Distribution and invasive potential of the black-tufted marmoset *Callithrix penicillata* in the Brazilian territory

Distribuição e potencial de invasão do mico estrela *Callithrix penicillata* no território brasileiro

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Biological invasions are one of the greatest existing threats to biodiversity. Invasive species can cause economic and environmental damage. *Callithrix penicillata* is naturally found in the Brazilian savanna and Caatinga. Its introduced populations have become a conservation problem due to its high occupancy potential, native fauna predation, competition with native primates, congeners and hybridization. We used Species Distribution Modeling (SDM) through the Maxent software in this study in order to identify areas with a higher probability of *C. penicillata* occurrence. The AUC value was close to 1 (AUC=0.966), with a curve value close to 1. Through the Jackknife test we observed that temperature seasonality was the variable most related to distribution (AUC=0.86), which agrees with other studies that show climatic variables influencing primate distribution. The Atlantic Forest in the Southeast and South regions of Brazil was indicated as susceptible to invasion by *C. penicillata*. The marmoset *C. penicillata* has become a successful invader of Atlantic Forest areas, causing depreciation in many native species and other problems. However, biological invasions might be mitigated or even extinguished through successful interventions and management.

Keywords: Ecosystem impact, Species Distribution Modeling, Primates.

Invasões biológicas são uma das maiores ameaças a biodiversidade, espécies invasoras podem causar prejuízos econômicos e ambientais. *Callithrix penicillata* é naturalmente encontrado no cerrado brasileiro e caatinga. Suas populações introduzidas tornaram-se um problema de conservação devido ao seu alto potencial de ocupação, predação da fauna nativa, competição com congêneres nativos e hibridação. Neste estudo utilizamos a Modelagem de Distribuição de Espécies (MEDE) através do software Maxent para identificar áreas com maior probabilidade de ocorrência de *C. penicillata*. O valor encontrado foi de AUC = 0,966, com valor da curva próximo a 1. Por meio do teste Jackknife, observamos que a sazonalidade da temperatura foi a variável mais relacionada à distribuição (AUC = 0,86), indo de acordo com outros estudos que demonstram que variáveis climáticas influenciam a distribuição de primatas. A Floresta Atlântica nas regiões Sudeste e Sul do Brasil foram as suscetíveis à invasão por *C. penicillata*. O sagui *C. penicillata* se tornou um invasor bem sucedido na Floresta Atlântica, onde vem causando vários danos e prejuízos para a fauna nativa desse bioma. No entanto invasões biológicas podem ser mitigadas ou mesmo quantidades quando são realizadas intervenções e manejo adequado.

Palavras-chave: Impacto nos ecossistemas, modelagem de Distribuição de Espécies, Primatas.

1. INTRODUCTION

Biological invasions are responsible for significant environmental alterations and are one of the greatest existing threats to biodiversity [1]. Once settled in a new habitat, the invasive species threatens the native biodiversity, being able to cause potentially irreparable economic and environmental losses [1]. In order to mitigate this global problem, tools have developed that enable us to predict invasion events [2]. Among these, Species Distribution Modeling (SDM) has become increasingly important for predict biological invasions [3, 4]. Species distribution models have been used in biogeography, conservation, ecological and paleontological studies [5].

Species Distribution Modeling can be designed promptly and with a low budget, helping to identify areas in which a species has a higher probability of occurring [6]. Precisely identifying areas that may be successfully occupied by invasive species is one of the greatest challenges when studying biological invasions [1]. Data used to determine the distribution of a species in a given geographical area is usually scarce and incomplete, which hinders conservation and management projects [7]. These projects are only made possible by knowing which areas have already been

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invaded and which ones are more susceptible to invasion. In this way, management strategies can be focused on areas of high-risk areas of invasion [1, 2].

The *Callithrix penicillata* (É Geoffroy 1812) is a well-known invasive species for some areas in Brazil [8]. The species is a small-sized arboreal primate that inhabits many vegetal physiognomies and may occur in secondary or disturbed vegetation, typical in Cerrado (Brazilian savannas) and Caatinga areas in the states of Bahia (reaching the northern borders of the Grande and São Francisco rivers in its northern distribution), Minas Gerais, Goiás, southwestern Piauí, Maranhão and northern São Paulo (north to the Tietê and Piracicaba rivers) [9].

This species was introduced in the states of Rio de Janeiro, Espírito Santo, São Paulo, Paraná and Santa Catarina, and also in some areas in eastern Minas Gerais, mainly in the Atlantic forest [9]. The Atlantic Forest is a world hotspot, with some of the highest rates of endemism and biodiversity in the entire planet. It originally spread approximately 1,300,000 km², but currently, only 22% of the original coverage exists [10, 11]. Most of its territory is found in the Southeast and South regions, which have the greatest demographic densities in Brazil. The forest is therefore threatened by urbanization, industrialization, deforestation, fragmentation, anthropic occupation, and recently biological invasions [10, 12].

Such sites include Conservation Units which function is to ensure the representativeness of significant and ecologically viable samples of different populations, habitats and ecosystems by preserving the existing biological patrimony [13]. Introduced *C. penicillata* populations have become a concerning issue for environmental conservation due to their general diet, tolerance for fragmentation and tendency to increase their density, especially in defaunated areas [14, 15] where they impact the native fauna, transmit diseases and hybridize with native congeners of the Atlantic Forest [16].

Negative impacts on avifauna by invasive marmosets have mainly been reported for birds and eggs predation [14, 17, 18, 19, 20]. Studies on the decline of bird populations, especially on islands, have pointed to the introduced marmosets as one of those responsible [20, 21, 22]. Conversely, invasive marmosets can play important ecological roles in outdated areas where there are no native primates, such as dispersers or maintaining important ecological relationships [23, 24]

*Callithrix penicillata* was chosen due to its relevance in the conservation scenario and the need for further investigations, since the existing studies [see 16, 20, 25] are limited to report on their local damage, such as predation record on native fauna and recorded hybridization with native congeners, but with no in-depth approach to the problem. Our goals were to discriminate the actual distribution of the *C. penicillata* and through the SDM modelling Maxent (Maximum Entropy) software to predict which areas are more probable to invasions by this species and to discuss the ecological relevance of invaded areas, as well as the losses caused by the marmoset in such sites. Finally, to provide data about the biological invasion and demonstrate the importance of predictive modelling in management and conservation actions for invasive species.

2. MATERIAL AND METHODS

We used the Maxent software (www.cs.princeton.edu/~schapire/maxent/) in order to estimate the potential species distributions. This algorithm requires the entry of a set of layers or environmental variables (e.g., precipitation rates, altitude, etc.) and a set of georeferenced occurrence locations in order to generate a SDM of a given species [7, 26], as used bellow.

The marmoset occurrence locations (302 occurrence points) (Figure 1) were attained through an extensive literature review in the Web of Science (apps-webofknowledge.ez25.periodicos.capes.gov.br), Scielo – Scientific Electronic Library Online (www.scielo.org/php/index.php), and Academic Google (scholar.google.com.br) databases, as well as consultations to biological collections (Appendix I) and in the Global Biodiversity Information Facility (gbif.sibbr.gov.br), Mammal Networked Information System (https://ecologicaldata.org/wiki/mammal-networked-information-system), SpeciesLink (splink.cria.org.br) and Táxeus (taxeus.com.br) databases. Unreferenced data was georeferenced through the Geoloc tool (splink.cria.org.br/geoloc) and Google Earth. Records with inaccurate information about the locality were discarded.
The environmental variables used in this study were the 19 listed by Hijmans et al. (2005) [27], attained from consulting the WordClim database (www.worldclim.org). Additionally, data on the altitude and vegetation of biomes were attained from the Instituto Nacional de Pesquisas Espaciais – INPE (www.dpi.inpe.br/Ambdata/index.php). In order to reduce overfitting, which tends to be larger with larger number of dimensions, through principal component analysis (PCA), we used six variables that together explained 99% of the data variation, BIO 4 (temperature seasonality), BIO 5 (Max Temperature of Warmest Month), BIO 10 (Mean Temperature of Warmest Quarter), BIO 11 (temperature mean of the coldest quarter), BIO 12 (Annual Precipitation) and BIO 15 (Precipitation Seasonality).

An independent dataset was then built and divided into training data and testing data in order to assess the quality and reliability of the model. The testing dataset was created by using a 25% randomization of the presence points (totaling 227 training points and 75 test points). The adjustment measure in the model was a random prediction with an AUC value = 0.5.

Two other statistical parameters were taken into account, the omission rate and the binomial proportion [28]. These parameters help us understand how much the model failed to predict the occurrence of test points and how statistically significant it is. Complementary analysis of data overlay in the marmoset occurrence in Conservation Units, phytogeographic domains and priority conservation areas (www.mapas.mma.gov.br/i3geo/datadownload.htm) were carried out using the DIVA-GIS software (www.diva-gis.org/download).
3. RESULTS AND DISCUSSION

Our results show that the sites which are more susceptible to *C. penicillata* invasion outside their likely occurrence area are in the Southeast of the Atlantic Forest (Figure 2).

The calculated values regarding the model’s reliability were AUC=0.923. Pearce & Ferrier (2000) [29] consider that values over 0.75 are indicators of good model performance, and therefore the closer the area under the curve is to 1, the smaller the probability of the model being a result from a random prediction. The model presented low values for both the omission rate (0.000) and the binomial test (0), indicating that the generated models are significantly different from those generated at random.

![Figure 2 - Geographical representation of the potential distribution for Callithrix penicillata in the Brazilian territory; white dots represent locations used to generate the model (training) and purple dots represent the locations used to test the model.](image)

Regarding the environmental variables that most influenced the model prediction, the Jackknife test showed that the species distribution is closely related with the variables: Max Temperature of Warmest Month (BIO 5) AUC=0.84, and Temperature Seasonality (BIO 4) AUC=0.83, followed by Annual Precipitation (BIO 12) AUC= 0.82. The influence of these variables on the species distribution is due to its natural habitat being the Cerrado, which has differences in the temperature seasonality throughout the year. Two distinct seasons are markedly present: the hot and rainy season (from October to April), in which 75% of the precipitation takes place and temperatures
range from 20°C to 28°C, and the cold and dry season (from May to September), with temperatures going as low as 16°C and relative air humidity getting close to 20% during droughts [30]. The Atlantic forest presents the highest potential for invasion, where the predominant climate is the humid tropical climate, which is marked by medium to high temperatures and high air humidity throughout the year and regular and well distributed rainfall [31]. The characteristics of this biome favor the occupation of *C. penicillata* in these areas. Climatic and environmental factors may interfere in the marmoset distribution in the Brazilian territory, thus creating areas with higher or lower invasion probability. However, it is necessary to consider that results are limited to the data currently available on locations of occurrence of the species who are mainly from the southeastern region of Brazil.

Other primate studies have shown the existence of an influence between environmental variables and the distribution limits, as well as the use of space [see 25, 32, 33]. For instance, the distribution limits for *Brachyteles arachnoides* (É. Geoffroy, 1806) are influenced by climatic factors (AUC=0.994) such as temperature and precipitation [34]. The environmental variables that most influenced the *B. arachnoides* distribution were temperature seasonality (AUC=0.96), followed by annual temperature mean (AUC=0.93) and maximum temperature of the hottest month (AUC=0.93). As found in our study, temperature seasonality was the variable most correlated to distribution. For *Callithrix flaviceps* (Thomas 1903), study with model attained through logistic regression (with a 95.6% concordance value) showed that climatic factors seem to limit its distribution, suggesting that there are areas with higher probabilities (> 40%) of species occurrence [25]. The occurrence of *C. flaviceps* was positively related to relative humidity (0.8057, sd ± 0.0229), and it seemed to show a preference for Ombrophilous forest areas (more than 50% of the occurrence was in Ombrophilous Forests).

In order to understand the impact of *C. penicillata* invasion, we analyze its distribution area throughout the country along with the Protected Areas (PA, Conservation Units – CU in Brazil) (Figure 3), Priority Conservation Areas and the Atlantic Forest domain itself (Figure 4). When *C. penicillata* occurrence is overlaid with Brazilian Conservation Units, it is evident that the species has invaded Conservation Units belonging to the Atlantic Forest (Appendix I).
Figure 3 - Protected Areas (blue): Federal, state and Municipal, Atlantic Rain Forest (dark blue) versus Callithrix penicillata occurrence (red dots) (Appendix I). This figure was generated in the DIVA-GIS 7.5.0 software [35].
The black-tufted marmoset (C. penicillata) is a generalist invader [14], with a plastic diet, a high habitat occupation potential, and a capability of occurring in a widely variety of phytophysiognomies such as disturbed areas or secondary vegetation [36]. Additionally, Callithrix genus is also one of the most frequent in illegal trade, commonly commercialized as pet [37]. It has great potential on the predation of the native fauna (bird eggs and birds, amphibian and serpent hatchlings) [14, 20, 38]. Causing many problems in the Atlantic Forest areas where they were introduced [13], as direct competition with native primate species for habitat and resources [39] and hybridization (H) with the endemic Callithrix ssp. which may result in the loss of unique genotypes, endemism suppression and population depreciation [40], as well as the transmission of diseases to both native primates and human beings [41].

Primates of the Callithrix genus are reservoir for diseases that afflict primates, including humans, and are often potential transmitters. Marmosets are classified by the National Health Foundation (Fundação Nacional de Saúde – FUNASA) as a host species and/or a possible biological risk parasite reservoir, and therefore are monitored by the Surveillance and Control Coordination of Biological Risk Factors (Coordenação de Vigilância e Controle dos Fatores de Risco Biológico) in order to prevent and avoid any changes in key and conditional environmental factors related to human health [42]. Records dating back to 1930 describe diseases being transmitted from primates down to humans, with encephalomyelitis (from Herpesvirus simiae) being one of the first [43]. Still, diseases from fungal, viral, bacterial and helminthic origins are currently described as cycling
between humans and other primates, such as rabies, herpes B, monkeypox, common cold, poliomyelitis, measles, yellow fever, dengue and others [42, 43].

Dozens of marmosets have been diagnosed with rabies, and human deaths have been caused by marmoset-transmitted rabies [44]. The Callithrix genus was the second most stricken by yellow fever among non-human primates [45] in the recent outbreaks of wild yellow fever that hit the southeast of the country between 2017-2018, the area most susceptible to invasion, caused high mortality of marmosets. The death of these animals mainly in urban areas with high population and occurrence of the Aedes aegypti mosquito increased the concern of health agencies about the risk of reurbanization of the disease in the country [46, 47]. Moreover, intestinal parasites may be transmitted by marmosets down to humans in urban areas frequented by marmosets and humans (such as parks or squares) [48].

While researching marmosets living in urban and forest areas, Verona (2008) [43] verified the presence of bacteria such as Escherichia coli (which may cause gastroenteritis, urinary infection, and meningitis in humans), Klebsiella oxytoca (causes infections in the urinary tract, and septicemia), Klebsiella pneumoniae (pneumonia), Sphingomonas paucimobilis (may cause peritonitis, cerebral abscesses, cervical adenopathy, respiratory infections, urinary infections, and meningitis) and Salmonella enteritidis (gastroenteritis). Aside from microfilaria, fungi, parasite eggs and nematode larva [43, 49].

Callithrix ssp. generally has the ability to survive in fragmented areas [5, 10]. Disturbed environments, especially when close to urban areas, are susceptible to colonization by generalist primates as the Callithrix genus [5, 9]. In southeast of the country, especially in the invaded areas, primates are living in environments near human settlements, they opportunistically interact with people aiming to supplement their diet [50]. This greater proximity then increases the risks of transmitting diseases for humans, and also increase the exposure of marmosets to parasites, risk attack by domestic animals, hunting for pets and susceptible to roadkill and electrocution when using power lines [19, 30, 31].

4. CONCLUSION

The Atlantic Forest is vulnerable to biological invasions since it is already under of pressure coming from urbanization, and degradation and environmental fragmentation. The marmoset Callithrix penicillata has become a successful invader of Atlantic Forest areas, causing depreciation in many native species, which already deal with various other pressures. Factors linked with urbanization and industrialization are harder to control since the human expansion process is not likely to be contained. However, biological invasions might be mitigated or even extinguished through successful interventions and management strategies when well applied can bring excellent results [sec: 51, 52].

The generated model reached desirable reliability rates and may be used to help plan the control of C. penicillata invasions. Further studies are needed in order to design better control measurements. Our results provide data that may contribute to the conservation of the Atlantic Forest by helping and clarifying the potential biological invasion process by the C. penicillata, outlining the current invasion profile, based on environmental characteristics. Showing, therefore, which regions are more likely to be invaded, as well as which environmental conditions may contribute to or limit the invasion; data which may be used in future conservation and management projects.

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### Appendix I

Records of the species *Callithrix penicillata* used in this study.

| #  | State | Provenance                              | Coordinates (WGS-84) | Source                |
|----|-------|-----------------------------------------|----------------------|-----------------------|
| 1  | ES    | Linhares                                | -19.45671/-40.08198  | MEL-M099              |
| 2  | ES    | Linhares                                | -19.45671/-40.08198  | MEL-M100              |
| 3  | ES    | Vitória                                 | -20.319444/-40.33777 | MBML-Mamíferos 187    |
| 4  | ES    | Vitória                                 | -20.319444/-40.33777 | MBML-Mamíferos 367    |
| 5  | ES    | Santa Teresa                             | -19.86111/-40.56111  | UFES-MAM -3291        |
| 6  | ES    | Itapemirim                               | -21.01667/-40.8      | UFES-MAM 3292         |
| 7  | ES    | Rio Preto                                | -20.70000/-41.8333   | MZUFV -1096           |
| 8  | ES    | Santa Leopoldina                         | -20.2333/-42.0333    | Nicolaevsky, 2011     |
| 9  | MG    | Thomaz Gonzaga                           | -18.4333/-44.3000    | manisnet.org          |
| 10 | MG    | Indianópolis, UHE Miranda                | -19.03860/-47.916900 | MCN-N -177            |
| 11 | MG    | Indianópolis                             | -19.03860/-47.916900 | MCN-N -174            |
| 12 | MG    | Indianópolis                             | -19.0386/-47.9169    | MCN-N -178            |
| 13 | MG    | Catas Altas                              | -20.07743/-43.41819  | MCN-N -3099           |
| 14 | MG    | Salinas                                  | -16.17029/-42.29029  | MCN-N -038            |
| 15 | MG    | Rio Piracicaba                           | -19.9296/-43.1700    | MCN-N -2470           |
| 16 | MG    | Santana do Riacho                        | -19.33/-43.73        | MCN-N -1952           |
| 17 | MG    | Belo Horizonte                           | -19.94923/-43.904585 | UFMG-BDT -000208     |
| 18 | MG    | Lagoa Santa                              | -19.633333/-43.883335| ZUEC-MAM 1840        |
| 19 | MG    | Lagoa Santa                              | -19.6272/-43.8894    | ZUEC-MAM 1840        |
| 20 | MG    | Passos                                   | -20.7191/-46.6094    | ZUEC-MAM 1601        |
| 21 | MG    | Pirapora                                 | -17.3449/-44.9418    | FNJV -7893           |
| 22 | MG    | Araponga                                 | -20.6667/-42.5333    | MZUFV -03032         |
| 23 | MG    | Fervedouro                               | -20.7258/-42.2789    | MZUFV -687           |
| 24 | MG    | Viçosa                                   | -20.7539/-42.8819    | MZUFV -686           |
| 25 | MG    | Ponte Nova                               | -20.24583/-42.770833 | Silva et al., 2018   |
| 26 | MG    | Rio Novo                                 | -21.4833/-43.1333    | MZUFV -487           |
| 27 | MG    | Viçosa                                   | -20.7539/-42.8819    | MZUFV -486           |
| 28 | MG    | Nova Ponte                               | -19.1528/-47.6744    | MZUFV -484           |
| 29 | MG    | Viçosa                                   | -20.745556/-43.01472 | MZUFV -792           |
| 30 | MG    | Baldim                                   | -19.288333/-43.956944| UFMG-BDT-958         |
| 31 | MG    | Clube de Caça e Pesca Itororó de Uberlândia | -18.46/-48.3       | Vilela & Del Claro, 2011 |
| 32 | MG    | Muriaé, Horto Florestal                  | -21.12170/-42.369136 | Fausto, 2009         |
| 33 | MG    | Lavras                                   | -21.25/-45           | Silva & Passamani, 2009 |
| 34 | MG    | Lavras                                   | -21.3541/-44.8894    | Silva et al., 2018   |
| 35 | MG    | Juiz de Fora, Fazenda Floresta           | -21.7432/-43.3098    | Neto et al., 2009    |
| 36 | MG    | Juiz de Fora, Jardim Botânico            | -21.7378/-43.3716    | Vale, 2013           |
| 37 | MG    | Juiz de Fora, Praça Jardas de Lery Santos | -21.7716/-43.3522    | Vale et al., 2018    |
| 38 | MG    | Juiz de Fora, Campus Universitário       | -21.7754/-43.3711    | Ribeiro et al., 2018 |
| 39 | MG    | Carangola                                | -20.7333/-42.0333    | MZUFV -455           |
| 40 | MG    | Leopoldina                               | -21.5333/-42.6333    | MZUFV -485           |
| 41 | MG    | Belo Horizonte, Horto Florestal          | -19.887875/-43.917919| gbif.sibbr.gov.br    |
| 42 | MG    | Santa Rita do Ibitipoca                 | -21.700000/-43.900000| Nogueira et al., 2009|
| 43 | MG    | Ouro Preto                               | -20.38698/-43.581354 | gbif.sibbr.gov.br    |
| 44 | MG | Ouro Preto, Parque Estadual do Ibacolomi | -20.4159/-43.5196 | Melo et al., 2009 |
| 45 | MG | Belo Horizonte | -19.62722/-43.88972 | Goulart et al., 2010 |
| 46 | MG | Belo Horizonte, Parque das Mangabeiras | -19.94/-43.9 | Câmara & Lessa, 1994 |
| 47 | MG | Viçosa, Mata do Paraíso | -20.79516/-42.87782 | Pereira, 2012 |
| 48 | MG | Viçosa, Mata da Biologia | -20.7558/-42.8594 | Pereira, 2012 |
| 49 | MG | Viçosa, Mata da Dendrologia | -20.7688/-42.8775 | Pereira, 2012 |
| 50 | MG | Viçosa, Mata Funarbe | -20.7761/-42.8702 | Pereira, 2012 |
| 51 | MG | Viçosa, Barrinha II | -20.7469/-42.9166 | Pereira, 2012 |
| 52 | MG | Viçosa | -20.75486/-42.87587 | gbif.sibbr.gov.br |
| 53 | MG | Augusto Lima | -18.000/-44.000 | gbif.sibbr.gov.br |
| 54 | MG | Conceição de Alagoas | -20.02/-48.23 | gbif.sibbr.gov.br |
| 55 | MG | Contagem | -19.900158/-44.110667 | taxeu.com.br |
| 56 | MG | Lagoa Formosa | -18.784933/-46.441994 | taxeu.com.br |
| 57 | MG | Perdigão | -19.944028/-45.081678 | taxeu.com.br |
| 58 | MG | Santo Antônio do Monte | -20.075486/-45.279922 | taxeu.com.br |
| 59 | MG | Buritis | -15.5540/-46.2720 | Nikolaevsky, 2011 |
| 60 | MG | Januária, Riacho da Cruz | -15.3355/-44.2461 | Nikolaevsky, 2011 |
| 61 | MG | Nepomuceno | -21.24467/-45.25070 | taxeu.com.br |
| 62 | MG | Paraopeba | -19.23477/-44.38157 | taxeu.com.br |
| 63 | MG | Nova Lima | -19.979031/-43.84304 | taxeu.com.br |
| 64 | MG | Belo Horizonte | -19.78688/-43.95731 | taxeu.com.br |
| 65 | MG | Maricá | -22.92651/-42.85205 | taxeu.com.br |
| 66 | MG | Perdizes | -19.3500/-47.2917 | Nikolaevsky, 2011 |
| 67 | MG | Cristália | -16.8002/-42.8622 | Nikolaevsky, 2011 |
| 68 | MG | Almenara | -16.04963/-40.859092 | Neves, 2008 |
| 69 | MG | Bambuí | -20.042467/-45.953567 | taxeu.com.br |
| 70 | MG | Conselheiro Lafaiete | -20.639417/-43.779158 | Silva et al., 2018 |
| 71 | MG | Capim Branco | -19.546414/-44.147528 | taxeu.com.br |
| 72 | MG | Caratinga | -19.812689/-42.122158 | taxeu.com.br |
| 73 | MG | Dores do Indaiá | -19.460771/-45.596489 | gbif.sibbr.gov.br |
| 74 | MG | Formiga | -45.426389/-20.464444 | UFMG-BDT-999 |
| 75 | MG | Santo Antônio | -20.325067/-42.605606 | taxeu.com.br |
| 76 | MG | Campus da Universidade de Belo Horizonte | -19.62722/-43.88972 | UFMG-BDT-3823 |
| 77 | MG | Itacarambi | -15.12142/-44.256669 | gbif.sibbr.gov.br |
| 78 | MG | Mata entre Jacinto e Santo Antônio do Jacinto | -16.223243/-30.306451 | Neves, 2008 |
| 79 | MG | Santo Antônio do Jacinto | -16.102408/-30.350346 | Neves, 2008 |
| 80 | MG | Várzea da Palma, Serra do Onça | -17.2355/-44.4455 | UFMG-BDT-1009 |
| 81 | MG | Aparecida do Taboado | -20.1200/-51.0700 | Nikolaevsky, 2011 |
| 82 | MG | Lagoa Santa Rio das Velhas | -19.62719/-43.889701 | splink.cria.org.br |
| 83 | MG | Lagoa Santa Rio das Velhas | -19.6300/-43.8800 | splink.cria.org.br |
| 84 | MG | São João do Glória | -20.7200/-46.6200 | manisnet.org |
| 85 | MG | Januária | -15.4833/-44.3667 | manisnet.org |
| 86 | MG | Água suja | -18.88/-47.63 | manisnet.org |
| 87 | MG | São João Del Rei | -21.143056/-44.285556 | Silva et al., 2018 |
| 88 | MG | Barbacena | -21.227125/-43.767894 | Silva et al., 2018 |
| 89 | MG | Araguari | -18.4833/-48.4333 | manisnet.org |
|   | Estado | Localização | Latitude | Longitude | Autor e Ano |
|---|--------|-------------|----------|-----------|-------------|
| 90 | MG     | São Roque, Fazenda Gameleira | -20.24527/-46.365833 | UFMG-BDT -1040 | Nicolaevsky, 2011 |
| 91 | MG     | Araguari, Rio Jordão | -18.6509/-48.1854 | - | Nicolaevsky, 2011 |
| 92 | MG     | Araguari | -18.6300/-48.1800 | - | Nicolaevsky, 2011 |
| 93 | MG     | Veríssimo | -19.7000/-48.3000 | - | Nicolaevsky, 2011 |
| 94 | MG     | Romaria | -18.8837/-47.5637 | - | Nicolaevsky, 2011 |
| 95 | MG     | Uberaba | -19.7500/-47.9200 | - | Nicolaevsky, 2011 |
| 96 | MG     | São João Batista | -20.6300/-46.5000 | - | Nicolaevsky, 2011 |
| 97 | MG     | Pedras de Maria | -15.5000/-44.3500 | - | Nicolaevsky, 2011 |
| 98 | MG     | Pirapora | -17.3449/-44.9418 | - | Nicolaevsky, 2011 |
| 99 | MG     | Lassance | -17.9000/-44.5700 | - | Nicolaevsky, 2011 |
|100 | MG     | Curvelo | -18.7500/-44.4200 | - | Nicolaevsky, 2011 |
|101 | MG     | Morada Nova de Minas | -18.8300/-45.1800 | - | Nicolaevsky, 2011 |
|102 | MG     | Pompeu, Fazenda Bugio | -19.2244/-44.93527 | UFMG-BDT -956 | Silva et al., 2018 |
|103 | MG     | São Paulo | -19.2808/-44.07111 | - | Silva et al., 2018 |
|104 | MG     | Conceição do Mato Dentro | -18.814444/-44.47778 | Silva et al., 2018 |
|105 | MG     | Almenara, Fazenda Estância | -16.0167/-40.8500 | - | Nicolaevsky, 2011 |
|106 | MG     | José Gonçalves, Fazenda Irmãos Athachi | -16.5830/-42.6333 | - | Nicolaevsky, 2011 |
|107 | MG     | Pará de de Minas | -19.785278/-44.651667 | Silva et al., 2018 |
|108 | MG     | Fazenda Canabrana, Augusto Lima | -18.034722/-44.236667 | Silva et al., 2018 |
|109 | MG     | Mata do Catingueira, Patos de Minas | -18.58/-46.52 | Reis et al., 2014 |
|110 | MG     | Parque Nacional da Serra do Cipó | -19.3333/-43.5667 | Leal et al., 2008 |
|111 | MG     | Parque Nacional das Sermepes Vivas | -17.9021/-43.7729 | Leal et al., 2008 |
|112 | MG     | Parque Estadual Serra do Rola Moça | -20.0769/-44.0267 | Leal et al., 2008 |
|113 | MG     | Aproveitamento Hidrelétrico de Queimado | -16.19/-47.27 | Prints & Malta, 2007 |
|114 | MG     | Acauá Reserve, Turmalina | -17.13/-42.77 | Silva et al., 2018 |
|115 | MG     | Botumirim | -17.13/-43.22 | Silva et al., 2018 |
|116 | MG     | Alfenas | -21.408056/-46.003333 | Silva et al., 2018 |
|117 | MG     | Parque Estadual Fernão Dias | -19.9333/-44.0667 | De Melo Júnior & Fernando, 2007 |
|118 | MG     | Córrego Contendas, Cristália | -16.75/-42.87 | Silva, 2014 |
|119 | MG     | Fazenda Mandasai, Grão Mogol | -16.57/-43.2 | Silva, 2014 |
|120 | MG     | Ipatinga | -19.371389/-26.05556 | Silva et al., 2018 |
|121 | MG     | Virgem da Lapa | -16.67/-41.98 | Silva, 2014 |
|122 | MG     | Fazenda Santa Maria, Itinga | -16.6/-41.93 | Silva, 2014 |
|123 | MG     | Santana do Riacho | -19.33/-43.73 | Silva, 2014 |
|124 | MG     | Flexiândia | -18.76/-44.9 | UFMG-BDT -726 |
|125 | MG     | Patos de Minas, Jadin Paraíso | -18.583796/-45.51038 | UFMG-BDT -322 |
|126 | MG     | Varginha | -21.346389/-45.522778 | Silva et al., 2018 |
|127 | MG     | Parque Municipal Américo Renne Giannetti, BH | -19.920796/-43.93780 | Duarte et al., 2011 |
|128 | MG     | Reserva Volta Grande, Conceição das Alagoas | -20.02/-48.23 | Silva, 2014 |
|129 | MG     | Veríssimo | -19.7/-48.3 | Silva, 2014 |
|130 | MG     | Água Suja | -18.88/-47.63 | Silva, 2014 |
|131 | MG     | Uberaba | -19.75/-47.92 | UFMG-BDT -531 |
|132 | MG     | Buenopolis | -17.9000/-44.1833 | Nicolaevsky, 2011 |
| Code | Location                                      | Latitude | Longitude | Author(s)                  |
|------|----------------------------------------------|----------|-----------|----------------------------|
| MG   | Barra do Paraopeba                           | -18.83/-45.18 | Silva, 2014 |
| MG   | Barão de Guaçu, Diamantina                   | -18.36/-43.74 | Silva, 2014 |
| MG   | Fazenda do Geraldo, Diamantina               | -18.38/-43.69 | Silva, 2014 |
| MG   | Itamogi                                      | -21.082107/47.041427 | gbif.sibbr.gov.br |
| MG   | Estrela do Indaiá                            | -19.53922//45.797581 | Silva, 2014 |
| MG   | Itaverava                                    | -20.677394/-43.617881 | Silva, 2014 |
| MG   | Virgem da Lapa, Porto de Madacarú            | -16.6220/-42.2194 | Nicolaevsky, 2011 |
| MG   | Capitólio                                    | -20.64808/-46.226199 | gbif.sibbr.gov.br |
| MG   | São Roque                                    | -20.2437/-46.3652 | UFMG-BDT-964 |
| MG   | Morro da Garçã                               | -18.5469/-44.6027 | Nicolaevsky, 2011 |
| MG   | São João Batista do Glória                   | -20.6300/46.5000 | Nicolaevsky, 2011 |
| MG   | Araxá                                        | -19.611038/46.915762 | gbif.sibbr.gov.br |
| RJ   | Guapimirim                                   | -22.48134/-42.986369 | gbif.sibbr.gov.br |
| RJ   | Silvânia                                     | -22.6130/-42.4036 | De Morais Jr et al., 2008 |
| RJ   | Teresópolis                                   | -22.33358/-42.983906 | gbif.sibbr.gov.br |
| RJ   | Parque Nacional da Serra dos Órgãos           | -22.40044/-42.830010 | Carvalho et al., 2013 |
| RJ   | Angra dos Reis, Ilha Grande                  | -23.156786/-44.180866 | Modesto & Bergallo, 2008 |
| RJ   | Reserva Biológica Poço das Antas             | -22.52394/-42.3129 | De Morais Jr et al., 2008 |
| RJ   | Parque Nacional do Itatiai                   | -22.74360/-44.57241 | Aximoff et al., 2016 |
| RJ   | Rio Bonito                                   | -22.73333/-42.55875 | De Morais Jr et al., 2008 |
| RJ   | Rio de Janeiro                               | -22.952269/-43.211761 | gbif.sibbr.gov.br |
| RJ   | Petrópolis, Cascata do Imbuí                 | -22.420793/-43.145759 | gbif.sibbr.gov.br |
| RJ   | Petrópolis                                   | -22.503181/-43.172643 | gbif.sibbr.gov.br |
| SP   | Luís Antônio, Jataí                          | -21.5833/-47.799999 | Nicolaevsky, 2011 |
| SP   | Barretos                                     | -20.5500/-48.5500 | Nicolaevsky, 2011 |
| SP   | São Paulo                                    | -23.695907/-46.666731 | gbif.sibbr.gov.br |
| SP   | Campinas                                     | -22.8999/-47.0600 | FNJV -7911 |
| SP   | Campinas                                     | -22.8999/-47.0600 | FNJV -7912 |
| SP   | Araçoiabada Serra                            | -23.520265/-47.565766 | gbif.sibbr.gov.br |
| SP   | Iperó                                        | -23.4344/-47.656575 | gbif.sibbr.gov.br |
| SP   | Jundiaí                                      | -23.17169/-46.898639 | gbif.sibbr.gov.br |
| SP   | Bauru                                        | -22.31445/-49.058695 | gbif.sibbr.gov.br |
| SP   | Parque Ecológico do Tietê                    | -23.4941/-46.5221 | Pereira et al., 2001 |
| SP   | Ribeirão Preto                               | -21.170401/-47.810324 | gbif.sibbr.gov.br |
| SP   | Ubatuba                                      | -23.42789/-45.082872 | De Melo Júnior & Fernando, 2007 |
| SP   | Piracicaba, Campus da Esalq                  | -22.71322/-47.6313 | Alexandrino et al., 2012 |
| SP   | Bosque de Campinas                           | -22.89999/-47.060001 | splink.cria.org.br |
| SP   | Araraquara                                   | -21.742423/-48.17302 | gbif.sibbr.gov.br |
| SP   | Jandira                                      | -23.550000/-46.866667 | Begotti & Landesmann, 2008 |
| SP   | São José do Rio Preto, Campus Unesp          | -20.786061/-49.35880 | Gomes & Lima-Gomes, 2011 |
| SP   | Cotia                                        | -23.7149/-46.9454 | taxeux.com.br |
| SP   | Bauru, APA Vargem Limpa                      | -22.33333/49.016667 | De Paula, 2005 |
| SP   | Ilha Anchieta                                | -23.53945/45.06357 | taxeux.com.br |
| SP   | São Carlos                                   | -21.9833/-47.8583 | Nicolaevsky, 2011 |
| SP   | Divinolândia                                 | -21.6/-46.733299 | gbif.sibbr.gov.br |
| Code | State | City | Coordinates | Source |
|------|-------|------|-------------|--------|
| SP   | Franca| -20.504575/-47.379647 | taxeus.com.br |
| SP   | Americana| -22.7299/-47.3300 | FNIV - 7915 |
| SP   | Ribeirão Preto| -21.170389/-47.860519 | taxeus.com.br |
| SP   | Itu| -18.957058/-49.431467 | taxeus.com.br |
| SP   | Patrocínio Paulista| -20.639061/-47.267758 | taxeus.com.br |
| SP   | Guará| -20.441036/-47.761714 | taxeus.com.br |
| SP   | São Joaquim da Barra| -20.573431/-47.816872 | taxeus.com.br |
| SP   | Santana de Parnaíba| -23.434819/-46.915603 | taxeus.com.br |
| SP   | Tucuruvi| -23.483213/-46.61359 | gbif.sibbr.gov.br |
| SP   | Tapiraiba| -30.5167/-46.7833 | splink.cria.org.br |
| SP   | Ubatuba, Parque Estadual Ilha Anchieta| -45.016667/-23.533333 | De Melo Júnior & Fernando, 2007 |
| SP   | Luís Antônio| -21.5833/-47.8 | splink.cria.org.br |
| SP   | Pedregulho| -20.256901/-47.4767 | Nicolaevsky, 2011 |
| SP   | São Sebastião da Grama| -21.7167/-46.700001 | splink.cria.org.br |
| SP   | Divinolândia| -21.6/-46.7333 | splink.cria.org.br |
| SP   | Estação Ecológica de Jataí| -21.5000/-47.7500 | Talamoni et al., 2000 |
| SP   | Estação Experimental de Luiz Antonio| -21.56972/-47.735000 | Talamoni et al., 2000 |
| SP   | Mairiporã| -23.328245/-46.683462 | taxeus.com.br |
| SP   | Campinas, Ribeirão das Cabras| -22.8855875/-46.9608089 | Lima, 2008 |
| SP   | Joaquim Egídeo| -22.873183/-46.935008 | Lima, 2008 |
| SP   | Souzas| -22.848366/-47.012925 | Lima, 2008 |
| SP   | Jardim Botânico de São Paulo| -23.638777/-46.625038 | gbif.sibbr.gov.br |
| DF   | Reserva Ecológica do IBGE| -15.9597/-47.8764 | Miranda & Faria, 2001 |
| DF   | Brasília| -15.72941/-47.858824 | gbif.sibbr.gov.br |
| DF   | Parque Nacional de Brasília| -15.740999/-47.923286 | gbif.sibbr.gov.br |
| DF   | Jardim Botânico de Brasília| -15.86677/-47.8333 | Miranda & Faria, 2001 |
| DF   | Brasília, Reserva Ecológica do Roncador| -15.83/-47.83 | Vilela & Faria, 2004 |
| DF   | Mata do Açúdinho, Fazenda Sucupira| -15.92/-48.03 | Vilela, 2007 |
| GO   | Santa Leopoldina| -20.2333/-42.0333 | Nicolaevsky, 2011 |
| GO   | Santa Helena de Goiás| -17.834811/-50.568283 | taxeus.com.br |
| GO   | Aruana| -14.934817/-50.100306 | taxeus.com.br |
| GO   | Mundo Novo de Goiás| -13.774975/-50.264947 | taxeus.com.br |
| GO   | São Miguel do Araguaia| -13.272800/-50.143919 | taxeus.com.br |
| GO   | Novo Crixas| -14.541153/-49.975594 | taxeus.com.br |
| GO   | Barro Alto| -15.92/-48.03 | manisnet.org |
| GO   | Inhumas| -16.3700/-49.5000 | Nicolaevsky, 2011 |
| GO   | Goiânia| -16.6799/-49.2550 | Nicolaevsky, 2011 |
| GO   | Itumbiara| -18.4200/-49.2200 | Nicolaevsky, 2011 |
| GO   | Catalão| -18.1700/-47.9500 | Nicolaevsky, 2011 |
| GO   | Anápolis| -16.3261/-48.9506 | splink.cria.org.br |
| GO   | Hidrolândia| -16.9700/-49.2200 | Nicolaevsky, 2011 |
| GO   | Carmo do Rio Verde| -15.4500/-49.7300 | Nicolaevsky, 2011 |
| GO   | Jaraguá| -15.7500/-49.3300 | Nicolaevsky, 2011 |
| GO   | Goiânia, Fazenda São José, Campus II| -16.7339/-49.2161 | Nicolaevsky, 2011 |
| GO   | Aragarças, Rio Araguaia| -15.9583/-52.1981 | Nicolaevsky, 2011 |
| GO   | Jaraguá| -15.7500/-49.3300 | Nicolaevsky, 2011 |
| Código | Estado | Informação Geográfica | Localização Geográfica |
|--------|--------|-----------------------|-----------------------|
| 224    | GO     | Parque Municipal Grande Retiro | -16.668889/-49.181111 Grande, 2012 |
| 225    | GO     | Morro do Macaco         | -15.777222/-48.939444 Grande, 2012 |
| 226    | GO     | Morro do Medanha        | -16.662222/-49.345000 Grande, 2012 |
| 227    | GO     | Jardim Madri            | -16.745556/-49.346667 Grande, 2012 |
| 228    | GO     | Madre Germânia          | -16.833889/-49.361111 Grande, 2012 |
| 229    | GO     | Parque Estadual Altamiro de Moura Pacheco | -16.5237/-49.1416 Grande, 2012 |
| 230    | GO     | Pilar                  | -14.68/-49.45 Nicolaevsky, 2011 |
| 231    | GO     | Veadeiros, Rio Corumbá  | -14.12/-47.52 Nicolaevsky, 2011 |
| 232    | GO     | Rio Uruhu              | -15.45/-49.73 Nicolaevsky, 2011 |
| 233    | GO     | Planaltina             | -15.62/-47.67 Nicolaevsky, 2011 |
| 234    | GO     | Goiânia, ECSJ da Universidade Católica de Goiás | -16.74/-49.05 Silva et al., 2008 |
| 235    | GO     | Inhumas                | -16.37/-49.5 Nicolaevsky, 2011 |
| 236    | GO     | Itumbiara, Rio Paraíba | -18.42/-49.22 Nicolaevsky, 2011 |
| 237    | GO     | Trindade               | -16.6700/-49.5000 Nicolaevsky, 2011 |
| 238    | GO     | Caldas Novas           | -17.7500/-48.6300 Nicolaevsky, 2011 |
| 239    | GO     | Nerópolis              | -16.4200/-49.2300 Nicolaevsky, 2011 |
| 240    | GO     | Alto Paraíso           | -14.14349/-47.489616 gbf.sibbr.gov.br |
| 241    | GO     | Pirenópolis            | -15.84593/-48.957375 gbf.sibbr.gov.br |
| 242    | GO     | Formosa, Fazenda São Manoel | -15.5372/-47.3344 Nicolaevsky, 2011 |
| 243    | MS     | Terenos                | -20.73/-54.92 Nicolaevsky, 2011 |
| 244    | MS     | Campo Grande           | -20.39/-54.59 Nicolaevsky, 2011 |
| 245    | MT     | Jarina, Peixoto de Azevedo | -10.333333/-53.2 MCN 164 |
| 246    | BA     | Malhada, Fazenda Belém | -9.4833/-37.9667 manisnet.org |
| 247    | BA     | Castelo Novo           | -14.64159/-39.20671 manisnet.org |
| 248    | BA     | Ilhéus, Fazenda Pirataquise | -14.8167/-39.0333 manisnet.org |
| 249    | BA     | Pontal                 | -14.7892/-39.0492 splink.cria.org.br |
| 250    | BA     | Itaeté, Macaco seco    | -12.9800/-41.1200 Nicolaevsky, 2011 |
| 251    | BA     | Malhada, Faz. da Serra | -14.3000/-43.7333 Nicolaevsky, 2011 |
| 252    | BA     | São Gonçalo            | -12.4500/-38.9500 Nicolaevsky, 2011 |
| 253    | BA     | Itinga, Fazenda Santana| -16.5000/-41.7719 Nicolaevsky, 2011 |
| 254    | BA     | Pindobaçu              | -10.7694/-40.3528 Nicolaevsky, 2011 |
| 255    | BA     | San Salvador           | -12.9833/-38.5167 manisnet.org |
| 256    | BA     | Lamarão                | -10.77/-40.35 manisnet.org |
| 257    | BA     | Barreiras              | -12.1300/-45.0000 Nicolaevsky, 2011 |
| 258    | BA     | Rio Jucuruçu           | -17.35/-39.22 Nicolaevsky, 2011 |
| 259    | BA     | Sebastião Laranjeiras  | -14.632778/-42.9425 manisnet.org |
| 260    | BA     | Belmonte               | -15.859796/-38.886904 manisnet.org |
| 261    | BA     | Curral Velho           | -9.9107303/-40.6583157 manisnet.org |
| 262    | BA     | Itaberaba              | -12.525806/-40.296151 manisnet.org |
| 263    | BA     | Lençois                | -12.553003/-41.39755 manisnet.org |
| 264    | BA     | Ilhéus, Fazenda São Caetano | -14.7892/-39.0492 manisnet.org |
| 265    | BA     | Guaíbim, município de Valença | -13.269572/-38.945311 Neves, 2008 |
| 266    | BA     | Mata na estrada entre Itapetinga e Catiba | -15.08380/-40.340205 Neves, 2008 |
| 267    | BA     | Mata entre Nova Canaã e Poções, | -14.784812/-40.212699 Neves, 2008 |
| 268    | BA     | Riachão das Neves      | -11.8000/-44.7300 Nicolaevsky, 2011 |
| 269    | BA     | Bom Jesus da Lapa      | -13.2500/-43.4200 Nicolaevsky, 2011 |
| BA  | Reserva da Michelin, município de Ituberá | -13.819411/-39.158224 | Neves, 2008 |
| BA  | Mata logo após a balsa do rio de Contas em Itacaré | -14.261560/-39.001363 | Neves, 2008 |
| BA  | Mata na região do Piracanga, distrito de Maraú | -14.219353/-38.992872 | Neves, 2008 |
| BA  | Mata na região do Piracanga, distrito de Maraú | -14.076325/-38.958686 | Neves, 2008 |
| BA  | Mata na estrada entre Maraú e o distrito de Algodões | -14.12558/-38.991948 | Neves, 2008 |
| BA  | Mata na estrada entre Maraú e Ubaitaba | -14.215853/-39.198629 | Neves, 2008 |
| BA  | Mata na estrada entre Camamú e o distrito de Travesão | -13.988347/-39.165719 | Neves, 2008 |
| BA  | REBIO Mata Escura, município de Jequitinhonha | -16.341856/-41.012016 | Neves, 2008 |
| BA  | Iraquara | -12.24635/-41.622157 | gbif.sibbr.gov.br |
| PE  | Recife | -8.05389/-34.881099 | splink.cria.org.br |
| TO  | Canabrava, Rua Tocantins | -9.2300/-48.2000 | Nicolaevsky, 2011 |
| TO  | Porto Nacional, Rio Tocantins | -10.7000/-48.4200 | Nicolaevsky, 2011 |
| TO  | Barrolândia | -9.8300/-48.7300 | Nicolaevsky, 2011 |
| TO  | BR 101 | -9.800186/-47.867007 | Santiago et al., 2019 |
| TO  | PONTE | -9.700184/-48.350361 | Santiago et al., 2019 |
| TO  | LARES | -11.000202/-48.550371 | Santiago et al., 2019 |
| TO  | LAMON | -9.883520/-48.350361 | Santiago et al., 2019 |
| TO  | MANAL | -11.583546/-47.000306 | Santiago et al., 2019 |
| TO  | ENERM | -12.233554/-48.383699 | Santiago et al., 2019 |
| TO  | ENERR | -12.633560/-47.867011 | Santiago et al., 2019 |
| TO  | Paranã | -12.5500/-47.7000 | Nicolaevsky, 2011 |
| SC  | Florianópolis | -27.583333/-48.500000 | Silva et al., 2009 |
| SC  | Joinville | -26.323886/-48.895783 | taxeus.com.br |
| SC  | Florianópolis, Campeche | -27.676062/-48.486223 | gbif.sibbr.gov.br |
| SC  | Blumenau, Água Verde | -26.908782/-49.13484 | gbif.sibbr.gov.br |
| SC  | Florianópolis, Parque Ecológico do Córrego Grande | -27.59900/-48.5130 | Nakamura, 2015 |
| PR  | Cianorte | -23.66333/-52.605000 | Passos et al., 2006 |
| PR  | Curitiba | -25.425462/-49.3066 | gbif.sibbr.gov.br |
| PR  | Paranaguá, Floresta Estadual do Palmito | -25.520000/-48.509167 | Passos et al., 2006 |
| PR  | São José dos Pinhais | -25.53472/-49.206389 | Passos et al., 2006 |
| PR  | Maringá | -23.425278/-51.938611 | MZEUM s/nº |
| PR  | Parque Barigúi, Curitiba | -25.427778/-49.273056 | Passos et al., 2006 |
| PR  | Mercês, Curitiba | -25.417551/-49.30819 | gbif.sibbr.gov.br |

Abbreviations:

MEL-Museu Elias Lorenzutti
MZUFV-Museu de Zoologia João Moojen, Universidade Federal de Viçosa
MCN-Coleção de Mastozologia do Museu de Ciências Naturais PUC- MINAS
UFMG-BDT Centro de coleções taxonômicas UFMG
ZUEC-MAM Museu de Zoologia da Universidade Estadual de Campinas
FNJV-Fonoteca Neotropical Jacques Vielliard e Museu de Zoologia Adão José Cardoso, Universidade Estadual de Campinas
MBML-Mamíferos Museu de Biologia Professor Mello Leitão
UFES-MAM Coleção de Mamíferos da Universidade Federal do Espírito Santo
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