Composition and diversity of phytophilous cladocerans of oxbow lakes of Southwest Amazonian, Acre state, Brazil

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ABSTRACT: The objective of this study was to inventory the community of cladocerans associated with macrophytes in oxbow lakes of the Chandless River, located within the Chandless State Park, during the local dry season. In three lakes covered with macrophytes, 90 sample units were collected, arranged over nine transects. Twenty species of cladocerans were found, which 16 are new records for the state of Acre. Mascote Lake had the largest abundance and richness, while São João Lake had the lowest indexes. The Shannon-Wiener index points to an average diversity within the work area, probably due to the difference in richness and abundance between the lakes.

Keywords: Cladocera; Freshwater; Macrophytes; Species Inventory.

Composição e diversidade de cladóceros fitófilos de lagos de meandro do sudoeste da Amazônia, estado do Acre, Brasil

RESUMO: O objetivo desse estudo foi inventariar a comunidade de cladóceros associados às macrófitas aquáticas em três lagos de meandro do rio Chandless, dentro do Parque Estadual Chandless, no período da estação seca local. Em três lagos com cobertura de macrófitas foram amostradas noventa unidades amostrais, dispostas ao longo de nove transectos. Foram encontradas vinte espécies de cladóceros, sendo que desses dezessete são novos registros para o estado do Acre. O lago Mascote foi o que apresentou maior abundância e riqueza, enquanto o lago São João foi o que apresentou as menores. O índice de Shannon-Wiener aponta para uma diversidade dentro de valores locais conhecidos, provavelmente por conta da diferença da riqueza e da abundância entre os lagos.

Palavras-chave: Cladocera; Água Doce; Macrófitas; Inventário De Espécies.
Introduction

Tropical varzea Amazon ecosystems undergo regular changes in water level, whose fluctuation can exceed 10 meters (Correa & Winemiller 2014, Junk et al. 2014). These flood pulses are reflected in all local fauna and flora, even those of oxbow lakes, which are formed due to the process of sedimentation and erosion of the river beds (Junk et al. 2014, Esteves, 1998). To aquatic plants, the flood pulse promotes an homogenizer effect (Thomaz et al. 2007). These local flood pulses are extremely important for the local diversity of cladocerans (Guntzel et al. 2010), including those that interact with aquatic plants, the phytophilous cladocerans.

Aquatic plants confer important habitat heterogeneity in aquatic environments, and the unique spatial structure of plants is important for the growth and survival of the other aquatic organisms (Dibble & Thomaz 2006, Suzuarana et al. 2016), such as phytophilous cladocerans. The high ecological plasticity of the macrophytes make these plants potential colonizers of a huge variety of aquatic ecosystems (Pompeo 2008). In contrast, several taxa of cladocerans are specialized in colonizing these environments, presenting evolutionary adaptations for this way of life (Fryer 1995).

The scarcity of data on phytophilous cladocerans makes it difficult to understand the relationship of this group with macrophytes, although more than two-thirds of the known cladocerans are associated with this group of plants (Elmoor-Loureiro 2000). However, Forró (2008) estimated that the fauna of freshwater cladocerans is two to four times richer than what is currently known, which indicates that this number may be even higher. The author also pointed out that half of the most common species in Brazil are from typically coastal families. In general, the cladocerans reach their largest diversity in lentic environments (Rocha et al. 2011), because they present better conditions for this type of organism, specially when we consider that most of the species are not effective swimmers (Bolduc et al. 2020).

Another contribution to the scarcity of phytophilous cladocerans data is the frequency of most studies in the limnetic zone. Ghidini et al. (2017) focused his study on the cladocerans associated with Eichhornia azurea (Pontederiaceae) in the central Amazon and already warned about the scarcity of similar studies in the region. Despite this, there is a recent effort to increase knowledge about the group (eg Guntzel et al. 2010, Souza et al. 2013, Ghidini et al. 2017). However, the group continues to be scarcely sampled in the Amazon.

When analyzing the species of cladocerans registered for Acre state, we found only 17 records. These records were made in studies that covered zooplankton as a whole group (Sendacz & Melo-Costa 1991, Keppeler & Hardy 2002, Keppeler 2003a, Keppeler 2003b, Keppeler & Hardy 2004, Oliveira et al. 2010, Silva et al. 2012, Santos et al. 2013, Silva et al. 2014, Nascimento & Keppeler 2017a, Nascimento & Keppeler 2017b), but most of them were focused on rotifers. One species of the Euryceridae family, one species of Ilyocypridae, two species of Bosminidae, two species of Moinidae, three species of Sididae, four species of Chydoridae and four species of Daphniidae are registered. However, it is worth pointing out that almost all of these records came from studies carried out in the limnetic zone, which probably resulted in a species composition quite different from what could be collected in the coastal zone.

Studying phytophilous cladocerans becomes relevant, especially because of their great bioindicator potential, and a greater understanding of this group should help in understanding their contribution to the stability and maintenance of aquatic systems (De Eyto et al. 2002). In addition to the aforementioned little knowledge of the group, the importance of these studies is reinforced when it is considered that the diversity of cladocerans increases as the available vegetation abounds to be used as their ecological niches (Bolduc et al. 2020). Therefore, the objective of this study was to evaluate the composition and abundance of cladocerans associated with macrophyte beds in oxbow lakes in the southwestern Amazon and make new records for the group in the state of Acre. We theorize that local diversity would be high, given the seemingly favorable conditions for this.

Material and Methods

1. Study area

This study was carried out in three oxbow lakes from the Chandless River, located in the municipality of Manoel Urbano-AC, within the geographical limits of the Chandless State Park. Chandless State Park (Parque Estadual Chandless- PEC) is an Integral Protection Conservation Unit (IPCU) and it was created by decree 10.670, of September 2, 2004, with 695,303 ha, which also cover part of the municipalities of Sena Madureira and Santa Rosa do Purus (Acre 2010).

Located in the center-south of the state of Acre (Figure 1), bordering the Brazilian border with Peru, the Chandless State Park is the largest conservation unit in the state, with an open rainforest as dominant vegetation, in addition to the dominance of bamboos (Mielke et al. 2010), which is typical of the region. The local climate at PEC is hot and humid, with an average temperature above 18°C (Acre 2010). A monsoon climate is a main characteristic of the region, with a moderate dry season and an average monthly rainfall of less than 60 mm (SEMA 2010). In this part of the state, the dry season runs from June to September, considering the previous and subsequent months as transition months (Acre 2012).

Figure 1. Map indicating the location of Chandless State Park (Parque Estadual Chandless- PEC) and the lakes available for the study (Buião lake, Mascote lake and São João lake).

According to the Sioli classification (1984), the lakes, created by the river as well, have white waters, that are subjected to the annual flood pulse of the river, which carries nutrients into the lakes. They vary in length, but all are at least 1,000 meters long. The study was carried out only in
the dry season (July 2019), due to the reduction of lake area that occurs at that time, increasing the chances of finding individuals in abundance.

The region has lakes along the Chandless River, at the north end of the park. Of these lakes, only three were able to carry out the study, due to the size of the macrophyte beds. Still, the beds had different successional stages on the lakes.

2. Data collection and analysis

In each lake, three transects of 200 m were sampled, two of them at the lakes ends and the third at the center of the lake. Within each transect, ten sample units were made, with a distance of 20 m between them. In each sample unit, 50 cm X 50 cm, two samples of cladocerans were collected, a quantitative sample and a qualitative sample. The quantitative samples were taken with the aid of bucket and filtered through a 100 μm mesh zooplankton conical net, 100 L of water in total was filtered to sample the macrophytes. For qualitative samples, macrophytes were collected inside the sample unit with the D grid, also with 100 μm mesh. The macrophytes and collected water were poured into a polyethylene container, where the macrophytes were washed and returned. The resulting water was also filtered through the 100 μm conical zooplankton mesh.

All samples were labeled and stored in 100 mL bottles. The collected micro-crustaceans were anesthetized with carbonated water (25 mL) and subsequently fixed in alcohol (final concentration at 70%), according to the methodology of Pinto-Coelho (2004). Analyses of the samples of phytophilous cladocerans were set at the Limnology Laboratory of the Federal University of Acre - UFAC, with the aid of an optical microscope. Due to the low number of organisms found in the pilot collection, the samples were analyzed in their entirety. The identification keys of Smirnov (1971), Smirnov (1976), Korovchinsky (1992) and Orlova-Bienkowskaja (2001) were used.

A multiparameter probe (model Akron AK87) estimated the temperature, pH, dissolved oxygen and electrical conductivity, while turbidity was determined with an Intrustrthem turbidimeter and depth and transparency were measured using a Secchi disk. These measurements were carried out close to the macrophyte beds of the transect to be collected in at a standardized time, totaling nine collections of physical-chemical parameters. In addition, we checked the macrophyte species composition to provide an improved differentiate of the lakes.

The importance of limnological variables for cladoceran community occurrence and abundance was quantified through a Redundancy Analysis (RDA), preceded by standardization (Legendre & Legendre 2012). Limnological variables were standardized (method: standardization) with mean = 0 and standard deviation = 1. The abundance data were also transformed by Hellinger (Legendre & Gallagher 2001) before the analysis, as this procedure produces precise estimates of the percentage of variation explained by the predictor variables (Peres-Neto et al. 2006), reproducing a species matrix (Hellinger) as a function of abiotic variables. The significance of the influence was obtained from 999 permutations, defining the significance for the axes together (Legendre & Legendre 2012). To determine whether the variables were significantly correlated with each other, Pearson’s correlation was performed. If there was a correlation between them, one of the correlated variables would be discarded.

The frequency of occurrence and the Dajoz Index (Dajoz 1973) was used to classify the cladocerans species as accidental (occurrence below 25%), accessory (occurrence between 25 to 50%) and constant (occurrence in more than 50% of the samples), calculated from the formula \( c = p \times 100/P \), where \( p \) is the number of samples containing the species and \( P \) is the total number of samples. For the analysis of diversity of phytophilous cladocerans, we used the Shannon-Wiener index, whose formula is \( H = \sum (pi \times \ln pi) \), where \( pi \) is the relative abundance of each species and \( H \) is the Neperian logarithm of relative abundance.

The analysis were performed with the aid of the Vegan (Oksanen et al. 2013) and Psych (Revelle 2020) packages in the RStudio software (R Core Team, 2020), considering the 5% significance level.

Results

Regarding macrophytes, the three lakes showed dominance of different species, despite having the common characteristic of the abundance of macrophytes. At Buião Lake, which had well-established beds all through its surface, in addition to some loose beds, the species Oxyccaryum cubense (Poep. & Kunth) Palla and Salvinia minima Baker predominated. In Mascote Lake, the predominant species were S. minima and Ricciocarpus natans (L.) Corda, which are pioneer species in the colonization of macrophytes beds; moreover, the beds were small and always on the margins of the lake. Finally, at São João Lake there was no longer any surface water free of macrophytes. The dominant species were Pistia stratiotes L and Utricularia gibba L. The water lettuce (P. stratiotes) organisms almost completely cover the water surface, and the few vacant spaces are filled by U. gibba individuals, who intertwine among the roots of water lettuce, forming a continuous network, making navigation within the lake difficult, which shows an advanced stage of colonization of macrophytes in the lake.

Besides the difference in the composition of the species of macrophytes in the lakes, their dissimilarity in limnological variables was also notable (see Table 1). Buião Lake is the deepest (\( \bar{X} = 1.65 \) m deep in the vicinity of the macrophyte beds), the least turbid and with the largest transparency (\( \bar{X} = 7.08 \) UNT and 55 cm, respectively) and the most alkaline, evidenced by means of DO and pH (\( \bar{X}_{\text{DO}} = 9.93 \) and \( \bar{X}_{\text{pH}} = 7.28 \), respectively). Mascote Lake is shallower (\( \bar{X} = 0.58 \) m) and most acidic, with an average of 26.3°C, 4.63 DO mg L\(^{-1}\), 66.3 μS cm\(^{-1}\) of electrical conductivity and a pH of 6.75. São João Lake also showed a tendency toward acidity, despite presenting the lowest average temperature (\( \bar{X} = 24.2^\circ\text{C} \)), which can be explained by the total vegetation cover of the lake.

During the investigation we found 2,529 individuals of cladocerans among the macrophytes, among them were 20 species, 16 genera and six families (Chydroridae, Daphniidae, Ilyocryptidae, Macrothricidae, Moinidae and Sidaeidae). The Chydroridae family was the most represented in variety (12 species) and abundance (1,641 individuals). The species Ephemeropus hybridus Daday, 1905 was the most abundant species, with 1,109 individuals, while the most frequent species was Oxyurella ciliata Bergamin, 1939, which occurred in 44 of the 90 sample units. Among all the registered species, only four of them (Alonella dadayi, Diaphanosoma spinulosum, Ovalona glabra and Simocephalus latirostris) had previous records for the state of Acre, thus 15 new records were established for the state (Table 2).

The Macrothricidae family was the second most representative, with three species, followed by the Sidaeidae family, with two species. The families Daphniidae, Ilyocryptidae and Moinidae registered only one species and that was in the Buião Lake. In addition to D. spinulosum, two other taxa occurred strictly in one lake. The species Leydigiopsis

https://doi.org/10.1590/1676-0611-BN-2020-1079
In general, in this lake, four species were classified as accessory (Table 3), it is evident that Mascote Lake showed a higher frequency of occurrence than São João Lake. São João Lake did not present an exclusive record. The species *Leydigiopsis curvirostris* and *O. glabra* occurred exclusively in Mascote Lake. São João Lake did not present an exclusive record.

Analyzing the rates of occurrence according to the Dajoz Index (Table 3), it is evident that Mascote Lake showed a higher frequency of occurrence in general. In this lake, four species were classified as accessory and four as constant, compared to three accessory and one constant in Buião Lake and only one constant in São João Lake, which did not present accessory species.

As for the influence of limnological variables, it was found that those that did not show correlation were conductivity, dissolved oxygen, temperature and turbidity. The variation in the community composition was significant (p = 0.024; R² = 0.32). The RDA ordered the collection sites according to the environmental variables, which allowed us to verify how the variables were related to the species composition (Figure 2), according to the direction of the axis.

The RDA results showed that approximately 66% of this observed variation can be explained by the environmental variables selected for the model. The first axis showed that 30.34% of the variation in total abundance is related to electrical conductivity, dissolved oxygen and turbidity, while the second axis indicates that temperature explains 20.41% of the variation in total species abundance.

The Buião lake transects have the largest amplitude of dissolved oxygen than the other lakes. The turbidity variable showed the largest amplitude in the São João lake transects. The species *Leydigiospis ornamenta* and *Kurzia polyspina* however, were related to dissolved oxygen. All species of the Macrothricidae family showed correlation with turbidity.

The Shannon-Wiener index pointed to a diversity of 1.89 for phytophilous cladocerans.

**Table 1.** Limnological variables measured in the lakes. T1 (Transect one); T2 (Transect two); T3 (Transect three); Dep (Depth); Tran (Transparency); Temp (Temperature); DO (Dissolved oxygen); EC (Electrical conductivity); Turb (Turbidity).

| Lakes          | Depth (m) | Tran (m) | Temp (°C) | DO (mg L⁻¹) | EC (μS cm⁻¹) | pH | Turb (UNT) |
|----------------|-----------|----------|-----------|-------------|--------------|----|------------|
| Buião T1       | 1.20      | 0.60     | 25.8      | 13.6        | 133.1        | 7.3| 6.67       |
| Buião T2       | 1.97      | 0.45     | 25.3      | 6.7         | 137.8        | 7.3| 6.28       |
| Buião T3       | 1.80      | 0.60     | 25.3      | 9.5         | 137.1        | 7.3| 8.29       |
| Mascote T1     | 0.55      | 0.15     | 27.6      | 6.0         | 104.8        | 6.7| 13.03      |
| Mascote T2     | 0.45      | 0.15     | 25.6      | 2.3         | 48.3         | 6.8| 17.00      |
| Mascote T3     | 0.75      | 0.45     | 25.6      | 5.6         | 45.7         | 6.8| 16.04      |
| São João T1    | 0.50      | 0.30     | 24.1      | 5.8         | 139.7        | 6.7| 19.31      |
| São João T2    | 1.50      | 0.50     | 24.1      | 1.2         | 132.8        | 6.8| 17.55      |
| São João T3    | 0.15      | 0.15     | 24.3      | 7.3         | 146.8        | 6.8| 16.55      |

**Table 2.** Taxon registered in each studied oxbow lakes with their abundance and species richness. Species with (*) are new records for the Acre state and those that did not show correlation were conductivity, dissolved oxygen, temperature and turbidity. The variation in the community composition was significant (p = 0.024; R² = 0.32). The RDA ordered the collection sites according to the environmental variables, which allowed us to verify how the variables were related to the species composition (Figure 2), according to the direction of the axis.

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The Shannon-Wiener index pointed to a diversity of 1.89 for phytophilous cladocerans.

**Discussion**

The limnological variables of the lakes were within the average fluctuation described by Salimon et al. (2013) for the Purus basin. Despite the strong differences between the lentic environment of the lake and the lotic of the river, the averages found were very similar to that described for the dry season. Ríos-Villamizar et al. (2011) corroborates by adding data for the lakes, where the physical-chemical characteristics were compatible with those found, except for the average transparency (120 cm).

The abundance of phytophilous cladocerans was much larger in Mascote Lake than in the other two lakes. Therefore, it is deductible that this community prefers shallow, turbid waters with a tendency to acidity. When addressing the phytophilous zooplankton of the Paraná River, Chaparro et al. (2016) also found a tendency toward larger abundance in the community when the waters were warmer and with low electrical transparency (120 cm).
Conductivity, characteristics that tend to be similar to those found in Mascote Lake. Although the Buião Lake had a higher correlation with temperature by the RDA, the lake with the highest average temperature was Mascote Lake. Although the Buião Lake had a higher correlation with conductivity, characteristics that tend to be similar to those found in Mascote Lake. These data describe an environment more similar to that found at Mascote Lake. Another factor that may also justify the predilection of cladocerans in this lake is the low biomass produced by the most common macrophyte species in the lake (S. minima and R. natans), which relates less with the reduction of oxygen levels by decomposition (Bianchini Jr. et al. 2008), since oxygenation is also an important factor for the greater abundance of phytophilous cladocerans (Takeda et al. 2003).

The RDA showed a preference of the Sididae, as well as the species *Simocephalus latirostris*, for higher temperatures. This trend had already been described by Zhao et al. (2020). Macrothricidae, however, seem to have a correlation with low levels of turbidity, which can complement the data of Guntzel et al. (2002), who found individuals of this family in abundance in high transparency lakes. The species *Moina minuta*, on the other hand, appears to have a correlation with lower levels of dissolved oxygen (DO), since it appeared at the base of the arrow of this variable in the RDA.

The Chydoridae family, being the largest in number of species in the study, did not present a common pattern of distribution. *Kurzia polypina* and *Oxyurella ciliata* showed a positive correlation with DO; in contrast, the species *Acroperus tupinamba* and *Coronatella cf. monacantha* was correlated with lower DO rates. Similarly, the species *Leydigiopsis ornata* showed a correlation with higher rates of electrical conductivity, in contrast to the species *Chydorus pubescens*, which demonstrated to prefer areas with low electrical conductivity.

The low number of species previously registered for the state of Acre corroborates the idea that the species composition differs largely from the limnetic zone to the littoral zone, even more if the collection in the latter is carried out among the aquatic vegetation, although the majority of the species found are not considered constant by the Dajoz

### Table 3. Absolute frequency and frequency of occurrence (F.O.) of species of cladocerans per lake. The frequencies of occurrence were classified according to the Dajoz Occurrence Index as accidental (until 25% occurrence, in white), accessory (from 25 to 50% occurrence, in light gray) and constant (more than 50% occurrence, in dark gray).

| Family       | Species                        | Buião | F.O. | Mascote | F.O. | São João | F.O. | Total |
|--------------|-------------------------------|-------|------|---------|------|----------|------|-------|
| Chydoridae   | *Acroperus tupinamba*          | 7     | 23.3 | 6       | 20   | 3        | 10   | 16    |
|              | *Alonella dadayi*             | 1     | 3.3  | 8       | 26.6 | 1        | 3.3  | 10    |
|              | *Anthalona verrucosa*         | 5     | 16.6 | 7       | 23.3 | 4        | 13.3 | 16    |
|              | *Chydorus eurynotus*          | 0     | 0    | 10      | 33.3 | 2        | 6.6  | 12    |
|              | *Chydorus pubescens*          | 1     | 3.3  | 3       | 10   | 0        | 0    | 4     |
|              | *Coronatella cf. monacantha*  | 3     | 10   | 5       | 16.6 | 0        | 0    | 8     |
|              | *Ephemeroptorus hybridus*     | 0     | 0    | 20      | 66.6 | 2        | 6.6  | 22    |
|              | *Kurzia polypina*             | 11    | 36.6 | 4       | 13.3 | 0        | 0    | 15    |
|              | *Leydigiopsis curvirostris*   | 0     | 0    | 4       | 13.3 | 0        | 0    | 4     |
|              | *Leydigiopsis ornata*         | 9     | 30   | 16      | 53.3 | 18       | 60   | 43    |
|              | *Ovalona glabra*              | 0     | 0    | 7       | 23.3 | 0        | 0    | 7     |
|              | *Oxyurella ciliata*           | 19    | 63.3 | 21      | 70   | 4        | 13.3 | 44    |
| Daphnidae    | *Simocephalus latirostris*    | 7     | 23.3 | 9       | 30   | 0        | 0    | 16    |
| Ilyocryptidae| *Ilyocryptus spinifer*        | 5     | 16.6 | 19      | 63.3 | 1        | 3.3  | 25    |
| Macrothricidae| *Macrothrix elegans*        | 0     | 0    | 2       | 6.6  | 3        | 10   | 5     |
|              | *Macrothrix paulensis*        | 0     | 0    | 8       | 26.6 | 1        | 3.3  | 9     |
|              | *Streblocerus pigmaeus*       | 2     | 6.6  | 9       | 30   | 5        | 16.6 | 16    |
| Moinidae     | *Moina micrura*              | 7     | 23.3 | 0       | 0    | 3        | 10   | 10    |
| Sididae      | *Diaphanosoma birgei*        | 13    | 43.3 | 24      | 80   | 3        | 10   | 40    |
|              | *Diaphanosoma spinulosum*    | 1     | 3.3  | 0       | 0    | 0        | 0    | 1     |

**Figure 2.** Biplot of the RDA showing the collection sites (LBU corresponding to Buião Lake, LMA corresponding to Mascote Lake, LSJ corresponding to São João Lake) and the relationship of the variables with the species.
Index. Furthermore, even if the other studies in the state have all been carried out in the limnetic zone, the sampling effort for cladocerans is still considerably low, since in a space of 26 years, only 11 studies on zooplankton (including cladocerans) have been published.

Despite being considered a benthic species, Ilyocryptus spinifer Herick, 1882 was a constant species in Mascote Lake. This probably happened because it is the shallowest of the three lakes with an average depth of 0.58 m in the transects. Another factor that may have contributed to the incidence of this species in the study is the abundance of the large grass Panicum aquaticum Poir., which was sometimes fixed or very close to being fixed to the substrate, which may have contributed to this high constancy. The same can be considered for the registration of species of the genus Chydorus, which are also considered benthic.

The Chydoridae, Macrothricidae and the species Simocephalus latirostris Stingelin, 1906 frequently appear in association with macrophytes (e.g., Guntzel et al. 2010 and Sousa et al. 2013) and are referred to as typically limnetic. However, in our study they were mostly found at an accessory frequency (except for Ephemeropus hybridus and Leydioglossis ornata). It is likely that these cladocerans were in the process of colonizing the macrophytes of the sampled lakes.

The species Diaphanosoma birgei Korineck, 1981 appeared as an accessory in Buão Lake and as a constant in Mascote Lake. This species is considered common (Santos-Wisniewski et al. 2011, Maia-Barbosa et al. 2014) and appears frequently among phytophilous cladocerans records (Sipaúba-Tavares & Dias 2014, Sousa et al. 2017), possibly because of foraging among the macrophytes, since it is considered limnetic.

Although 14 of the 20 species are new records for the state of Acre, all of them have previous records for the Amazon. Santos et al. (2014) reports the occurrence of three species on the list for the Madeira River basin, in Rondônia. These are Chydorus pubescens, D. birgei and I. spinifer. More recently, Souza et al. (2019) included the species Anthalona verrucosa, Chydorus eurynotus and Macrothrix elegans among the records for the Madeira basin. Thus, the records of these species closest to the state of Acre were more than 700 km away.

For the other species considered new records, the closest records are from the state of Amazonas. Rocha et al. (2017) recorded the species Oxyarella ciliata and L. ornata in the Amazon river Basin, more than 1,200 km from the points collected in this study. The other taxa were previously registered in the Negro River basin, with Brandorff et al. (1982) those responsible for the registration of Macrothrix paulensis, Ghidini & Santos-Silva (2011) those responsible for the registration of Streblocerus paulensis, Ghidini et al. (2014) reports the occurrence of three species on the list for the state of Acre for the materials provided and SEMA for the logistical and financial support, for this study to take place in the Chandless State Park. The first author also thanks the CNPq grant given during his master’s period.

Acknowledgments

The authors are grateful for the assistance of the Federal University of Acre for the materials provided and SEMA for the logistical and financial support, for this study to take place in the Chandless State Park. The first author also thanks the CNPq grant given during his master’s period.

Author Contributions

Guilherme Sampaio Cabral: Contribution in the concept of the study; data collection; data analysis and interpretation; manuscript preparation; contribution to critical revision, adding intellectual content.

Ronaldo Souza da Silva: Contribution in data analysis and interpretation; manuscript preparation; contribution to critical revision, adding intellectual content.

Ronilda Maria Gonçalves Araujo: Contribution in data analysis and interpretation; manuscript preparation; contribution to critical revision, adding intellectual content.

André Ricardo Ghidini: Contribution in the concept of the study; data collection; data analysis and interpretation; manuscript preparation; contribution to critical revision, adding intellectual content.

Conflicts of Interest

The authors declare that they have no conflict of interest related to the publication of this manuscript.

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