	birds	*A. aureolatum*	-	-	Guglielmone *et al.* 2003
166	2003	Curitiba	1L	*Tachyphonus coronatus*	birds	*A. aureolatum*	-	-	Guglielmone *et al.* 2003
167	2003	Curitiba	4N,52L	*Thamnophilus caerulescens*	birds	*A. aureolatum*	-	-	Guglielmone *et al.* 2003
168	2003	Curitiba	21L	*Thamnophilus ruficapillus*	birds	*A. aureolatum*	-	-	Guglielmone *et al.* 2003
169	2003	Curitiba	14N,186L	*Troglodytes aedon*	birds	*A. aureolatum*	-	-	Guglielmone *et al.* 2003
170	2003	Curitiba	2N,9L	*Turdus albicollis*	birds	*A. aureolatum*	-	-	Guglielmone *et al.* 2003
171	2003	Curitiba	10N	*Turdus amaurochalinus*	birds	*A. aureolatum*	-	-	Guglielmone *et al.* 2003
172	2003	Curitiba	1N	*Zonotrichia capensis*	birds	*A. aureolatum*	-	-	Guglielmone *et al.* 2003
173	2017	Três Barras do Paraná	4N	*Synallaxis ruficapilla*	birds	*A. aureolatum*	-	-	Luz *et al.* 2017

174	2017	Três Barras do Paraná	2N	*Conopophaga lineata*	birds	*A. aureolatum*	-	-	Luz *et al.* 2017
175	2017	Três Barras do Paraná	2N	*Turdus albicollis*	birds	*A. aureolatum*	-	-	Luz *et al.* 2017
176	2003	Paranaguá	1N	*Atilla rufus*	birds	*A. calcaratum*	1434	MHNCI	This study
177	2002	Paranaguá	1N	*Dysithamnus mentalis*	birds	*A. calcaratum*	1416	MHNCI	This study
178	1995	Guaraqueçaba	2N	*Habia rubica*	birds	*A. calcaratum*	525	MHNCI	This study
179	1995	Guaraqueçaba	1N	*Habia rubica*	birds	*A. calcaratum*	540	MHNCI	This study
180	2003	Paranaguá	2N	*Habia rubica*	birds	*A. calcaratum*	1423	MHNCI	This study
181	1992	Adrianópolis	1N	*Lanio melanops*	birds	*A. calcaratum*	1541B	MHNCI	This study
182	2002	São Pedro do Iguaçu	1N	*Lanio melanops*	birds	*A. calcaratum*	1411	MHNCI	This study
183	2004	Paranaguá	1N	*Lanio melanops*	birds	*A. calcaratum*	1829	MHNCI	This study
184	2005	Londrina	2N	*Lanio melanops*	birds	*A. calcaratum*	1734	MHNCI	This study
185	1990	Guaraqueçaba	1N	*Mackenziaena severa*	birds	*A. calcaratum*	397	MHNCI	This study
186	2011	Telêmaco Borba	1N	*Pyrrhocoma ruficeps*	birds	*A. calcaratum*	1862	MHNCI	This study
187	1992	Guaraqueçaba	1N	*Ramphocelus bresilius*	birds	*A. calcaratum*	552	MHNCI	This study
188	2002	Londrina	3N	*Saltator similis*	birds	*A. calcaratum*	1741	MHNCI	This study
189	2003	Paranaguá	1N	*Schiffornis virescens*	birds	*A. calcaratum*	1418	MHNCI	This study
190	1993	Morretes	1N	*Tachyphonus coronatus*	birds	*A. calcaratum*	568	MHNCI	This study
191	2002	São Pedro do Iguaçu	1N	*Thamnophilus caerulescens*	birds	*A. calcaratum*	1412	MHNCI	This study
192	2003	Paranaguá	1N	*Xenops minutus*	birds	*A. calcaratum*	1437	MHNCI	This study
193	2012	Londrina	5N	birds	birds	*A. calcaratum*	-	-	Pacheco *et al.* 2012

194	2012	São Jorge D´ Oeste	3N	birds	birds	*A. calcaratum*	-	-	Pacheco *et al.* 2012
195	2012	Adrianópolis	3N	birds	birds	*A. calcaratum*	-	-	Pacheco *et al.* 2012
196	2004	Vale do Ribeira	1N	*Conopophaga lineata*	birds	*A. calcaratum*	1694	MHNCI	This study
197	2004	São Jorge D´ Oeste	1L	*Tachyphonus coronatus*	birds	*A. calcaratum*	1700	MHNCI	This study
198	2004	Londrina	1N	*Trichothraupis melanops*	birds	*A. calcaratum*	1710	MHNCI	This study
199	2005	Vale do Ribeira	1L	*Pyriglena leucoptera*	birds	*A. calcaratum*	1745	MHNCI	This study
200	2006	Vale do Ribeira	1N	*Xiphocolaptes albicollis*	birds	*A. calcaratum*	1752	MHNCI	This study
201	2017	Três Barras do Paraná	1N	*Dysithamnus mentalis*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
202	2017	Três Barras do Paraná	1N	*Mackenziaena severa*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
203	2017	Três Barras do Paraná	3N	*Drymophila malura*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
204	2017	Três Barras do Paraná	2N	*Platyrinchus mystaceus*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
205	2017	Três Barras do Paraná	1N	*Mionectes rufiventris*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
206	2017	Três Barras do Paraná	1N	*Poecilotriccus plumbeiceps*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
207	2017	Três Barras do Paraná	1N	*Leptopogon amaurocephalus*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
208	2017	Três Barras do Paraná	1N	*Syndactyla rufosuperciliata*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
209	2017	Três Barras do Paraná	1N	*Automolus leucophthalmus*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017

210	2017	Três Barras do Paraná	1N	*Anabacerthia lichtensteini*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
211	2017	Três Barras do Paraná	1N	*Hylophilus poicilotis*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
212	2017	Três Barras do Paraná	2N	*Basileuterus culicivorus*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
213	2017	Três Barras do Paraná	17N	*Lanio melanops*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
214	2017	Três Barras do Paraná	2N	*Saltator similis*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
215	2017	Três Barras do Paraná	7N	*Tachyphonus coronatus*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
216	2017	Três Barras do Paraná	4N	*Schiffornis virescens*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
217	2017	Três Barras do Paraná	1L	*Ramphotrigon megacephalum*	birds	*A. calcaratum*	-	-	Luz *et al.* 2017
218	2004	Londrina	1N	*Thamnophilus doliatus*	birds	*A. dubitatum*	1709	MHNCI	This study
219	1991	Campina Grande do Sul	1N	*Penelope obscura*	birds	*A. incisum*	1362	MHNCI	Arzua *et al.* 2005
220	2002	Londrina	1N	*Automolus leucophthalmus*	birds	*A. longirostre*	1744	MHNCI	This study
221	2002	São Pedro do Iguaçu	2N	*Baryphthengus ruficapillus*	birds	*A. longirostre*	1501	MHNCI	This study
222	2002	São Pedro do Iguaçu	1N	*Basileuterus culicivorus*	birds	*A. longirostre*	1413	MHNCI	Arzua *et al.* 2005
223	1993	Piraquara	1N	*Celeus flavescens*	birds	*A. longirostre*	1407	MHNCI	Arzua *et al.* 2005
224	1995	Guaraqueçaba	1N	*Chiroxiphia caudata*	birds	*A. longirostre*	539	MHNCI	This study
225	1992	Guaraqueçaba	2N	*Conopophaga melanops*	birds	*A. longirostre*	554	MHNCI	This study

226	2004	São Jorge D´ Oeste	1N	*Cyanoloxia brissonii*	birds	*A. longirostre*	1701	MHNCI	This study
227	2004	São Jorge D´ Oeste	1N	*Cyanoloxia brissonii*	birds	*A. longirostre*	1715	MHNCI	This study
228	1996	Guaraqueçaba	1N	*Dendrocincla fuliginosa*	birds	*A. longirostre*	546	MHNCI	This study
229	2004	São Jorge D´ Oeste	2N	*Dysithamnus mentalis*	birds	*A. longirostre*	1717	MHNCI	This study
230	1995	Morretes	1N	*Euphonia pectoralis*	birds	*A. longirostre*	1405	MHNCI	Arzua *et al.* 2005
231	1995	Guaraqueçaba	1N	*Euphonia pectoralis*	birds	*A. longirostre*	534	MHNCI	This study
232	2000	Centenário do Sul	1N	*Euphonia violacea*	birds	*A. longirostre*	1450	MHNCI	Arzua *et al.* 2005
233	2004	São Jorge D´ Oeste	1N	*Furnarius rufus*	birds	*A. longirostre*	1714	MHNCI	This study
234	2004	Londrina	1N	*Geothlypis aequinoctialis*	birds	*A. longirostre*	1713	MHNCI	This study
235	2004	Adrianópolis	1N	*Geothlypis aequinoctialis*	birds	*A. longirostre*	1720	MHNCI	This study
236	2006	Adrianópolis	1N	*Habia rubica*	birds	*A. longirostre*	1753	MHNCI	This study
237	2000	Jaguariaíva	1N	*Lanio cucullatus*	birds	*A. longirostre*	976	MHNCI	This study
238	1992	Curitiba	1N	*Lanio melanops*	birds	*A. longirostre*	561	MHNCI	This study
239	1995	Guaraqueçaba	1N	*Lanio melanops*	birds	*A. longirostre*	522	MHNCI	This study
240	2002	São Pedro do Iguaçu	2N	*Lanio melanops*	birds	*A. longirostre*	1408A	MHNCI	This study
241	2003	Paranaguá	1N	*Lanio melanops*	birds	*A. longirostre*	1419	MHNCI	Arzua *et al.* 2005
242	2003	Paranaguá	1N	*Lanio melanops*	birds	*A. longirostre*	1421	MHNCI	This study
243	2003	Paranaguá	1N	*Lanio melanops*	birds	*A. longirostre*	1426	MHNCI	Arzua *et al.* 2005

244	2004	São Jorge D´ Oeste	2N	*Lanio melanops*	birds	*A. longirostre*	1716	MHNCI	This study
245	1990	Antonina	1N	*Mackenziaena severa*	birds	*A. longirostre*	41	MHNCI	Arzua *et al.* 2005
246	2003	Paranaguá	1N	*Manacus manacus*	birds	*A. longirostre*	1422A	MHNCI	Arzua *et al.* 2005
247	2004	Adrianópolis	1N	*Manacus manacus*	birds	*A. longirostre*	1698	MHNCI	This study
248	2006	Londrina	1N	*Myiothlypis leucoblephara*	birds	*A. longirostre*	1750	MHNCI	This study
249	1992	Guaraqueçaba	1N	*Philydor atricapillus*	birds	*A. longirostre*	553	MHNCI	This study
250	2003	Paranaguá	1N	*Philydor atricapillus*	birds	*A. longirostre*	1427	MHNCI	Arzua *et al.* 2005
251	1993	Piraquara	1N	*Pulsatrix koeniswaldiana*	birds	*A. longirostre*	1406	MHNCI	Arzua *et al.* 2005
252	1995	Curitiba	1N	*Pyroderus scutatus*	birds	*A. longirostre*	544	MHNCI	This study
253	2005	Adrianópolis	1N	*Saltator fuliginosus*	birds	*A. longirostre*	1747	MHNCI	This study
254	2004	Londrina	5N	*Saltator similis*	birds	*A. longirostre*	1712	MHNCI	This study
255	2003	Londrina	1N	*Sittasomus griseicapillus*	birds	*A. longirostre*	1638	MHNCI	Arzua *et al.* 2005
256	1993	Morretes	1N	*Tachyphonus coronatus*	birds	*A. longirostre*	568	MHNCI	This study
257	2004	Adrianópolis	2N	*Tachyphonus coronatus*	birds	*A. longirostre*	1719	MHNCI	This study
258	2005	Adrianópolis	1N	*Tachyphonus coronatus*	birds	*A. longirostre*	1749	MHNCI	This study
259	1993	Morretes	1N	*Tangara peruviana*	birds	*A. longirostre*	567	MHNCI	This study
260	1990	Antonina	2N	*Tangara seledon*	birds	*A. longirostre*	1355	MHNCI	Arzua *et al.* 2005
261	1992	Morretes	1N	*Tangara seledon*	birds	*A. longirostre*	96	MHNCI	This study

262	1993	Morretes	1N	*Tangara seledon*	birds	*A. longirostre*	565	MHNCI	This study
263	1993	Ponta Grossa	1N	*Tersina viridis*	birds	*A. longirostre*	1356	MHNCI	Arzua *et al.* 2005
264	1992	Guaraqueçaba	2N	*Thamnophilus caerulescens*	birds	*A. longirostre*	556	MHNCI	This study
265	2005	Londrina	1N	*Thamnophilus doliatus*	birds	*A. longirostre*	1740	MHNCI	This study
266	1989	Morretes	2N	*Tolmomyias sulphurescens*	birds	*A. longirostre*	1	MHNCI	This study
267	1994	Curitiba	1N	*Turdus flavipes*	birds	*A. longirostre*	1440	MHNCI	This study
268	2004	Londrina	1N	*Turdus leucomelas*	birds	*A. longirostre*	1711	MHNCI	This study
269	2005	São Jorge D´ Oeste	1N	*Turdus leucomelas*	birds	*A. longirostre*	1739	MHNCI	This study
270	1995	Guaraqueçaba	1N	*Turdus rufiventris*	birds	*A. longirostre*	531	MHNCI	This study
271	2004	Adrianópolis	1N	*Turdus rufiventris*	birds	*A. longirostre*	1702	MHNCI	This study
272	2004	São Jorge D´ Oeste	1N	*Turdus rufiventris*	birds	*A. longirostre*	1714	MHNCI	This study
273	2005	Adrianópolis	1N	*Turdus rufiventris*	birds	*A. longirostre*	1746	MHNCI	This study
274	2004	Adrianópolis	1N	*Vireo chivi*	birds	*A. longirostre*	1721	MHNCI	This study
275	2012	Londrina	9N	birds	birds	*A. longirostre*	-	-	Pacheco *et al.* 2012
276	2012	São Jorge D´ Oeste	15N	birds	birds	*A. longirostre*	-	-	Pacheco *et al.* 2012
277	2012	Adrianópolis	10N	birds	birds	*A. longirostre*	-	-	Pacheco *et al.* 2012
278	2002	Paranaguá	2L	*Chiroxiphia caudata*	birds	*A. longirostre*	1247	MHNCI	Arzua *et al.* 2005
279	2002	Paranaguá	1N	*Thryothorus longirostris*	birds	*A. longirostre*	1248	MHNCI	This study
280	2002	Paranaguá	1L	*Mionectes rufiventris*	birds	*A. longirostre*	1249	MHNCI	Arzua *et al.* 2005

281	2002	Paranaguá	1L	*Habia rubica*	birds	*A. longirostre*	1250	MHNCI	Barros & Baggio 1992; Arzua *et al.* 2005
282	2002	Paranaguá	1N	*Basileuterus culicivorus*	birds	*A. longirostre*	1252	MHNCI	Arzua *et al.* 2005
283	2002	Paranaguá	1L	*Dendrocincla turdina*	birds	*A. longirostre*	1254	MHNCI	Arzua *et al.* 2005
284	2002	Paranaguá	1L	*Chiroxiphia caudata*	birds	*A. longirostre*	1255	MHNCI	Arzua *et al.* 2005
285	2002	Paranaguá	1N	*Dendrocincla turdina*	birds	*A. longirostre*	1444	MHNCI	Arzua *et al.* 2005
286	2000	São Pedro do Iguaçu	1N	*Turdus rufiventris*	birds	*A. longirostre*	1467	MHNCI	Arzua *et al.* 2005
287	1990	Antonina	1N	*Tolmomyias sulphurescens*	birds	*A. longirostre*	1493	MHNCI	Arzua *et al.* 2005
288	1996	Centenário do Sul	1N	*Turdus rufiventris*	birds	*A. longirostre*	1502	MHNCI	Arzua *et al.* 2005
289	1993	Piraquara	2N	*Myiodynastes maculatus*	birds	*A. longirostre*	1530	MHNCI	Arzua *et al.* 2005
290	1994	Morretes	1N	*Tangara seledon*	birds	*A. longirostre*	1535	MHNCI	Arzua *et al.* 2005
291	1993	Piraquara	1N	*Conopophaga lineata*	birds	*A. longirostre*	1538	MHNCI	Arzua *et al.* 2005
292	1993	Tijucas do Sul	1N	*Myiarchus ferox*	birds	*A. longirostre*	1568	MHNCI	Arzua *et al.* 2005
293	1994	Fênix	1N	*Baryphthengus ruficapillus*	birds	*A. longirostre*	1580	MHNCI	Arzua *et al.* 2005
294	1993	Guaraqueçaba	1N	*Phylloscartes ventralis*	birds	*A. longirostre*	1618	MHNCI	Arzua *et al.* 2005
295	2004	Vale do Ribeira	1L	*Euphonia violacea*	birds	*A. longirostre*	1695	MHNCI	This study

296	2004	Vale do Ribeira	10L	*Saltator similis*	birds	*A. longirostre*	1697	MHNCI	This study
297	2004	São Jorge D´ Oeste	1L	*Leptopogon amaurocephalus*	birds	*A. longirostre*	1699	MHNCI	This study
298	2004	Vale do Ribeira	5L	*Chiroxiphia caudata*	birds	*A. longirostre*	1703	MHNCI	This study
299	2004	Vale do Ribeira	1L	*Pyriglena leucoptera*	birds	*A. longirostre*	1704	MHNCI	This study
300	2004	São Jorge D´ Oeste	1L	*Cyclarhis gujanensis*	birds	*A. longirostre*	1705	MHNCI	This study
301	2004	São Jorge D´ Oeste	1L	*Turdus leucomelas*	birds	*A. longirostre*	1706	MHNCI	This study
302	2004	São Jorge D´ Oeste	1L	*Turdus leucomelas*	birds	*A. longirostre*	1707	MHNCI	This study
303	2004	São Jorge D´ Oeste	1L	*Turdus leucomelas*	birds	*A. longirostre*	1708	MHNCI	This study
304	2004	São Jorge D´ Oeste	1N	*Turdus rufiventris*	birds	*A. longirostre*	1718	MHNCI	This study
305	2004	Vale do Ribeira	1L	*Geothlypis aequinoctialis*	birds	*A. longirostre*	1722	MHNCI	This study
306	2004	São Jorge D´ Oeste	1L	*Geothlypis aequinoctialis*	birds	*A. longirostre*	1723	MHNCI	This study
307	2004	São Jorge D´ Oeste	1L	*Basileuterus culicivorus*	birds	*A. longirostre*	1724	MHNCI	This study
308	2004	São Jorge D´ Oeste	1L	*Leptopogon amaurocephalus*	birds	*A. longirostre*	1725	MHNCI	This study
309	2004	São Jorge D´ Oeste	1L	*Basileuterus culicivorus*	birds	*A. longirostre*	1727	MHNCI	This study
310	2005	São Jorge D´ Oeste	2L	*Turdus leucomelas*	birds	*A. longirostre*	1730	MHNCI	This study
311	2005	São Jorge D´ Oeste	2L	*Turdus leucomelas*	birds	*A. longirostre*	1731	MHNCI	This study

312	2005	Vale do Ribeira	3L	*Chiroxiphia caudata*	birds	*A. longirostre*	1732	MHNCI	This study
313	2005	Vale do Ribeira	1L	*Crotophaga ani*	birds	*A. longirostre*	1733	MHNCI	This study
314	2005	São Jorge D´ Oeste	1N	*Pitangus sulphuratus*	birds	*A. longirostre*	1736	MHNCI	This study
315	2005	São Jorge D´ Oeste	7L	*Leptopogon amaurocephalus*	birds	*A. longirostre*	1738	MHNCI	This study
316	2005	Londrina	1L	*Dysithamnus mentalis*	birds	*A. longirostre*	1742	MHNCI	This study
317	2005	Londrina	1L	*Trichothraupis melanops*	birds	*A. longirostre*	1743	MHNCI	This study
318	2005	Vale do Ribeira	1N,2L	*Tachyphonus coronatus*	birds	*A. longirostre*	1748	MHNCI	This study
319	1993	Piraquara	1N	*Pulsatrix koeniswaldiana*	birds	*A. longirostre*	1406-A	MHNCI	Arzua *et al.* 2005
320	2002	São Pedro do Iguaçu	2N	*Trichothraupis melanops*	birds	*A. longirostre*	1409-A	MHNCI	This study
321	2003	Paranaguá	1N	*Trichothraupis melanops*	birds	*A. longirostre*	1421-A	MHNCI	Arzua *et al.* 2005
322	1993	Guaraqueçaba	1N	*Tachyphonus coronatus*	birds	*A. longirostre*	1621-A	MHNCI	Arzua *et al.* 2005
323	2008	Londrina	1L	*Automolus leucophthalmus*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
324	2008	Londrina	1L	*Basileuterus leucoblepharus*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
325	2008	São Jorge D´ Oeste	2L	*Basileuterus culicivorus*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
326	2008	Adrianópolis	12L/N	*Chiroxiphia caudata*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
327	2008	Adrianópolis	1L/N	*Crotophaga ani*	birds	*A. longirostre*	-	-	Barros-Battesti 2008

328	2008	Adrianópolis	1L/N	*Pitylus fuliginosus*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
329	2008	São Jorge D´ Oeste	1L/N	*Dysithamnus mentalis*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
330	2008	São Jorge D´ Oeste	1L/N	*Elaenia sp.*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
331	2008	Adrianópolis	1L/N	*Euphonia violacea*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
332	2008	São Jorge D´ Oeste	1L/N	*Furnarius rufus*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
333	2008	Adrianópolis	1L/N	*Geothlypis aequinoctialis*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
334	2008	Londrina	2L/N	*Geothlypis aequinoctialis*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
335	2008	São Jorge D´ Oeste	1L/N	*Geothlypis aequinoctialis*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
336	2008	Adrianópolis	1L/N	*Habia rubica*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
337	2008	São Jorge D´ Oeste	13L/N	*Leptopogon amaurocephalus*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
338	2008	Adrianópolis	1L/N	*Manacus manacus*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
339	2008	São Jorge D´ Oeste	2L/N	*Passerina brissonii*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
340	2008	São Jorge D´ Oeste	1L/N	*Pitangus sulphuratus*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
341	2008	Adrianópolis	2L/N	*Pyriglena leucoptera*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
342	2008	Adrianópolis	12L/N	*Saltator similis*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
343	2008	Londrina	9L	*Saltator similis*	birds	*A. longirostre*	-	-	Barros-Battesti 2008

344	2008	Adrianópolis	4L/N	*Tachyphonus coronatus*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
345	2008	Londrina	1L/N	*Thamnophilus doliatus*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
346	2008	Adrianópolis	3L/N	*Tityra cayana*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
347	2008	Londrina	3L/N	*Trichothraupis melanops*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
348	2008	São Jorge D´ Oeste	3L/N	*Trichothraupis melanops*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
349	2008	Londrina	1L/N	*Automolus leucophthalmus*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
350	2008	São Jorge D´ Oeste	1L/N	*Cyclarhis gujanensis*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
351	2008	São Jorge D´ Oeste	2L/N	*Basileuterus culicivorus*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
352	2008	Londrina	1L	*Turdus leucomelas*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
353	2008	São Jorge D´ Oeste	11L/N	*Turdus leucomelas*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
354	2008	Adrianópolis	2L/N	*Turdus rufiventris*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
355	2008	São Jorge D´ Oeste	1L/N	*Turdus rufiventris*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
356	2008	Adrianópolis	1L/N	*Vireo chivi*	birds	*A. longirostre*	-	-	Barros-Battesti 2008
357	2017	Três Barras do Paraná	2N	*Biatas nigropectus*	birds	*A. longirostre*	-	-	Luz *et al.* 2017
358	2017	Três Barras do Paraná	1N	*Campylorhamphus falcularius*	birds	*A. longirostre*	-	-	Luz *et al.* 2017
359	2017	Três Barras do Paraná	1N	*Xiphocolaptes albicollis*	birds	*A. longirostre*	-	-	Luz *et al.* 2017

360	2017	Três Barras do Paraná	15N	*Xiphorhynchus fuscus*	birds	*A. longirostre*	-	-	Luz *et al.* 2017
361	2017	Três Barras do Paraná	8N	*Pyrrhocoma ruficeps*	birds	*A. longirostre*	-	-	Luz *et al.* 2017
362	2017	Três Barras do Paraná	2N	*Tachyphonus coronatus*	birds	*A. longirostre*	-	-	Luz *et al.* 2017
363	2017	Três Barras do Paraná	1N	*Schiffornis virescens*	birds	*A. longirostre*	-	-	Luz *et al.* 2017
364	2017	Três Barras do Paraná	3N	*Turdus leucomelas*	birds	*A. longirostre*	-	-	Luz *et al.* 2017
365	2017	Três Barras do Paraná	1L	*Cyanoloxia brissonii*	birds	*A. longirostre*	-	-	Luz *et al.* 2017
366	2003	São Pedro do Paraná	1N	*Taraba major*	birds	*A. nodosum*	1451	MHNCI	This study
367	2012	São Jorge D´ Oeste	2N	birds	birds	*A. ovale*	-	-	Pacheco *et al.* 2012
368	2004	Londrina	1N	*Turdus albicollis*	birds	*A. ovale*	1692	MHNCI	This study
369	2004	São Jorge D´ Oeste	16L	*Passerina brissonii*	birds	*A. ovale*	1726	MHNCI	This study
370	2008	Londrina	1N	*Turdus albicollis*	birds	*A. ovale*	-	-	Barros-Battesti 2008
371	2017	Três Barras do Paraná	2N	*Drymophila rubricollis*	birds	*A. ovale*	-	-	Luz *et al.* 2017
372	2012	Adrianópolis	4L	birds	birds	*A. parkeri*	-	-	Pacheco *et al.* 2012
373	2004	Vale do Ribeira	15L	*Chiroxiphia caudata*	birds	*A. parkeri*	1693	MHNCI	This study
374	2004	Vale do Ribeira	1L	*Chiroxiphia caudata*	birds	*A. parkeri*	1696	MHNCI	This study
375	2008	Adrianópolis	20L	*Chiroxiphia caudata*	birds	*A. parkeri*	-	-	Barros-Battesti 2008

376	2017	Três Barras do Paraná	1N	*Mackenziaena severa*	birds	*A. parkeri*	-	-	Luz *et al.* 2017
377	2017	Três Barras do Paraná	1N	*Lanio melanops*	birds	*A. parkeri*	-	-	Luz *et al.* 2017
378	2017	Três Barras do Paraná	1N	*Tachyphonus coronatus*	birds	*A. parkeri*	-	-	Luz *et al.* 2017
379	1990	Tijucas do Sul	42L	*Cichlocolaptes leucophrus*	birds	*A. sculptum* (published as *A. cajennense* s.l.)	1243	MHNCI	Arzua *et al.* 2005
380	1990	Tijucas do Sul	4L	*Tachyphonus coronatus*	birds	*A. sculptum* (published as *A. cajennense* s.l.)	1244	MHNCI	Arzua *et al.* 2005
381	1990	Tijucas do Sul	5L	*Conopophaga lineata*	birds	*A. sculptum* (published as *A. cajennense* s.l.)	1246	MHNCI	Arzua *et al.* 2005
382	1990	Tijucas do Sul	3L	*Pyrrhocoma ruficeps*	birds	*A. sculptum* (published as *A. cajennense* s.l.)	1367-B	MHNCI	This study
383	1989	Campina Grande do Sul	14L	*Pachyramphus viridis*	birds	*Amblyomma* sp.	10	MHNCI	This study
384	1989	Campina Grande do Sul	48L	*Lepidocolaptes squamatus*	birds	*Amblyomma* sp.	11	MHNCI	This study
385	1990	Almirante Tamandaré	10L	*Cyclarhis gujanensis*	birds	*Amblyomma* sp.	44	MHNCI	This study
386	1989	Guaraqueçaba	1L	*Tachyphonus coronatus*	birds	*Amblyomma* sp.	45	MHNCI	This study
387	1990	Jaguariaíva	5L	*Turdus rufiventris*	birds	*Amblyomma* sp.	47	MHNCI	This study
388	1994	Campo Largo	6L	*Trichothraupis melanops*	birds	*Amblyomma* sp.	395	MHNCI	This study
389	1990	Guaraqueçaba	1N	*Mackenziaena severa*	birds	*Amblyomma* sp.	397	MHNCI	This study

390	1990	Curitiba	2L	*Thachyphonus coronatus*	birds	*Amblyomma* sp.	505	MHNCI	This study
391	1990	Curitiba	1L	*Turdus nigriceps*	birds	*Amblyomma* sp.	506	MHNCI	This study
392	1991	Curitiba	2L	*Conopophaga lineata*	birds	*Amblyomma* sp.	507	MHNCI	This study
393	1992	Curitiba	4L	*Lepidocolaptes squamatus*	birds	*Amblyomma* sp.	508	MHNCI	This study
394	1992	Curitiba	2L	*Phylloscartes ventralis*	birds	*Amblyomma* sp.	509	MHNCI	This study
395	1992	Curitiba	3N	*Haplospiza unicolor*	birds	*Amblyomma* sp.	510	MHNCI	This study
396	1992	Curitiba	1N	*Tachyphonus coronatus*	birds	*Amblyomma* sp.	511	MHNCI	This study
397	1992	Curitiba	16L	*Chiroxiphia caudata*	birds	*Amblyomma* sp.	512	MHNCI	This study
398	1992	Curitiba	11L	*Leptopogon amaurocephalus*	birds	*Amblyomma* sp.	513	MHNCI	This study
399	1992	Curitiba	1L	*Thachyphonus coronatus*	birds	*Amblyomma* sp.	514	MHNCI	This study
400	1992	Curitiba	1L	*Cyclarhis gujanensis*	birds	*Amblyomma* sp.	515	MHNCI	This study
401	1992	Quatro Barras	1L	*Myiophobus fasciatus*	birds	*Amblyomma* sp.	516	MHNCI	This study
402	1993	Curitiba	1L	*Turdus rufiventris*	birds	*Amblyomma* sp.	519	MHNCI	This study
403	1995	Guaraqueçaba	1L	*Chiroxiphia caudata*	birds	*Amblyomma* sp.	520	MHNCI	This study
404	1995	Guaraqueçaba	1L	*Turdus albicollis*	birds	*Amblyomma* sp.	521	MHNCI	This study
405	1995	Guaraqueçaba	2L	*Chiroxiphia caudata*	birds	*Amblyomma* sp.	523	MHNCI	This study
406	1995	Guaraqueçaba	1L	*Schiffornis virescens*	birds	*Amblyomma* sp.	524	MHNCI	This study
407	1995	Guaraqueçaba	1L	*Habia rubica*	birds	*Amblyomma* sp.	526	MHNCI	This study

408	1995	Guaraqueçaba	1L	*Dacnis cayana*	birds	*Amblyomma* sp.	527	MHNCI	This study
409	1995	Guaraqueçaba	1L	*Dendrocincla fuliginosa*	birds	*Amblyomma* sp.	528	MHNCI	This study
410	1995	Guaraqueçaba	1L	*Schiffornis virescens*	birds	*Amblyomma* sp.	529	MHNCI	This study
411	1995	Guaraqueçaba	2L	*Drymophila squamata*	birds	*Amblyomma* sp.	530	MHNCI	This study
412	1995	Guaraqueçaba	1N	*Turdus rufiventris*	birds	*Amblyomma* sp.	531	MHNCI	This study
413	1995	Guaraqueçaba	1L	*Sittasomus griseicapillus*	birds	*Amblyomma* sp.	532	MHNCI	This study
414	1995	Guaraqueçaba	14L	*Dendrocincla fuliginosa*	birds	*Amblyomma* sp.	533	MHNCI	This study
415	1995	Guaraqueçaba	3N	*Dacnis cayana*	birds	*Amblyomma* sp.	535	MHNCI	This study
416	1995	Guaraqueçaba	2L	*Chiroxiphia caudata*	birds	*Amblyomma* sp.	536	MHNCI	This study
417	1995	Guaraqueçaba	4L	*Sittasomus griseicapillus*	birds	*Amblyomma* sp.	537	MHNCI	This study
418	1995	Guaraqueçaba	1L	*Chiroxiphia caudata*	birds	*Amblyomma* sp.	538	MHNCI	This study
419	1996	Guaraqueçaba	5L	*Automolus leucophthalmus*	birds	*Amblyomma* sp.	545	MHNCI	This study
420	1996	Guaraqueçaba	2L	*Leptopogon amaurocephalus*	birds	*Amblyomma* sp.	547	MHNCI	This study
421	1996	Guaraqueçaba	2L	*Dendrocincla fuliginosa*	birds	*Amblyomma* sp.	548	MHNCI	This study
422	1996	Guaraqueçaba	2L	*Tachyphonus coronatus*	birds	*Amblyomma* sp.	549	MHNCI	This study
423	1996	Guaraqueçaba	8L	*Lepidocolaptes fuscus*	birds	*Amblyomma* sp.	550	MHNCI	This study
424	1996	Guaraqueçaba	4L	*Lepidocolaptes fuscus*	birds	*Amblyomma* sp.	551	MHNCI	This study

425	1992	Guaraqueçaba	1N	*Basileuterus culicivorus*	birds	*Amblyomma* sp.	555	MHNCI	This study
426	1992	Morretes	2L	*Tangara cyanocephala*	birds	*Amblyomma* sp.	559	MHNCI	This study
427	1992	Morretes	1L	*Euphonia pectoralis*	birds	*Amblyomma* sp.	560	MHNCI	This study
428	1992	Morretes	3L	*Tangara seledon*	birds	*Amblyomma* sp.	562	MHNCI	This study
429	1992	Morretes	1L	*Euphonia musica*	birds	*Amblyomma* sp.	563	MHNCI	This study
430	1992	Morretes	1L	*Tangara cyanocephala*	birds	*Amblyomma* sp.	564	MHNCI	This study
431	1993	Morretes	2L	*Habia rubica*	birds	*Amblyomma* sp.	566	MHNCI	This study
432	1993	Morretes	1L	*Tachyphonus cristatus*	birds	*Amblyomma* sp.	569	MHNCI	This study
433	1994	Curitiba	1L	*Turdus rufiventris*	birds	*Amblyomma* sp.	571	MHNCI	This study
434	1993	Curitiba	1L	*Platyrinchus mystaceus*	birds	*Amblyomma* sp.	634	MHNCI	This study
435	1993	Curitiba	1L	*Lepidocolaptes fuscus*	birds	*Amblyomma* sp.	635	MHNCI	This study
436	1993	Curitiba	1L	*Lathrotriccus euleri*	birds	*Amblyomma* sp.	636	MHNCI	This study
437	1993	Curitiba	1L	*Syndactyla rufosuperciliata*	birds	*Amblyomma* sp.	637	MHNCI	This study
438	1995	Curitiba	6L	*Tachyphonus coronatus*	birds	*Amblyomma* sp.	640	MHNCI	This study
439	1995	Curitiba	9L	*Lepidocolaptes fuscus*	birds	*Amblyomma* sp.	641	MHNCI	This study
440	1995	Curitiba	6L	*Tachyphonus coronatus*	birds	*Amblyomma* sp.	642	MHNCI	This study
441	1995	Curitiba	2L	*Hylophilus poicilotis*	birds	*Amblyomma* sp.	643	MHNCI	This study
442	1995	Almirante Tamandaré	1L	*Lepidocolaptes fuscus*	birds	*Amblyomma* sp.	644	MHNCI	This study

443	1993	Curitiba	2L	*Saltator similis*	birds	*Amblyomma* sp.	646	MHNCI	This study
444	1993	Curitiba	1L	*Basileuterus leucoblepharus*	birds	*Amblyomma* sp.	648	MHNCI	This study
445	1997	Tunas do Paraná	3L	*Chiroxiphia caudata*	birds	*Amblyomma* sp.	652	MHNCI	Barros & Baggio 1992
446	1997	Tunas do Paraná	2L	*Trichothraupis melanops*	birds	*Amblyomma* sp.	653	MHNCI	This study
447	1993	Tijucas do Sul	7L	*Pyrrhocoma ruficeps*	birds	*Amblyomma* sp.	1245	MHNCI	This study
448	2002	Paranaguá	1L	*Dendrocincla turdina*	birds	*Amblyomma* sp.	1251	MHNCI	This study
449	2002	Paranaguá	1N	*Lepidocolaptes fuscus*	birds	*Amblyomma* sp.	1253	MHNCI	This study
450	2002	São Pedro do Iguaçu	1L	*Dacnis cayana*	birds	*Amblyomma* sp.	1410	MHNCI	This study
451	2002	São Pedro do Iguaçu	1L	*Trichothraupis melanops*	birds	*Amblyomma* sp.	1414	MHNCI	This study
452	2002	São Pedro do Iguaçu	3L	*Trichothraupis melanops*	birds	*Amblyomma* sp.	1415	MHNCI	This study
453	2003	Paranaguá	2L	*Schiffornis virescens*	birds	*Amblyomma* sp.	1417	MHNCI	This study
454	2003	Paranaguá	2L	*Lepidocolaptes fuscus*	birds	*Amblyomma* sp.	1420	MHNCI	This study
455	2003	Araucária	5L	*Poospiza lateralis*	birds	*Amblyomma* sp.	1424	MHNCI	This study
456	2003	Paranaguá	5L	*Schiffornis virescens*	birds	*Amblyomma* sp.	1425	MHNCI	This study
457	2003	Paranaguá	1L	*Sittasomus griseicapillus*	birds	*Amblyomma* sp.	1428	MHNCI	This study
458	2003	Paranaguá	2L	*Leptopogon amaurocephalus*	birds	*Amblyomma* sp.	1429	MHNCI	This study
459	2003	Paranaguá	4L	*Chiroxiphia caudata*	birds	*Amblyomma* sp.	1430	MHNCI	This study

460	2003	Paranaguá	1L	*Manacus manacus*	birds	*Amblyomma* sp.	1431	MHNCI	This study
461	2003	Paranaguá	2L	*Leptopogon amaurocephalus*	birds	*Amblyomma* sp.	1432	MHNCI	This study
462	2003	Paranaguá	2N	*Formicarius colma*	birds	*Amblyomma* sp.	1433	MHNCI	This study
463	2003	Paranaguá	1L	*Trichothraupis melanops*	birds	*Amblyomma* sp.	1435	MHNCI	This study
464	2003	Paranaguá	1L	*Thryothorus longirostris*	birds	*Amblyomma* sp.	1436	MHNCI	This study
465	1991	Telemaco Borba	6L	*Habia rubica*	birds	*Amblyomma* sp.	1468	MHNCI	This study
466	1991	Telemaco Borba	9L	*Leptopogon amaurocephalus*	birds	*Amblyomma* sp.	1469	MHNCI	This study
467	1991	Telemaco Borba	1N, 4L	*Amaurospiza moesta*	birds	*Amblyomma* sp.	1470	MHNCI	This study
468	1991	Telemaco Borba	2L	*Chiroxiphia caudata*	birds	*Amblyomma* sp.	1471	MHNCI	This study
469	1991	Telemaco Borba	1L	*Platyrinchus mystaceus*	birds	*Amblyomma* sp.	1472	MHNCI	This study
470	1991	Telemaco Borba	1L	*Trichothraupis melanops*	birds	*Amblyomma* sp.	1473	MHNCI	This study
471	2002	Araucária	11L	*Conopophaga lineata*	birds	*Amblyomma* sp.	1476	MHNCI	This study
472	1994	Campo Largo	7L	*Thamnophilus caerulescens*	birds	*Amblyomma* sp.	1477	MHNCI	This study
473	1994	Campo Largo	16L	*Leptopogon amaurocephalus*	birds	*Amblyomma* sp.	1478	MHNCI	This study
474	1994	Campo Largo	2L	*Sittasomus griseicapillus*	birds	*Amblyomma* sp.	1479	MHNCI	This study
475	1994	Campo Largo	1L	*Lepidocolaptes fuscus*	birds	*Amblyomma* sp.	1480	MHNCI	This study
476	1994	Campo Largo	1L	*Turdus rufiventris*	birds	*Amblyomma* sp.	1481	MHNCI	This study
477	1994	Campo Largo	2L	*Saltator similis*	birds	*Amblyomma* sp.	1482	MHNCI	This study

478	1994	Campo Largo	1L	*Turdus albicollis*	birds	*Amblyomma* sp.	1483	MHNCI	This study
479	1994	Campo Largo	16L	*Picumnus cirratus*	birds	*Amblyomma* sp.	1484	MHNCI	This study
480	1994	Campo Largo	3L	*Chiroxiphia caudata*	birds	*Amblyomma* sp.	1485	MHNCI	This study
481	1994	Campo Largo	6L	*Dysithamnus mentalis*	birds	*Amblyomma* sp.	1486	MHNCI	This study
482	1994	Campo Largo	1L	*Basileuterus culicivorus*	birds	*Amblyomma* sp.	1487	MHNCI	This study
483	1994	Campo Largo	1L	*Stephanophorus diadematus*	birds	*Amblyomma* sp.	1488	MHNCI	This study
484	1994	Campo Largo	1L	*Turdus albicollis*	birds	*Amblyomma* sp.	1489	MHNCI	This study
485	1994	Campo Largo	2L	*Saltator similis*	birds	*Amblyomma* sp.	1490	MHNCI	This study
486	2003	São João do Triunfo	2L	*Chiroxiphia caudata*	birds	*Amblyomma* sp.	1491	MHNCI	This study
487	1991	Tijucas do Sul	6L	*Cichlocolaptes leucophrus*	birds	*Amblyomma* sp.	1494	MHNCI	This study
488	1992	Curitiba	3L	*Phylloscartes ventralis*	birds	*Amblyomma* sp.	1495	MHNCI	This study
489	1990	Antonina	17L	*Pyriglena leucoptera*	birds	*Amblyomma* sp.	1496	MHNCI	This study
490	1991	Telemaco Borba	2L	*Trichothraupis melanops*	birds	*Amblyomma* sp.	1497	MHNCI	This study
491	1989	Campina Grande do Sul	87L	*Lepidocolaptes squamatus*	birds	*Amblyomma* sp.	1498	MHNCI	This study
492	1997	Cerro Azul	7L	*Tachyphonus coronatus*	birds	*Amblyomma* sp.	1499	MHNCI	This study
493	1992	Adrianópolis	12L	*Trichothraupis melanops*	birds	*Amblyomma* sp.	1500	MHNCI	This study
494	1992	Quatro Barras	1N	*Turdus rufiventris*	birds	*Amblyomma* sp.	1528	MHNCI	This study
495	1992	Guaraqueçaba	1N	*Thamnophilus caerulescens*	birds	*Amblyomma* sp.	1529	MHNCI	This study

496	1992	Curitiba	1L	*Thamnophilus caerulescens*	birds	*Amblyomma* sp.	1533	MHNCI	This study
497	1992	Curitiba	28L	*Chiroxiphia caudata*	birds	*Amblyomma* sp.	1536	MHNCI	This study
498	1995	Curitiba	1N	*Turdus amaurochalinus*	birds	*Amblyomma* sp.	1540	MHNCI	This study
499	1995	Curitiba	4L	*Platyrinchus mystaceus*	birds	*Amblyomma* sp.	1542	MHNCI	This study
500	1995	Curitiba	11L	*Cyclarhis gujanensis*	birds	*Amblyomma* sp.	1544	MHNCI	This study
501	1995	Curitiba	4L	*Pyrrhocoma ruficeps*	birds	*Amblyomma* sp.	1545	MHNCI	This study
502	1995	Curitiba	8L	*Cyclarhis gujanensis*	birds	*Amblyomma* sp.	1546	MHNCI	This study
503	1995	Curitiba	3L	*Tachyphonus coronatus*	birds	*Amblyomma* sp.	1548	MHNCI	This study
504	1995	Curitiba	1L	*Sittasomus griseicapillus*	birds	*Amblyomma* sp.	1549	MHNCI	This study
505	1995	Curitiba	7L	*Turdus albicollis*	birds	*Amblyomma* sp.	1550	MHNCI	This study
506	1995	Curitiba	3L	*Leptopogon amaurocephalus*	birds	*Amblyomma* sp.	1551	MHNCI	This study
507	1995	Curitiba	22L	*Platyrinchus mystaceus*	birds	*Amblyomma* sp.	1552	MHNCI	This study
508	1995	Curitiba	2L	*Tachyphonus coronatus*	birds	*Amblyomma* sp.	1555	MHNCI	This study
509	1995	Curitiba	7L	*Turdus albicollis*	birds	*Amblyomma* sp.	1556	MHNCI	This study
510	1992	Curitiba	5L	*Tachyphonus coronatus*	birds	*Amblyomma* sp.	1558	MHNCI	This study
511	1992	Curitiba	1L	*Leucochloris albicollis*	birds	*Amblyomma* sp.	1559	MHNCI	This study
512	1995	Curitiba	7L	*Chiroxiphia caudata*	birds	*Amblyomma* sp.	1560	MHNCI	This study

513	1995	Curitiba	11L	*Thamnophilus caerulescens*	birds	*Amblyomma* sp.	1561	MHNCI	This study
514	1995	Curitiba	12L	*Lepidocolaptes fuscus*	birds	*Amblyomma* sp.	1562	MHNCI	This study
515	1995	Curitiba	1L	*Veniliornis spilogaster*	birds	*Amblyomma* sp.	1563	MHNCI	This study
516	1995	Curitiba	2L	*Platyrinchus mystaceus*	birds	*Amblyomma* sp.	1564	MHNCI	This study
517	1995	Curitiba	1L	*Lepidocolaptes fuscus*	birds	*Amblyomma* sp.	1565	MHNCI	This study
518	1995	Curitiba	19L	*Lepidocolaptes fuscus*	birds	*Amblyomma* sp.	1566	MHNCI	This study
519	1995	Curitiba	7L	*Thamnophilus caerulescens*	birds	*Amblyomma* sp.	1567	MHNCI	This study
520	1994	Guaraqueçaba	1L	*Xenops minutus*	birds	*Amblyomma* sp.	1575	MHNCI	This study
521	1994	Fênix	1L	*Cnemotriccus fuscatus*	birds	*Amblyomma* sp.	1579	MHNCI	This study
522	1994	Fênix	14L	*Myiopagis viridicata*	birds	*Amblyomma* sp.	1581	MHNCI	This study
523	1994	Fênix	1L	*Turdus nigriceps*	birds	*Amblyomma* sp.	1582	MHNCI	This study
524	1994	Fênix	3L	*Selenidera maculirostris*	birds	*Amblyomma* sp.	1583	MHNCI	This study
525	1994	Fênix	7L	*Pipra fasciicauda*	birds	*Amblyomma* sp.	1584	MHNCI	This study
526	1994	Fênix	3L	*Elaenia sp.*	birds	*Amblyomma* sp.	1585	MHNCI	This study
527	1994	Fênix	1L	*Turdus amaurochalinus*	birds	*Amblyomma* sp.	1586	MHNCI	This study
528	1994	Fênix	1L	*Pipra fasciicauda*	birds	*Amblyomma* sp.	1587	MHNCI	This study
529	1994	Fênix	1L	*Turdus amaurochalinus*	birds	*Amblyomma* sp.	1588	MHNCI	This study
530	1994	Fênix	1L	*Turdus amaurochalinus*	birds	*Amblyomma* sp.	1589	MHNCI	This study
531	1995	Curitiba	1L	*Turdus nigriceps*	birds	*Amblyomma* sp.	1590	MHNCI	This study

532	1995	Curitiba	2N	*Syndactyla rufosuperciliata*	birds	*Amblyomma* sp.	1592	MHNCI	This study
533	1995	Curitiba	1N	*Turdus rufiventris*	birds	*Amblyomma* sp.	1594	MHNCI	This study
534	1994	Curitiba	1L	*Chiroxiphia caudata*	birds	*Amblyomma* sp.	1596	MHNCI	This study
535	1996	Curitiba	1N	*Platycichla flavipes*	birds	*Amblyomma* sp.	1600	MHNCI	This study
536	1994	Curitiba	9L	*Lepidocolaptes fuscus*	birds	*Amblyomma* sp.	1601	MHNCI	This study
537	1994	Curitiba	1L	*Syndactyla rufosuperciliata*	birds	*Amblyomma* sp.	1602	MHNCI	This study
538	1994	Curitiba	5L	*Stephanophorus diadematus*	birds	*Amblyomma* sp.	1604	MHNCI	This study
539	19995	Almirante Tamandaré	2L	*Lepidocolaptes squamatus*	birds	*Amblyomma* sp.	1608	MHNCI	This study
540	1995	Almirante Tamandaré	1L	*Turdus rufiventris*	birds	*Amblyomma* sp.	1612	MHNCI	This study
541	1995	Almirante Tamandaré	27L	*Stephanophorus diadematus*	birds	*Amblyomma* sp.	1613	MHNCI	This study
542	1993	Guaraqueçaba	3L	*Lathrotriccus euleri*	birds	*Amblyomma* sp.	1614	MHNCI	This study
543	1993	Guaraqueçaba	1N	*Philydor atricapillus*	birds	*Amblyomma* sp.	1615	MHNCI	This study
544	1993	Guaraqueçaba	2N	*Pyriglena leucoptera*	birds	*Amblyomma* sp.	1616	MHNCI	This study
545	1993	Guaraqueçaba	1N	*Drymophila squamata*	birds	*Amblyomma* sp.	1617	MHNCI	This study
546	1993	Guaraqueçaba	1L	*Philydor atricapillus*	birds	*Amblyomma* sp.	1619	MHNCI	This study
547	1993	Guaraqueçaba	1N	*Conopophaga lineata*	birds	*Amblyomma* sp.	1620	MHNCI	This study

548	1993	Guaraqueçaba	1L	*Myiodynastes maculatus*	birds	*Amblyomma* sp.	1622	MHNCI	This study
549	1993	Guaraqueçaba	9N	*Pyriglena leucoptera*	birds	*Amblyomma* sp.	1623	MHNCI	This study
550	1989	Campina Grande do Sul	2L	*Heliobletus contaminatus*	birds	*Amblyomma* sp.	1624	MHNCI	This study
551	1989	Campina Grande do Sul	1L	*Saltator maxillosus*	birds	*Amblyomma* sp.	1625	MHNCI	This study
552	1989	Campina Grande do Sul	1L	*Cyclarhis gujanensis*	birds	*Amblyomma* sp.	1626	MHNCI	This study
553	1991	Piraquara	2L	*Syndactyla rufosuperciliata*	birds	*Amblyomma* sp.	1338-C	MHNCI	This study
554	2002	São Pedro do Iguaçu	7L	*Trichothraupis melanops*	birds	*Amblyomma* sp.	1408-B	MHNCI	This study
555	2002	São Pedro do Iguaçu	4L	*Trichothraupis melanops*	birds	*Amblyomma* sp.	1409-B	MHNCI	This study
556	2003	Paranaguá	8L	*Manacus manacus*	birds	*Amblyomma* sp.	1422-B	MHNCI	This study
557	1994	Curitiba	4L	*Turdus rufiventris*	birds	*Amblyomma* sp.	1603-B	MHNCI	This study
558	1995	Almirante Tamandaré	1L	*Turdus rufiventris*	birds	*Amblyomma* sp.	1606-B	MHNCI	This study
559	1995	Almirante Tamandaré	2L	*Turdus rufiventris*	birds	*Amblyomma* sp.	1607-B	MHNCI	This study
560	1993	Guaraqueçaba	1N	*Tachyphonus coronatus*	birds	*Amblyomma* sp.	1621-B	MHNCI	This study
561	1993	Curitiba	1L	*Turdus rufiventris*	birds	*Amblyomma* sp.	572-B	MHNCI	This study
562	1995	Curitiba	6L	*Turdus rufiventris*	birds	*Amblyomma* sp.	607-B	MHNCI	This study
563	1995	Curitiba	1L	*Turdus rufiventris*	birds	*Amblyomma* sp.	608-A	MHNCI	This study
564	2008	Londrina	1L/N	*Dysithamnus mentalis*	birds	*Amblyomma* sp.	-	-	Barros-Battesti 2008
565	2008	Adrianópolis	1L/N	*Conopophaga lineata*	birds	*Amblyomma* sp.	-	-	Barros-Battesti 2008

566	2008	São Jorge D´ Oeste	1L/N	*Thraupis bonariensis*	birds	*Amblyomma* sp.	-	-	Barros-Battesti 2008
567	2008	São Jorge D´ Oeste	1L/N	*Tachyphonus coronatus*	birds	*Amblyomma* sp.	-	-	Barros-Battesti 2008
568	2008	São Jorge D´ Oeste	18L/N	*Passerina brissonii*	birds	*Amblyomma* sp.	-	-	Barros-Battesti 2008
569	2008	Adrianópolis	1L/N	*Pyriglena leucoptera*	birds	*Amblyomma* sp.	-	-	Barros-Battesti 2008
570	2008	Adrianópolis	1L/N	*Turdus albicollis*	birds	*Amblyomma* sp.	-	-	Barros-Battesti 2008
571	2008	Adrianópolis	1L/N	*Tachyphonus coronatus*	birds	*Amblyomma* sp.	-	-	Barros-Battesti 2008
572	2008	Londrina	3L/N	*Trichothraupis melanops*	birds	*Amblyomma* sp.	-	-	Barros-Battesti 2008
573	2008	Londrina	1L/N	*Volatinia jacarina*	birds	*Amblyomma* sp.	-	-	Barros-Battesti 2008
574	2008	Londrina	1L/N	*Thamnophilus caerulescens*	birds	*Amblyomma* sp.	-	-	Barros-Battesti 2008
575	2008	Londrina	1L/N	*Automolus leucophthalmus*	birds	*Amblyomma* sp.	-	-	Barros-Battesti 2008
576	2008	São Jorge D´ Oeste	1L/N	*Xiphocolaptes albicollis*	birds	*Amblyomma* sp.	-	-	Barros-Battesti 2008
577	2017	Três Barras do Paraná	1L	*Dysithamnus mentalis*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
578	2017	Três Barras do Paraná	2N	*Mackenziaena severa*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
579	2017	Três Barras do Paraná	1L	*Sittasomus griseicapillus*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
580	2017	Três Barras do Paraná	2L	*Campylorhamphus falcularius*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
581	2017	Três Barras do Paraná	1L	*Xiphorhynchus fuscus*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017

582	2017	Três Barras do Paraná	1L	*Hemitriccus diops*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
583	2017	Três Barras do Paraná	1L	*Mionectes rufiventris*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
584	2017	Três Barras do Paraná	2L	*Poecilotriccus plumbeiceps*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
585	2017	Três Barras do Paraná	3L	*Leptopogon amaurocephalus*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
586	2017	Três Barras do Paraná	1L	*Synallaxis ruficapilla*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
587	2017	Três Barras do Paraná	1L	*Hylophilus poicilotis*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
588	2017	Três Barras do Paraná	4L	*Pyrrhocoma ruficeps*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
589	2017	Três Barras do Paraná	1L	*Lanio melanops*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
590	2017	Três Barras do Paraná	2L	*Saltator similis*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
591	2017	Três Barras do Paraná	1L	*Tachyphonus coronatus*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
592	2017	Três Barras do Paraná	1L	*Conopophaga lineata*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
593	2017	Três Barras do Paraná	2L	*Turdus leucomelas*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
594	2017	Três Barras do Paraná	1L	*Turdus albicollis*	birds	*Amblyomma* sp.	-	-	Luz *et al.* 2017
595	1990	Tijucas do Sul	3F	*Pyrrhocoma ruficeps*	birds	*H. juxtakochi*	1367-A	MHNCI	This study
596	2008	Londrina	1L, 1N	*Turdus albicollis*	birds	*H. juxtakochi*	-	-	Barros-Battesti 2008
597	2008	Adrianópolis	1L	*Turdus rufiventris*	birds	*H. juxtakochi*	-	-	Barros-Battesti 2008

598	2005	Londrina	1L	*Turdus albicollis*	birds	*Haemaphysalis* sp.	1735	MHNCI	This study
599	2006	Vale do Ribeira	1L	*Turdus rufiventris*	birds	*Haemaphysalis* sp.	1751	MHNCI	This study
600	2003	Curitiba	4F, 7N, 7L	birds	birds	*I. auritulus*	-	-	Arzua *et al.* 2003
601	1990	Curitiba	1F	*Turdus albicollis*	birds	*I. auritulus*	91	MHNCI	Arzua & Barros-Battesti 1999
602	1990	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	92	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 1994
603	1992	Curitiba	1N	*Turdus rufiventris*	birds	*I. auritulus*	93	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 1994
604	1992	Curitiba	2N, 4L	*Turdus rufiventris*	birds	*I. auritulus*	94	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 1994
605	1992	Curitiba	2N,2L	*Turdus rufiventris*	birds	*I. auritulus*	100	MHNCI	Arzua & Barros-Battesti 1999
606	1993	Curitiba	4F	*Turdus rufiventris*	birds	*I. auritulus*	101	MHNCI	Arzua & Barros-Battesti 1999

607	1992	Curitiba	1N, 1L	*Conopophaga lineata*	birds	*I. auritulus*	102	MHNCI	Arzua & Barros-Battesti 1999
608	1992	Curitiba	1N	*Syndactyla rufosuperciliata*	birds	*I. auritulus*	103	MHNCI	Arzua & Barros-Battesti 1999
609	1993	Curitiba	2N	*Turdus amaurochalinus*	birds	*I. auritulus*	518	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
610	1993	Curitiba	1N	*Syndactyla rufosuperciliata*	birds	*I. auritulus*	543	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
611	1993	Curitiba	1N	*Syndactyla rufosuperciliata*	birds	*I. auritulus*	557	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
612	1993	Curitiba	1L	*Turdus rufiventris*	birds	*I. auritulus*	558	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
613	1994	Curitiba	1N	*Turdus rufiventris*	birds	*I. auritulus*	570	MHNCI	Arzua *et al.* 2005
614	1993	Curitiba	1N	*Syndactyla rufosuperciliata*	birds	*I. auritulus*	573	MHNCI	Arzua & Barros-Battesti 1999;

615	1993	Curitiba	1N	*Turdus rufiventris*	birds	*I. auritulus*	574	MHNCI	Arzua *et al.* 2005 Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
616	1993	Curitiba	1F, 1N	*Turdus rufiventris*	birds	*I. auritulus*	575	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
617	1993	Curitiba	1L	*Turdus rufiventris*	birds	*I. auritulus*	576	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
618	1993	Curitiba	1F, 1N	*Turdus rufiventris*	birds	*I. auritulus*	577	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
619	1993	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	578	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
620	1993	Curitiba	1N	*Turdus rufiventris*	birds	*I. auritulus*	579	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005

621	1993	Curitiba	1F	*Columbina talpacoti*	birds	*I. auritulus*	580	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
622	1993	Curitiba	1F,1N	*Turdus rufiventris*	birds	*I. auritulus*	581	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
623	1993	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	582	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
624	1993	Curitiba	2F	*Turdus rufiventris*	birds	*I. auritulus*	583	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
625	1993	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	584	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
626	1994	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	585	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
627	1994	Curitiba	2F, 1N	*Turdus rufiventris*	birds	*I. auritulus*	586	MHNCI	Arzua & Barros-

628	1994	Curitiba	1N	*Turdus rufiventris*	birds	*I. auritulus*	587	MHNCI	Battesti 1999; Arzua *et al.* 2005 Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
629	1994	Curitiba	2F	*Turdus rufiventris*	birds	*I. auritulus*	589	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005 Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
630	1994	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	590	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005 Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
631	1994	Curitiba	2F	*Turdus rufiventris*	birds	*I. auritulus*	591	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005 Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
632	1994	Curitiba	1L	*Basileuterus leucoblepharus*	birds	*I. auritulus*	592	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005 Arzua & Barros-Battesti 1999;
633	1994	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	593	MHNCI	

634	1994	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	594	MHNCI	Arzua *et al.* 2005 Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
635	1994	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	595	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
636	1994	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	596	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
637	1994	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	597	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
638	1994	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	598	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
639	1994	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	599	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005

640	1994	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	600	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
641	1994	Curitiba	4F	*Turdus rufiventris*	birds	*I. auritulus*	601	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
642	1994	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	602	MHNCI	Arzua & Barros-Battesti 1999
643	1995	Curitiba	1N	*Turdus rufiventris*	birds	*I. auritulus*	603	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
644	1995	Curitiba	1N	*Trichothraupis melanops*	birds	*I. auritulus*	604	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
645	1995	Curitiba	2N	*Turdus rufiventris*	birds	*I. auritulus*	605	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
646	1995	Almirante Tamandaré	1N	*Turdus rufiventris*	birds	*I. auritulus*	606	MHNCI	Arzua & Barros-Battesti 1999;

647	1995	Curitiba	1F, 2N, 2L	*Clibanornis dendrocolaptoides*	birds	*I. auritulus*	609	MHNCI	Arzua *et al.* 2005
648	1995	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	610	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
649	1995	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	611	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
650	1995	Almirante Tamandaré	2N, 4L	*Turdus rufiventris*	birds	*I. auritulus*	649	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
651	1995	Almirante Tamandaré	1N	*Turdus rufiventris*	birds	*I. auritulus*	650	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
652	1995	Almirante Tamandaré	1N	*Turdus rufiventris*	birds	*I. auritulus*	651	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005

653	1999	Curitiba	1N	*Turdus rufiventris*	birds	*I. auritulus*	902	MHNCI	Arzua *et al.* 2005
654	1999	Curitiba	1N	*Turdus rufiventris*	birds	*I. auritulus*	903	MHNCI	Arzua *et al.* 2005
655	1999	Curitiba	1N, 1L	*Synallaxis ruficapilla*	birds	*I. auritulus*	909	MHNCI	Arzua *et al.* 2005
656	1999	Curitiba	2F	*Turdus rufiventris*	birds	*I. auritulus*	943	MHNCI	Arzua *et al.* 2005
657	2000	Curitiba	4L	*Turdus rufiventris*	birds	*I. auritulus*	995	MHNCI	Arzua *et al.* 2005
658	2000	Curitiba	1N	*Turdus rufiventris*	birds	*I. auritulus*	1008	MHNCI	Arzua *et al.* 2005
659	1993	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	1492	MHNCI	Arzua *et al.* 2005
660	1993	Piraquara	1L	*Haplospiza unicolor*	birds	*I. auritulus*	1537	MHNCI	Arzua *et al.* 2005
661	1995	Curitiba	11L	*Turdus rufiventris*	birds	*I. auritulus*	1547	MHNCI	Arzua *et al.* 2005
662	1995	Curitiba	1L	*Turdus rufiventris*	birds	*I. auritulus*	1554	MHNCI	Arzua *et al.* 2005
663	1995	Curitiba	1N	*Turdus albicollis*	birds	*I. auritulus*	1557	MHNCI	Arzua *et al.* 2005
664	1994	Curitiba	1F	*Turdus albicollis*	birds	*I. auritulus*	1569	MHNCI	Arzua *et al.* 2005
665	1993	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	1570	MHNCI	Arzua *et al.* 2005
666	1993	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	1571	MHNCI	Arzua *et al.* 2005
667	1994	Curitiba	3N, 13L	*Turdus rufiventris*	birds	*I. auritulus*	1572	MHNCI	Arzua *et al.* 2005
668	1994	Curitiba	1N, 4L	*Turdus rufiventris*	birds	*I. auritulus*	1573	MHNCI	Arzua *et al.* 2005

669	1995	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	1591	MHNCI	Arzua *et al.* 2005
670	1995	Curitiba	1L	*Turdus nigriceps*	birds	*I. auritulus*	1593	MHNCI	Arzua *et al.* 2005
671	1995	Almirante Tamandaré	1N	*Turdus amaurochalinus*	birds	*I. auritulus*	1595	MHNCI	Arzua *et al.* 2005
672	1995	Curitiba	1F	*Turdus nigriceps*	birds	*I. auritulus*	1597	MHNCI	Arzua *et al.* 2005
673	1995	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	1598	MHNCI	Arzua *et al.* 2005
674	1995	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	1599	MHNCI	Arzua *et al.* 2005
675	1994	Curitiba	1N	*Poospiza lateralis*	birds	*I. auritulus*	1605	MHNCI	Arzua *et al.* 2005
676	1994	Curitiba	2N	*Turdus rufiventris*	birds	*I. auritulus*	1609	MHNCI	Arzua *et al.* 2005
677	1994	Curitiba	1N	*Poospiza lateralis*	birds	*I. auritulus*	1610	MHNCI	Arzua *et al.* 2005
678	1994	Curitiba	5L	*Turdus rufiventris*	birds	*I. auritulus*	1611	MHNCI	Arzua *et al.* 2005
679	2013	Curitiba	1F, 2N	*Turdus rufiventris*	birds	*I. auritulus*	1775	MHNCI	This study
680	2013	Curitiba	1F	*Turdus rufiventris*	birds	*I. auritulus*	1776	MHNCI	This study
681	2013	Curitiba	6L	*Turdus rufiventris*	birds	*I. auritulus*	1777	MHNCI	This study
682	2000	Curitiba	1N	*Turdus rufiventris*	birds	*I. auritulus*	1007-B	MHNCI	Arzua *et al.* 2005
683	2000	Curitiba	2F	*Turdus rufiventris*	birds	*I. auritulus*	1027-B	MHNCI	Arzua *et al.* 2005
684	1994	Curitiba	5N, 2L	*Turdus rufiventris*	birds	*I. auritulus*	1603-A	MHNCI	Arzua *et al.* 2005
685	1995	Almirante Tamandaré	1N	*Turdus rufiventris*	birds	*I. auritulus*	1606-A	MHNCI	Arzua *et al.* 2005

686	1995	Almirante Tamandaré	5N	*Turdus rufiventris*	birds	*I. auritulus*	1607-A	MHNCI	Arzua *et al.* 2005
687	1993	Curitiba	1F,1N	*Turdus rufiventris*	birds	*I. auritulus*	572-A	MHNCI	Arzua & Barros-Battesti 1999; Arzua *et al.* 2005
688	1994	Curitiba	2N	*Turdus rufiventris*	birds	*I. auritulus*	588-A	MHNCI	Arzua *et al.* 2005
689	1995	Curitiba	1N	*Turdus rufiventris*	birds	*I. auritulus*	607-A	MHNCI	Arzua *et al.* 2005
690	1995	Curitiba	8L	*Turdus rufiventris*	birds	*I. auritulus*	608-B	MHNCI	Arzua *et al.* 2005
691	1999	Curitiba	1L	*Turdus rufiventris*	birds	*I. auritulus*	915-B	MHNCI	Arzua *et al.* 2005
692	1999	Curitiba	1N	*Turdus rufiventris*	birds	*I. auritulus*	918-B	MHNCI	Arzua *et al.* 2005
693	1999	Curitiba	1L	*Turdus rufiventris*	birds	*I. auritulus*	922 -B	MHNCI	Arzua *et al.* 2005
694	1999	Curitiba	1N	*Turdus rufiventris*	birds	*I. auritulus*	937-B	MHNCI	Arzua *et al.* 2005
695	2002	Curitiba	3N, 4L	*Synallaxis ruficapilla*	birds	*I. auritulus*	-	-	Arzua *et al.* 2003
696	2002	Curitiba	3N, 4L	*Turdus rufiventris*	birds	*I. auritulus*	-	-	Arzua *et al.* 2003
697	1994	Quatro Barras	1F,1N	*Streptoprocne biscutata*	birds	*I. paranaensis*	612	MHNCI	Barros-Battesti *et al.* 2003; Arzua *et al.* 2005
698	1994	Quatro Barras	1N	*Streptoprocne biscutata*	birds	*I. paranaensis*	613	MHNCI	Barros-Battesti *et al.*

									2003; Arzua *et al.* 2005
699	1994	Quatro Barras	1N	*Streptoprocne biscutata*	birds	*I. paranaensis*	614	MHNCI	Arzua *et al.* 2005
700	1994	Quatro Barras	1F	*Streptoprocne biscutata*	birds	*I. paranaensis*	615	MHNCI	Barros-Battesti *et al.* 2003; Arzua *et al.* 2005
701	1994	Quatro Barras	2F, 3N	*Streptoprocne biscutata*	birds	*I. paranaensis*	616	MHNCI	Barros-Battesti *et al.* 2003; Arzua *et al.* 2005
702	1994	Quatro Barras	1F	*Streptoprocne biscutata*	birds	*I. paranaensis*	617	MHNCI	Arzua *et al.* 2005
703	1994	Quatro Barras	1F	*Streptoprocne biscutata*	birds	*I. paranaensis*	618	MHNCI	Arzua *et al.* 2005
704	1994	Quatro Barras	1N	*Streptoprocne biscutata*	birds	*I. paranaensis*	619	MHNCI	Arzua *et al.* 2005
705	1994	Quatro Barras	1N	*Streptoprocne biscutata*	birds	*I. paranaensis*	620	MHNCI	Arzua *et al.* 2005
706	1994	Quatro Barras	1F	*Streptoprocne biscutata*	birds	*I. paranaensis*	621	MHNCI	Arzua *et al.* 2005
707	1994	Quatro Barras	1N	*Streptoprocne biscutata*	birds	*I. paranaensis*	622	MHNCI	Arzua *et al.* 2005
708	1994	Quatro Barras	1N	*Streptoprocne biscutata*	birds	*I. paranaensis*	623	MHNCI	Arzua *et al.* 2005
709	1994	Quatro Barras	1F	*Streptoprocne biscutata*	birds	*I. paranaensis*	624	MHNCI	Arzua *et al.* 2005
710	1995	Quatro Barras	2L	*Streptoprocne biscutata*	birds	*I. paranaensis*	625	MHNCI	Barros-Battesti *et al.* 2003; Arzua *et al.* 2005

711	1994	Quatro Barras	1F	*Streptoprocne biscutata*	birds	*I. paranaensis*	626	MHNCI	Arzua *et al.* 2005
712	1995	Quatro Barras	1F	*Streptoprocne biscutata*	birds	*I. paranaensis*	627	MHNCI	Barros-Battesti *et al.* 2003; Arzua *et al.* 2005
713	1995	Quatro Barras	1N	*Streptoprocne biscutata*	birds	*I. paranaensis*	628	MHNCI	Barros-Battesti *et al.* 2003; Arzua *et al.* 2005
714	1994	Quatro Barras	1M	*Streptoprocne biscutata*	birds	*I. paranaensis*	629	MHNCI	Arzua *et al.* 2005
715	1995	Quatro Barras	2N	*Streptoprocne biscutata*	birds	*I. paranaensis*	630	MHNCI	Barros-Battesti *et al.* 2003; Arzua *et al.* 2005
716	1995	Quatro Barras	1N	*Streptoprocne biscutata*	birds	*I. paranaensis*	631	MHNCI	Arzua *et al.* 2005
717	1994	Quatro Barras	1N	*Streptoprocne biscutata*	birds	*I. paranaensis*	632	MHNCI	Arzua *et al.* 2005
718	1995	Quatro Barras	1N	*Streptoprocne biscutata*	birds	*I. paranaensis*	633	MHNCI	Arzua *et al.* 2005
719	2000	Ponta Grossa	1N	*Streptoprocne zonaris*	birds	*I. paranaensis*	1474	MHNCI	Arzua *et al.* 2005
720	2000	Ponta Grossa	1N	*Streptoprocne biscutata*	birds	*I. paranaensis*	1475	MHNCI	Arzua *et al.* 2005
721	1992	Piraquara	1N	*Basileuterus culicivorus*	birds	*Ixodes fuscipes* (published as *I. aragaoi*)	1526	MHNCI	Arzua *et al.* 2005
722	1992	Piraquara	1N	*Thamnophilus caerulescens*	birds	*Ixodes fuscipes* (published as *I. aragaoi*)	1527	MHNCI	Arzua *et al.* 2005

723	1993	Piraquara	1N	*Tachyphonus coronatus*	birds	*Ixodes fuscipes* (published as *I. aragaoi*)	1534	MHNCI	Arzua *et al.* 2005
724	1993	Piraquara	1N	*Campylorhamphus falcularius*	birds	*Ixodes fuscipes* (published as *I. aragaoi*)	1539	MHNCI	Arzua *et al.* 2005
725	1993	Piraquara	1N	*Syndactyla rufosuperciliata*	birds	*Ixodes fuscipes* (published as *I. aragaoi*)	1543	MHNCI	Arzua *et al.* 2005
726	1993	Piraquara	1N	*Drymophila malura*	birds	*Ixodes fuscipes* (published as *I. aragaoi*)	1553	MHNCI	Arzua *et al.* 2005
727	1993	Piraquara	1L	*Lepidocolaptes fuscus*	birds	*Ixodes fuscipes* (published as *I. aragaoi*)	1578	MHNCI	Arzua *et al.* 2005
728	1991	Piraquara	1N	*Syndactyla rufosuperciliata*	birds	*Ixodes fuscipes* (published as *I. aragaoi*)	1338-B	MHNCI	Arzua *et al.* 2005
729	1992	Adrianópolis	2N	*Trichothraupis melanops*	birds	*Ixodes fuscipes* (published as *I. aragaoi*)	1541-A	MHNCI	Arzua *et al.* 2005
730	1993	Piraquara	11M, 6F	*Cerdocyon thous*	canids	*A. aureolatum*	107	MHNCI	Arzua *et al.* 2005
731	1995	Curitiba	3M	*Cerdocyon thous*	canids	*A. aureolatum*	135	MHNCI	Arzua *et al.* 2005
732	1953	São Mateus do Sul	1F	*Cerdocyon thous*	canids	*A. aureolatum*	146	MHNCI	Arzua *et al.* 2005
733	2000	São José dos Pinhais	1F	*Cerdocyon thous*	canids	*A. aureolatum*	1239	MHNCI	Arzua *et al.* 2005

734	2002	Colombo	3M, 2F	*Cerdocyon thous*	canids	*A. aureolatum*	1369	MHNCI	Arzua *et al.* 2005
735	2002	Araucária	2M,1F	*Cerdocyon thous*	canids	*A. aureolatum*	1375	MHNCI	Arzua *et al.* 2005
736	2013	Guarapuava	5M, 1F	*Cerdocyon thous*	canids	*A. aureolatum*	-	-	Seki *et al.* 2013
737	1990	Pirai do Sul	5M, 1F	*Cerdocyon thous*	canids	*A. ovale*	30	MHNCI	Arzua *et al.* 2005
738	2004	Guaraqueçaba	5M,4F,2N	*Cerdocyon thous*	canids	*A. ovale*	1682	MHNCI	This study
739	1983	Ponta Grossa	6M,1F	*Lycalopex gymnocercus* (published as *Dusicyon gymnocercus*)	canids	*A. tigrinum*	76	MHNCI	Barros & Baggio 1992
740	1983	Ponta Grossa	6M,1F	*Lycalopex gymnocercus* (published as *Dusicyon gymnocercus*)	canids	*A. tigrinum*	77	MHNCI	Barros & Baggio 1992
741	1993	Ponta Grossa	8M, 4F	*Chrysocyon brachyurus*	canids	*A. tigrinum*	108	MHNCI	Arzua *et al.* 2005
742	2013	Guarapuava	1F, 1M	*Cerdocyon thous*	canids	*H. juxtakochi*	-	-	Seki *et al.* 2013
743	2002	Santo Antônio da Platina	3N	*Mazama* sp.	deer	*A. dubitatum*	435C	MHNCI	This study
744	2016	Guarapuava	1F	*Mazama gouazoubira*	deer	*A. parvum*	-	-	Mongruel *et al.* 2016
745	2002	Santo Antonio da Platina	1M	*Mazama* sp.	deer	*A. triste*	435-B	MHNCI	Arzua *et al.* 2005
746	2016	Guarapuava	1A, 1N	*Mazama gouazoubira*	deer	*H. juxtakochi*	-	-	Mongruel *et al.* 2016
747	2017	-	1N	*Mazama* sp.	deer	*H. juxtakochi*	160	VBDL	This study

748	1945	_	1F	*Mazama gouazoubira*	deer	*H. juxtakochi*	59	MHNCI	Barros & Baggio 1992
749	2002	Prudentópolis	3M,2F,12N,1L	*Mazama gouazoubira*	deer	*H. juxtakochi*	1236	MHNCI	Arzua *et al.* 2005
750	1996	Lapa	1F	*Mazama* sp.	deer	*H. juxtakochi*	1386	MHNCI	Arzua *et al.* 2005
751	1996	Guaratuba	1M, 2L	*Mazama* sp.	deer	*H. juxtakochi*	1388	MHNCI	Arzua *et al.* 2005
752	1993	Pinhão	2F	*Mazama* sp.	deer	*H. juxtakochi*	1400	MHNCI	Arzua *et al.* 2005
753	2014	Foz do Iguaçu	1M	*Mazama* sp.	deer	*I. fuscipes*	-	-	Labruna *et al.* 2020
754	2016	Guarapuava	1A	*Mazama gouazoubira*	deer	*R. microplus*	-	-	Mongruel *et al.* 2016
755	2002	Santo Antonio da Platina	3M, 1F, 1N	*Mazama* sp.	deer	*R. microplus*	434	MHNCI	Arzua *et al.* 2005
756	2002	Santo Antonio da Platina	3M,22F,1N	*Mazama* sp.	deer	*R. microplus*	435-A	MHNCI	Arzua *et al.* 2005
757	2019	São José dos Pinhais	1M, 1F	*Herpailurus yagouaroundi*	felids	*A. aureolatum*	451	VBDL	This study
758	1993	Curitiba	24M, 14F	*Puma concolor*	felids	*A. aureolatum*	118	MHNCI	Arzua *et al.* 2005
759	1995	Carambeí	1M, 4F	*Puma concolor*	felids	*A. aureolatum*	173	MHNCI	Arzua *et al.* 2005
760	1987	Morretes	1N	*Leopardus guttulus*	felids	*A. fuscum*	14	MHNCI	This study
761	1987	Morretes	1N	*Leopardus guttulus* (published as *Felis tigrina*)	felids	*A. longirostre*	14	MHNCI	Barros & Baggio 1992
762	1989	Almirante Tamandaré	1F	*Herpailurus yagouaroundi*	felids	*A. ovale*	46	MHNCI	Barros & Baggio 1992

763	2004	Foz de Iguaçu	2A	*Leopardus guttulus*	felids	*A. ovale*	-	-	Labruna *et al.* 2005
764	2004	Foz de Iguaçu	13A	*Puma concolor*	felids	*A. ovale*	-	-	Labruna *et al.* 2005
765	1993	Foz do Iguaçu	2F	*Leopardus pardalis* (published as *Felis pardalis*)	felids	*A. ovale*	-	-	Sinkoc *et al.* 1998
766	1993	Foz do Iguaçu	1M, 1F, 2N	*Panthera onca*	felids	*A. ovale*	-	-	Sinkoc *et al.* 1998
767	1993	Foz do Iguaçu	1M, 1F, 3N	*Panthera onca*	felids	*A. ovale*	-	-	Sinkoc *et al.* 1998
768	1993	Foz do Iguaçu	15M, 1F, 1N	*Panthera onca*	felids	*A. ovale*	-	-	Sinkoc *et al.* 1998
769	2002	Santo Antônio da Platina	1N	*Puma concolor*	felids	*A. sculptum*	1391	MHNCI	Arzua *et al.* 2005
770	2018	Araucária	1F	*Didelphis aurita*	marsupials	*A. aureolatum*	325	VBDL	This study
771	-	Ponta Grossa	1M	*Lutreolina crassicaudata*	marsupials	*A. aureolatum*	148	MHNCI	Arzua *et al.* 2005
772	1983	Ponta Grossa	1N	*Didelphis albiventris*	marsupials	*A. brasiliense*	69B	MHNCI	This study
773	1983	Ponta Grossa	1N	*Didelphis albiventris*	marsupials	*A. brasiliense*	62B	MHNCI	This study
774	1983	Ponta Grossa	3N	*Lutreolina crassicaudata*	marsupials	*A. dubitatum*	80B	MHNCI	This study
775	1983	Ponta Grossa	1N	*Didelphis albiventris*	marsupials	*A. dubitatum*	65	MHNCI	Barros & Baggio 1992
776	1983	Ponta Grossa	3N	*Didelphis albiventris*	marsupials	*A. dubitatum*	68B	MHNCI	This study
777	1983	Ponta Grossa	2N	*Didelphis albiventris*	marsupials	*A. dubitatum*	71B	MHNCI	This study
778	1983	Ponta Grossa	1N	*Didelphis albiventris*	marsupials	*A. dubitatum*	63	MHNCI	Barros & Baggio 1992

779	2017	Maringá	1N	*Didelphis albiventris*	marsupials	*A. dubitatum*	201	VBDL	Massini *et al.* 2019
780	2017	Maringá	1N	*Didelphis albiventris*	marsupials	*A. dubitatum*	202	VBDL	Massini *et al.* 2019
781	2017	Maringá	4N	*Didelphis albiventris*	marsupials	*A. dubitatum*	203	VBDL	Massini *et al.* 2019
782	2017	Maringá	1N	*Didelphis albiventris*	marsupials	*A. dubitatum*	204	VBDL	Massini *et al.* 2019
783	2019	-	1N	*Didelphis albiventris*	marsupials	*A. dubitatum*	389	VBDL	This study
784	2020	Maringá	1N	*Lutreolina crassicaudata*	marsupials	*A. dubitatum*	78B	MHNCI	This study
785	2020	Maringá	4N	*Lutreolina crassicaudata*	marsupials	*A. dubitatum*	-	-	Blanco *et al.* 2017
786	2008	Adrianópolis	10A	*Didelphis albiventris*	marsupials	*A. ovale*	-	-	Barros-Battesti 2008
787	2017	Maringá	11L	*Didelphis albiventris*	marsupials	*Amblyomma* sp.	203	VBDL	Massini *et al.* 2019
788	1983	Ponta Grossa	1L	*Didelphis albiventris*	marsupials	*Amblyomma* sp.	67	MHNCI	This study
789	2018	Araucária	1F	*Didelphis aurita*	marsupials	*I. loricatus*	325	VBDL	This study
790	2017	-	11M, 1F	*Didelphis* sp.	marsupials	*I. loricatus*	164	VBDL	This study
791	2019	-	1F	*Didelphis albiventris*	marsupials	*I. loricatus*	379	VBDL	This study
792	2019	-	1F	*Didelphis aurita*	marsupials	*I. loricatus*	385	VBDL	This study
793	2019	-	1M, 1F	*Didelphis aurita*	marsupials	*I. loricatus*	387	VBDL	This study
794	1945	-	1M,1F	*Philander opossum*	marsupials	*I. loricatus*	56	MHNCI	Arzua *et al.* 2005
795	1945	Guaratuba	1F,1L	*Philander opossum*	marsupials	*I. loricatus*	57	MHNCI	Barros & Baggio 1992
796	1945	-	1M,1F	*Didelphis* sp.	marsupials	*I. loricatus*	58	MHNCI	Barros & Baggio 1992

797	1983	Ponta Grossa	2M,3F	*Didelphis aurita* (published as *Didelphis marsupialis*)	marsupials	*I. loricatus*	61	MHNCI	Barros & Baggio 1992
798	1983	Ponta Grossa	1M	*Didelphis albiventris*	marsupials	*I. loricatus*	64	MHNCI	Barros & Baggio 1992
799	1983	Ponta Grossa	2M	*Didelphis albiventris*	marsupials	*I. loricatus*	66	MHNCI	Barros & Baggio 1992
800	1983	Ponta Grossa	1F	*Didelphis albiventris*	marsupials	*I. loricatus*	70	MHNCI	Barros & Baggio 1992
801	1983	Ponta Grossa	2F	*Didelphis albiventris*	marsupials	*I. loricatus*	72	MHNCI	Barros & Baggio 1992
802	1983	Ponta Grossa	1F	*Lutreolina crassicaudata*	marsupials	*I. loricatus*	79	MHNCI	Barros & Baggio 1992
803	1983	Ponta Grossa	1F, 3N	*Lutreolina crassicaudata*	marsupials	*I. loricatus*	81	MHNCI	Barros & Baggio 1992
804	1992	Pinhão	1M, 3F	*Philander opossum*	marsupials	*I. loricatus*	95	MHNCI	Arzua *et al.* 2005
805	1994	Curitiba	1M	*Didelphis albiventris*	marsupials	*I. loricatus*	125	MHNCI	Arzua *et al.* 2005
806	1996	Curitiba	1F	*Didelphis aurita* (published as *Didelphis marsupialis*)	marsupials	*I. loricatus*	196	MHNCI	Arzua *et al.* 2005
807	1991	Antonina	2F	*Philander opossum*	marsupials	*I. loricatus*	391	MHNCI	Arzua *et al.* 2005
808	1999	Pinhão	1M, 1N	*Didelphis albiventris*	marsupials	*I. loricatus*	414	MHNCI	Arzua *et al.* 2005
809	1983	Castro	1F	*Didelphis albiventris*	marsupials	*I. loricatus*	420	MHNCI	This study
810	1983	Castro	1F	*Didelphis albiventris*	marsupials	*I. loricatus*	421	MHNCI	Arzua *et al.* 2005

811	1996	Tunas do Paraná	1F	*Philander opossum*	marsupials	*I. loricatus*	1237	MHNCI	Arzua *et al.* 2005
812	1996	Quatro Barras	1M, 1F	*Philander opossum*	marsupials	*I. loricatus*	1385	MHNCI	Arzua *et al.* 2005
813	1992	Pinhão	1F	*Philander opossum*	marsupials	*I. loricatus*	1389	MHNCI	Arzua *et al.* 2005
814	2002	Campo Largo	2F	*Didelphis* sp.	marsupials	*I. loricatus*	1392	MHNCI	Arzua *et al.* 2005
815	1995	Curitiba	1M	*Didelphis albiventris*	marsupials	*I. loricatus*	144-C	MHNCI	Arzua *et al.* 2005
816	1995	Curitiba	1M	*Didelphis albiventris*	marsupials	*I. loricatus*	149-A	MHNCI	Arzua *et al.* 2005
817	1996	Tunas do Paraná	1F	*Philander opossum*	marsupials	*I. loricatus*	360-A	MHNCI	Arzua *et al.* 2005
818	1983	Ponta Grossa	6F, 2N	*Didelphis aurita* (published as *Didelphis marsupialis*)	marsupials	*I. loricatus*	62-A	MHNCI	Arzua *et al.* 2005
819	1983	Ponta Grossa	1M, 2F	*Didelphis albiventris*	marsupials	*I. loricatus*	68-A	MHNCI	Arzua *et al.* 2005
820	1983	Ponta Grossa	5M, 7F	*Didelphis albiventris*	marsupials	*I. loricatus*	69-A	MHNCI	Arzua *et al.* 2005
821	1983	Ponta Grossa	1M	*Didelphis albiventris*	marsupials	*I. loricatus*	71-A	MHNCI	Arzua *et al.* 2005
822	1984	Ponta Grossa	1F	*Lutreolina crassicaudata*	marsupials	*I. loricatus*	78-A	MHNCI	Arzua *et al.* 2005
823	1983	Ponta Grossa	1F	*Lutreolina crassicaudata*	marsupials	*I. loricatus*	80-A	MHNCI	Arzua *et al.* 2005
824	1999	Bituruna	23N	*Monodelphis* sp.	marsupials	*Ixodes fuscipes* (published as *I. aragaoi*)	442	MHNCI	Arzua *et al.* 2005

825	1986	Paranaguá	1M, 5F	*Galictis cuja*	mustelid	*A. aureolatum*	43	MHNCI	Barros & Baggio 1992
826	1986	Paranaguá	1M, 1F	*Galictis cuja*	mustelid	*A. ovale*	5	MHNCI	Barros & Baggio 1992
827	1990	Matinhos	68M, 34F	*Lontra longicaudis* (published as *Lutra longicaudis*)	mustelid	*A. ovale*	20	MHNCI	Arzua *et al.* 2005
828	1998	Guaratuba	37M, 24F	*Eira barbara*	mustelid	*A. ovale*	1334	MHNCI	Arzua *et al.* 2005
829	1993	Foz do Iguaçu	1M	*Galictis cuja*	mustelid	*A. ovale*	-	-	Sinkoc *et al.* 1998
830	1993	Foz do Iguaçu	1F	*Galictis cuja*	mustelid	*A. ovale*	-	-	Sinkoc *et al.* 1998
831	2019	São José dos Pinhais	1F, 2N	*Alouatta guariba*	non-human primates	*A. aureolatum*	381	VBDL	Martins *et al.* 2021
832	1988	Foz do Iguaçu	1F	*Sapajus apella* (published as *Cebus apella*)	non-human primates	*A. ovale*	53	MHNCI	Barros & Baggio 1992
833	2012	Lapa	2N	*Alouatta guariba*	non-human primates	*A. parkeri*	1860	MHNCI	This study
834	2019	-	1N	*Alouatta guariba*	non-human primates	*A. parkeri*	323	VBDL	Martins *et al.* 2021
835	1993	Campina Grande do Sul	3M, 4F	*Procyon cancrivorus*	procionid	*A. aureolatum*	113	MHNCI	Arzua *et al.* 2005
836	2000	Prudentópolis	5M, 3F	*Procyon cancrivorus*	procionid	*A. aureolatum*	423	MHNCI	Arzua *et al.* 2005
837	2000	Pinhão	1M	*Nasua nasua*	procionid	*A. aureolatum*	1242	MHNCI	Arzua *et al.* 2005
838	2004	Foz de Iguaçu	4A	*Procyon cancrivorus*	procionid	*A. aureolatum*	-	-	Labruna *et al.* 2005

839	2017	Foz do Iguaçu	77N	*Nasua nasua*	procionid	*A. brasiliense*	-	-	Magalhães-Matos *et al.* 2017
840	2004	Foz de Iguaçu	1N	*Nasua nasua*	procionid	*A. brasiliense*	-	-	Labruna *et al.* 2005
841	2017	Foz do Iguaçu	427N	*Nasua nasua*	procionid	*A. coelebs*	-	-	Magalhães-Matos *et al.* 2017
842	1983	Ponta Grossa	1N	*Nasua nasua*	procionid	*A. dubitatum*	74	MHNCI	Barros & Baggio 1992
843	1983	Ponta Grossa	3N	*Nasua nasua*	procionid	*A. incisum*	75	MHNCI	Barros & Baggio 1992
844	2017	Foz do Iguaçu	22M, 24F	*Nasua nasua*	procionid	*A. ovale*	-	-	Magalhães-Matos *et al.* 2017
845	1988	Foz do Iguaçu	13M, 4F	*Nasua nasua*	procionid	*A. ovale*	13	MHNCI	Barros & Baggio 1992
846	1988	Matinhos	7M, 3F	*Procyon cancrivorus*	procionid	*A. ovale*	82	MHNCI	Arzua *et al.* 2005
847	1984	Matinhos	5M, 3F	*Procyon cancrivorus*	procionid	*A. ovale*	83	MHNCI	Arzua *et al.* 2005
848	1993	Adrianópolis	1M, 1F	*Procyon cancrivorus*	procionid	*A. ovale*	114	MHNCI	Arzua *et al.* 2005
849	1992	Adrianópolis	1M,3F	*Procyon cancrivorus*	procionid	*A. ovale*	1387	MHNCI	Arzua *et al.* 2005
850	2004	Ponta Grossa	7A	*Nasua nasua*	procionid	*A. ovale*	-	-	Labruna *et al.* 2005
851	2004	Foz de Iguaçu	7A	*Nasua nasua*	procionid	*A. ovale*	-	-	Labruna *et al.* 2005
852	2017	Foz do Iguaçu	6N	*Nasua nasua*	procionid	*H. juxtakochi*	-	-	Magalhães-Matos *et al.* 2017

853	1983	Ponta Grossa	1F	*Nasua nasua*	procionid	*I. loricatus*	73	MHNCI	Barros & Baggio 1992
854	1993	**exotic tick (registered in Curitiba)	1F	*Caiman crocodilus*	reptiles	*A. dissimile*	-	-	Serra-Freire & Peralta 1993
855	2017	-	3F	*Tupinambis* sp.	reptiles	*A. fuscum*	133	VBDL	This study
856	2010	Curitiba	1M, 1F, 1L	*Hydrochoerus hydrochaeris*	rodents	*A. dubitatum*	-	-	Nava *et al.* 2010
857	2010	Foz de Iguaçu	1M, 1F, 1N	*Hydrochoerus hydrochaeris*	rodents	*A. dubitatum*	-	-	Nava *et al.* 2010
858	2011	Londrina	40A	*Hydrochoerus hydrochaeris*	rodents	*A. dubitatum*	-	-	Toledo *et al.* 2011
859	2018	Pinhais	5M, 1F, 4N	*Hydrochoerus hydrochaeris*	rodents	*A. dubitatum*	163	VBDL	This study
860	2019	Piraquara	1M, 2N	*Hydrochoerus hydrochaeris*	rodents	*A. dubitatum*	349	VBDL	This study
861	1998	Curitiba	23M, 1F, 2L	*Hydrochoerus hydrochaeris*	rodents	*A. dubitatum*	433	MHNCI	Arzua *et al.* 2005
862	2012	Paranaguá	4M,2F	*Hydrochoerus hydrochaeris*	rodents	*A. dubitatum*	1786	MHNCI	This study
863	2011	Foz de Iguaçu	48M, 92F	*Hydrochoerus hydrochaeris*	rodents	*A. dubitatum*	-	-	Fortes *et al.* 2011
864	1993	Foz do Iguaçu	4M,4F	*Hydrochoerus hydrochaeris*	rodents	*A. dubitatum*	-	-	Sinkoc *et al.* 1998
865	1993	Foz do Iguaçu	5F	*Hydrochoerus hydrochaeris*	rodents	*A. dubitatum*	-	-	Sinkoc *et al.* 1998
866	1988	São José dos Pinhais	1M, 1F	*Sphiggurus villosus*	rodents	*A. parkeri* (published as *A. geayi)*	7	MHNCI	Barros & Baggio 1992
867	1987	Mangueirinha	1M	*Sphiggurus spinosus*	rodents	*A. parkeri*	16	MHNCI	Barros & Baggio 1992;

									Labruna *et al.* 2009
868	1990	Campina Grande do Sul	1M, 1F	*Sphiggurus spinosus*	rodents	*A. parkeri* (published as *A. geayi)*	31	MHNCI	Barros & Baggio 1992
869	-	Bocaiúva do Sul	2M	*Sphiggurus villosus* (published as *Sphiggurus spinosus*)	rodents	*A. parkeri* (published as *A. geayi)*	39	MHNCI	Barros & Baggio 1992
870	1989	Tunas do Paraná	1M	*Sphiggurus villosus*	rodents	*A. parkeri*	1240	MHNCI	Labruna *et al.* 2009; Arzua *et al.* 2005
871	1999	São José dos Pinhais	2M	*Sphiggurus* sp.	rodents	*A. parkeri*	1397	MHNCI	Labruna *et al.* 2009; Arzua *et al.* 2005
872	2004	Quatro Barras	1M, 1F	*Sphiggurus* sp.	rodents	*A. parkeri*	1689-A	MHNCI	This study
873	1992	Irati	3M, 2F	*Sphiggurus* sp.	rodents	*A. parkeri* (published as *A. geayi)*	87-A	MHNCI	Arzua *et al.* 2005
874	2008	Telêmaco Borba	1N	*Sphiggurus villosus*	rodents	*A. longirostre*	1865	MHNCI	This study
875	2018	Quatro Barras, PR	5M	*Sphiggurus villosus*	rodents	*A. longirostre*	162	VBDL	Valente *et al.* 2019a
876	2018	Curitiba	1F	*Sphiggurus villosus*	rodents	*A. longirostre*	210	VBDL	This study
877	2018	Araucária	2M, 1F	*Sphiggurus villosus*	rodents	*A. longirostre*	270	VBDL	This study
878	2018	-	1M	*Sphiggurus villosus*	rodents	*A. longirostre*	271	VBDL	Valente *et al.* 2019a
879	2018	-	1M, 1F	*Sphiggurus villosus*	rodents	*A. longirostre*	324	VBDL	Valente *et al.* 2019a

880	2018	-	1M	*Sphiggurus villosus*	rodents	*A. longirostre*	326	VBDL	Valente *et al.* 2019a
881	2019	Piraquara	1F	*Sphiggurus villosus*	rodents	*A. longirostre*	384	VBDL	Valente *et al.* 2019a
882	2019	-	16M, 2F, 3N	*Sphiggurus villosus*	rodents	*A. longirostre*	386	VBDL	Valente *et al.* 2019a
883	2019	-	2M, 2F, 1N	*Sphiggurus villosus*	rodents	*A. longirostre*	390	VBDL	Valente *et al.* 2019a
884	1989	Arapoti	5M, 3F	*Sphiggurus spinosus*	rodents	*A. longirostre*	17	MHNCI	Barros & Baggio 1992
885	1990	Curitiba	1M	*Sphiggurus villosus*	rodents	*A. longirostre*	49	MHNCI	Barros & Baggio 1992
886	1992	Almirante Tamandaré	1M	*Sphiggurus* sp.	rodents	*A. longirostre*	86	MHNCI	Labruna *et al.* 2009
887	1991	Araucária	1M, 2F	*Sphiggurus* sp.	rodents	*A. longirostre*	88	MHNCI	Labruna *et al.* 2009
888	1992	Pinhão	1M	*Sphiggurus* sp.	rodents	*A. longirostre*	97	MHNCI	This study
889	1992	Pinhão	1M	*Sphiggurus* sp.	rodents	*A. longirostre*	98	MHNCI	This study
890	1992	Pinhão	1M	*Sphiggurus* sp.	rodents	*A. longirostre*	1577	MHNCI	Arzua *et al.* 2005
891	1990	Campina Grande do Sul	1M	*Sphiggurus villosus*	rodents	*A. longirostre*	52-B	MHNCI	Labruna *et al.* 2009; Arzua *et al.* 2005
892	1992	Irati	3M	*Sphiggurus* sp.	rodents	*A. longirostre*	87-B	MHNCI	Arzua *et al.* 2005
893	1993	-	1M	*Sphiggurus villosus* (published as *Coendou villosus*)	rodents	*A. longirostre*	-	-	Fonseca 1933
894	2017	Jaguariaíva	4N	*Akodon montensis*	rodents	*A. ovale*	-	-	Blanco *et al.* 2017

895	2017	Paranaguá	7N	*Euryoryzomys russatus*	rodents	*A. ovale*	-	-	Blanco *et al.* 2017
896	2017	Jaguariaíva	15N	*Euryoryzomys russatus*	rodents	*A. ovale*	-	-	Blanco *et al.* 2017
897	2017	Paranaguá	1N, 1L	*Oligoryzomys nigripes*	rodents	*A. ovale*	-	-	Blanco *et al.* 2017
898	2017	Paranaguá	1N	*Oligoryzomys* sp.	rodents	*A. ovale*	-	-	Blanco *et al.* 2017
899	2017	Paranaguá	1N	*Thaptomys nigrita*	rodents	*A. ovale*	-	-	Blanco *et al.* 2017
900	1990	Campina Grande do Sul	1M	*Sphiggurus villosus*	rodents	*A. ovale*	52-C	MHNCI	Arzua *et al.* 2005
901	2008	Adrianópolis	2A	*Nectomys squamipes*	rodents	*A. ovale*	-	-	Barros-Battesti 2008
902	1990	Araucária	1N	*Sphiggurus villosus*	rodents	*A. parkeri*	48	MHNCI	Arzua *et al.* 2005; Labruna *et al.* 2009
903	1990	Campina Grande do Sul	1N	*Sphiggurus villosus*	rodents	*A. parkeri*	52D	MHNCI	This study
904	1990	Campina Grande do Sul	1N	*Sphiggurus villosus*	rodents	*A. parkeri*	1383	MHNCI	This study
905	2018	Quatro Barras, PR	2M, 1F	*Sphiggurus villosus*	rodents	*A. parkeri*	162	VBDL	Valente *et al.* 2019a
906	2018	-	1M, 1N	*Sphiggurus villosus*	rodents	*A. parkeri*	271	VBDL	Valente *et al.* 2019a
907	2019	-	2F, 2N	*Sphiggurus villosus*	rodents	*A. parkeri*	346	VBDL	Valente *et al.* 2019a
908	2019	Piraquara	1M	*Sphiggurus villosus*	rodents	*A. parkeri*	384	VBDL	Valente *et al.* 2019a
909	2011	Londrina	2A	*Hydrochoerus hydrochaeris*	rodents	*A. sculptum* (published as *A. cajennense* s.l.)	-	-	Toledo *et al.* 2011

910	1990	Campina Grande do Sul	1F	*Sphiggurus villosus*	rodents	*A. sculptum* (published as *A. cajennense* s.l.)	52-A	MHNCI	Arzua *et al.* 2005
911	1993	Foz do Iguaçu	3F	*Hydrochoerus hydrochaeris*	rodents	*A. triste*	-	-	Sinkoc *et al.* 1998
912	2019	Piraquara	5L	*Hydrochoerus hydrochaeris*	rodents	*Amblyomma* sp.	349	VBDL	This study
913	2018	-	222L	*Sphiggurus villosus*	rodents	*Amblyomma* sp.	271	VBDL	Valente *et al.* 2019a
914	2018	-	1L	*Sphiggurus villosus*	rodents	*Amblyomma* sp.	326	VBDL	Valente *et al.* 2019a
915	1991	Tijucas do Sul	1N, 1L	*Nectomys squamipes*	rodents	*Amblyomma* sp.	343	MHNCI	This study
916	-	Ilha do Rabelo	1N,1L	*Akodon* sp.	rodents	*Amblyomma* sp.	450	MHNCI	This study
917	-	Ilha do Rabelo	6L	*Akodon* sp.	rodents	*Amblyomma* sp.	658	MHNCI	This study
918	-	Ilha do Rabelo	5N, 1L	*Akodon* sp.	rodents	*Amblyomma* sp.	659	MHNCI	This study
919	-	Ilha do Rabelo	3L	*Akodon* sp.	rodents	*Amblyomma* sp.	660	MHNCI	This study
920	-	Ilha do Rabelo	2N, 1L	*Akodon* sp.	rodents	*Amblyomma* sp.	661	MHNCI	This study
921	1993	Morretes	1N	*Oryzomys* sp.	rodents	*Amblyomma* sp.	1688-A	MHNCI	This study
922	1988	Foz do Iguaçu	1N	*Oryzomys* sp.	rodents	*Amblyomma* sp.	225-B	MHNCI	This study
923	1993	Adrianópolis	19N	*Akodon* sp.	rodents	*Amblyomma* sp.	466-B	MHNCI	This study
924	1993	Guaratuba	1N	*Delomys sp.*	rodents	*Amblyomma* sp.	469-B	MHNCI	This study
925	-	Ilha do Rabelo	5L	*Akodon* sp.	rodents	*Amblyomma* sp.	662-A	MHNCI	This study
926	2008	Adrianópolis	25A	*Oryzomys russatus*	rodents	*Amblyomma* sp.	-	-	Barros-Battesti 2008
927	2011	Foz de Iguaçu	114N, 6L	*Hydrochoerus hydrochaeris*	rodents	*Amblyomma* sp.	-	-	Fortes *et al.* 2011
928	1987	Campina Grande do Sul	1N	*Delomys dorsalis*	rodents	*Haemaphysalis* sp.	458	MHNCI	This study
929	1993	Piraquara	4N	*Oryzomys* sp.	rodents	*Haemaphysalis* sp.	463-B	MHNCI	This study

930	2008	Adrianópolis	52A	*Nectomys squamipes*	rodents	*I. schulzei*	-	-	Barros-Battesti 2008
931	2008	Adrianópolis	2A	*Oryzomys russatus*	rodents	*I. schulzei*	-	-	Barros-Battesti 2008
932	2007	Adrianópolis	1N, 2L	*Akodon montensis*	rodents	*I. schulzei*	-	-	Onofrio *et al.* 2013
933	2007	Adrianópolis	52N	*Nectomys squamipes*	rodents	*I. schulzei*	-	-	Onofrio *et al.* 2013
934	2007	Adrianópolis	2N	*Oryzomys russatus*	rodents	*I. schulzei*	-	-	Onofrio *et al.* 2013
935	2005	Jaguariaiva	4N, 1L	*Akodon* sp.	rodents	*Ixodes sp.*	1677	MHNCI	This study
936	1993	Adrianópolis	1N	*Akodon* sp.	rodents	*Ixodes sp.*	480-B	MHNCI	This study
937	1984	Piraquara	5L	*Akodon serrensis*	rodents	*Ixodes sp.*	718-A	MHNCI	This study
938	1984	Piraquara	1N	*Oligoryzomys flavescens*	rodents	*Ixodes sp.*	720-F	MHNCI	This study
939	1988	São José dos Pinhais	1F	*Sphiggurus villosus*	rodents	*R. microplus*	8	MHNCI	This study
940	2019	Ponta Grossa and Porto Amazonas	638M, 232F, 40N	*Sus scrofa*	Suina	*A. brasiliense*	-	-	Kmetiuk *et al.* 2019
941	2010	Guarapuava	1F	*Tayassu pecari*	Suina	*A. dubitatum*	-	-	Nava *et al.* 2010
942	2019	Ponta Grossa and Porto Amazonas	1N	*Sus scrofa*	Suina	*A. dubitatum*	-	-	Kmetiuk *et al.* 2019
943	2010	Guarapuava	1F	*Tayassu pecari*	Suina	*A. dubitatum*	-	-	Nava *et al.* 2010
944	2018	Guaravera	1F	*Sus scrofa*	Suina	*A. ovale*	328	VBDL	This study
945	2018	Guaravera	1F	*Sus scrofa*	Suina	*A. sculptum*	328	VBDL	This study
946	2019	Ponta Grossa and Porto Amazonas	4F	*Sus scrofa*	Suina	*A. sculptum*	-	-	Kmetiuk *et al.* 2019

947	1994	Foz do Iguaçu	2M, 1F, 3N, 1L	*Tayassu pecari*	Suina	*A. sculptum* (published as *A. cajennense* s.l.)	119-A	MHNCI	Arzua *et al.* 2005
948	1994	Foz do Iguaçu	1F, 3N	*Tayassu pecari*	Suina	*A. sculptum* (published as *A. cajennense* s.l.)	121-A	MHNCI	Arzua *et al.* 2005
949	1994	Foz do Iguaçu	1M	*Tayassu pecari*	Suina	*A. sculptum* (published as *A. cajennense* s.l.)	122-A	MHNCI	Arzua *et al.* 2005
950	1994	Foz do Iguaçu	3M	*Tayassu pecari*	Suina	*A. sculptum* (published as *A. cajennense* s.l.)	123-A	MHNCI	Arzua *et al.* 2005
951	1988	Foz do Iguaçu	2M, 1F, 1N	*Tapirus terrestris*	tapir	*A. brasiliense*	50	MHNCI	Barros & Baggio 1992
952	1945	_	1F	*Tapirus terrestris*	tapir	*A. brasiliense*	55 B	MHNCI	Arzua *et al.* 2005
953	1945	_	11F	*Tapirus terrestris*	tapir	*A. coelebs*	55 A	MHNCI	Arzua *et al.* 2005
954	1945	_	7F	*Tapirus terrestris*	tapir	*A. incisum*	55 C	MHNCI	Arzua *et al.* 2005
955	2017	Foz do Iguaçu	6M, 6F	*Tapirus terrestris*	tapir	*A. sculptum*	6	VBDL	This study
956	2014	Foz de Iguaçu	4M, 3F	*Tapirus terrestris*	tapir	*A. sculptum*	-	-	Nava *et al.* 2014
957	1988	Foz do Iguaçu	1F	*Tapirus terrestris*	tapir	*H. juxtakochi*	54	MHNCI	Barros & Baggio 1992
958	2002	Telemaco Borba	1F	*Tamandua tetradactyla*	Xenarthra	*A. aureolatum*	1404	MHNCI	Arzua *et al.* 2005
959	2003	Piraí do Sul	1N	*Myrmecophaga tridactyla*	Xenarthra	*A. brasiliense*	1365	MHNCI	Arzua *et al.* 2005
960	2008	Telêmaco Borba	3N	*Tamandua tetradactyla*	Xenarthra	*A. brasiliense*	1863D	MHNCI	This study

961	2018	Curitiba	2F	*Tamandua tetradactyla*	Xenarthra	*A. calcaratum*	200	VBDL	This study
962	2018	-	1M	*Tamandua tetradactyla*	Xenarthra	*A. calcaratum*	322	VBDL	This study
963	2019	-	3M, 2F	*Tamandua tetradactyla*	Xenarthra	*A. calcaratum*	348	VBDL	This study
964	2019	-	2M	*Tamandua tetradactyla*	Xenarthra	*A. calcaratum*	452	VBDL	This study
965	1988	Paranaguá	1F	*Tamandua tetradactyla*	Xenarthra	*A. calcaratum*	51	MHNCI	Arzua *et al.* 2005
966	1991	Arapoti	1F	*Tamandua tetradactyla*	Xenarthra	*A. calcaratum*	85	MHNCI	Arzua *et al.* 2005
967	1991	Arapoti	5M, 3F	*Tamandua tetradactyla*	Xenarthra	*A. calcaratum*	89	MHNCI	Arzua *et al.* 2005
968	2000	Guarapuava	1M	*Tamandua tetradactyla*	Xenarthra	*A. calcaratum*	1380	MHNCI	Arzua *et al.* 2005
969	2000	Guarapuava	1M, 1F	*Tamandua tetradactyla*	Xenarthra	*A. calcaratum*	1576	MHNCI	Arzua *et al.* 2005
970	2006	São José dos Pinhais	13M,5F	*Tamandua tetradactyla*	Xenarthra	*A. calcaratum*	1678	MHNCI	This study
971	2006	Paranaguá	9M,4F,2N	*Tamandua tetradactyla*	Xenarthra	*A. calcaratum*	1679	MHNCI	This study
972	2006	Paranaguá	11M,2F	*Tamandua tetradactyla*	Xenarthra	*A. calcaratum*	1680	MHNCI	This study
973	2008	Telêmaco Borba	2N	*Tamandua tetradactyla*	Xenarthra	*A. dubitatum*	1863E	MHNCI	This study
974	-	***from Amazonas state (registered in Curitiba)	1M	*Bradypus*	Xenarthra	*A. geayi*	15	MHNCI	Labruna *et al.* 2009

975	1995	União da Vitória	1M, 2F	*Tamandua tetradactyla*	Xenarthra	*A. nodosum*	189	MHNCI	Arzua *et al.* 2005
976	-	Jaguariaíva	1F	*Tamandua tetradactyla*	Xenarthra	*A. pseudoconcolor*	-	MHNCI	Arzua *et al.* 2005

*A: adult ticks, published with no defined sex; **exotic tick (registered in Curitiba); ***tick collected on *Bradypus* from Amazonas state (registered in Curitiba).