

Activity period of Southern house wren *Troglodytes musculus* Naumann, 1823 (Passeriformes: Troglodytidae) on edges of Atlantic Forest fragments in João Pessoa (State of Paraíba, Northeast Brazil)

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Abstract. Southern house wren *Troglodytes musculus* Naumann, 1823 (Passeriformes: Troglodytidae) is widely distributed in Brazil, occurring on the edges of forests and urban areas, considerable a passeriform usually found in antropized landscape. Birds use vocal signs in diverse activities during the circadian cycle (eg.: in reproduction, territorial defense, alert of predators and competitors, individual recognition, etc), employing vocal signs under energetic balance for development of diary activities. The aim of this study was to evaluate the diary activity period of *T. musculus* through their vocalizations. The sampling were made during two days in edges of Atlantic Forest fragments in João Pessoa, State of Paraíba, Brazil. Using the method of playback, vocal response of Southern house wren was measured in six periods for each day: H1 (5 h-7 h), H2 (7 h-9 h), H3 (9 h-11 h), H4 (11 h-13 h), H5 (13 h-15 h) and H6 (15 h-17 h). Differences among the periods was tested through of Kruskal-Wallis test, and Mann-Whitney test with Bonferroni's corrections. In order to separate the periods groups, was applied Cluster test and non-Metric Multidimensional Scaling. Were registered 2,421 vocalizations, which 2,229 in morning (H1 to H3) and 122 (H4 to H6) in the afternoon period. Results indicated there were differences among the diary activities period of *T. musculus* ($p = 0.0008171$), with early hours of morning (H1 and H2) did not differ between each other

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($p = 0.183$), however differing from the others. The H3 and H6 periods also not differ between each other ($p = 0.784$), but differing significantly from H4 and H5, that did not record no one vocalization ($p = 1$). Cluster analyses support these results, clustering: Group 1 (H1 and H2); Group 2 (H4 and H5) and Group 3 (H3 and H6). The periods with the highest frequencies of vocal sings (Group 1) showed the most favorable conditions to vocalize, be they microclimatic (better sound transmission due lowest wind intensity and air turbulence) or behaviors (females attraction, territorial invasion, etc.). On the other hand, non-recording of vocalizations of Group 2 suggest unfavorable periods to vocalize. In addition, Southern house wren concentrate their energetic reserves foraging in these periods. The intermediary records of Group 3 indicate that the periods H3 and H6 require an expensive energetic cost to vocalize due the lowest success in an effective communication. In that way, this present study suggest there was a pattern in diary activity period in Southern House Wren populations evaluated, with no overlap of activities, complementing the knowledge of the specie biology and behavior.

Keyword: Southern house wren; Period of activity; Vocalization; Edges of Atlantic Forest fragments.

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Introduction

Southern house wren *Troglodytes musculus* Naumann, 1823 (Passeriformes: Troglodytidae) has about 12 cm of total length, is brown colored and it belongs to the Family Troglodytidae, which includes mostly endemic birds in American continent. Their geographic distribution extends from Canada to Southern Chile and Argentina, having the largest distribution in the southern hemisphere (Sick, 2001).

Although it is classified as insectivorous (Marini, 2001; Blendinger, 2005), Southern house wrens also eats seeds and fruit (Voss and Sander 1980; Sick 1997). *T. musculus* uses a wild range of habitats, occurring in forest edges and on Cerrado biome, even urban environment as gardens and houses, nesting in almost any place with a hole, like woods, cracks, roofs or abandoned nests (Sick, 2001). Such as other family members, this species has high vocalization quality, which is hard to

paraphrase (Sick, 2001), and is capable of forming duets during mating. However, this species can present cases of polygamy during mating season as highlighted by Llambías (2012).

Acoustic signals are very important for some animals in several aspects (Maynard-Smith and Harper, 2003). Birds vocals signals assist in reproduction (males attracting females and stimulating them), territory defense (males repelling rivals), individual recognition and warning for predators and competitors (Kroodsma and Byers, 1991; Fasanella and Fernández, 2009). Despite the advantages and disadvantages in using of vocal songs, it still was an evolutionary success to the majority of bird families (Slabbekoorn and Smith, 2002).

Birds perform various activities during their circadian cycle. They have different behaviors along the day like singing, foraging and resting, for example. The energetic balance seems to be a key factor that influences the

frequency and time in which Southern House Wren sings (Thomas, 2002). Thus, the purpose of this study was to evaluate the periods of daily activity of *T. musculus* by its vocalizations.

Metodology

Study areas

Sampling was carried out on Atlantic Forest fragments edges in two locations (Figure 1), Mata do Buraquinho (07° 06' S, 34° 52' W) and Mata do Cuiá

(7° 11' S, 34° 51' W), in Municipality of João Pessoa, State of Paraíba, Northeast Brazil, during Sept. 6 and 7, 2016.

Due the construction of the BR-230 highway the Mata do Buraquinho forest was divided in two fragments, a continuous forest of 471 ha protected in "Refúgio de Vida Silvestre Mata do Buraquinho", and 11 small fragments inside of the limits of the Federal University of Paraíba *campus* (Dias, 2006).

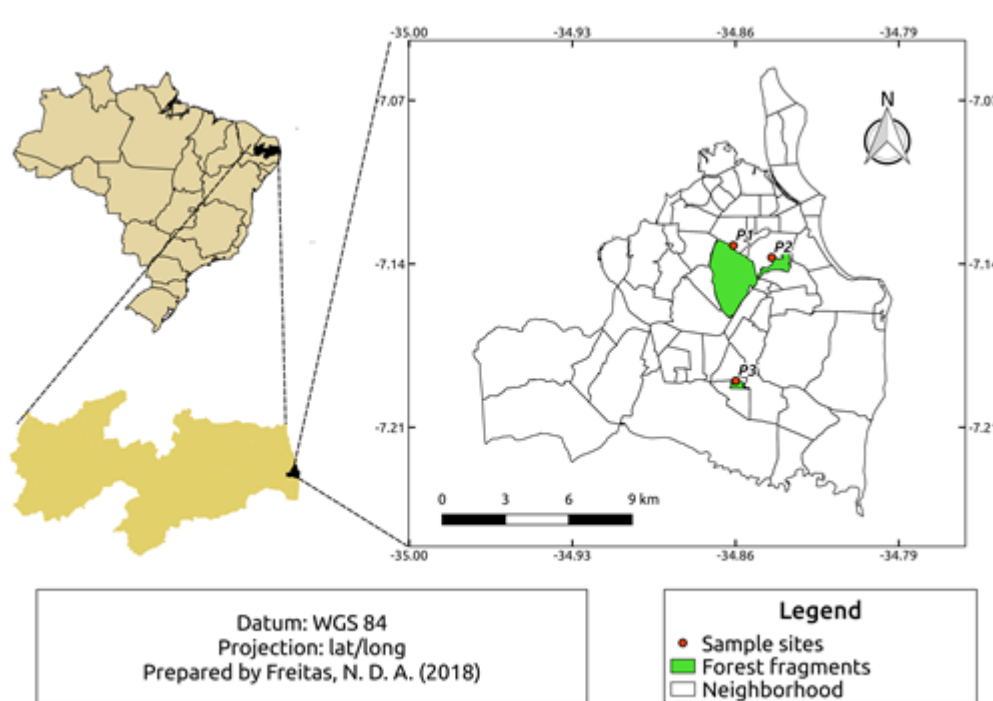


Figure 1. Detail of the study areas and sampling points.

Mata do Cuiá (20.8 ha) is located at the Parque Natural Municipal do Cuiá that has areas of intensive and restricted use (Lima, 2012). The relief of the area presents coastal sedimentary plains or tablelands (dominant form), characterized by surfaces that interpose, dividing the river basin development of Cuiá. Mata do Cuiá represents a remnant of vegetation of the Atlantic Forest biome at an advanced stage of regeneration,

representing 49.44% of the total area of the Parque Natural Municipal do Cuiá, being considered as the sector of greater relevance for conservation, therefore, of restricted use (Silva and Braga, 2017).

According to the climatic classification proposed by Köppen (1901) and Alvares et al. (2014), the climate of the region is As', characterized by being hot and humid, which exerts strong conditioning on the local

environment. The rainy season begins in March and runs through August. The dry season begins in September and lasts until February. Temperature indices vary between 26 °C-27 °C and annual average rainfall does not normally exceed 2,000 mm (Silva and Braga, 2017).

Sampling design

Were established three collection points at the edge of the forest board fragments:

P1 - located next to Refúgio de Vida Silvestre Mata do Buraquinho (7° 07' 55.4" S, 34° 51' 39.1" W)

P2 - located in the domains of the campus I of Universidade Federal da Paraíba (7° 08' 14.2" S, 34°50'40"W), and

P3 - located in Geisel Neighborhood near to Mata do Cuiá (7° 11' 24.4" S, 34° 51' 35.4" W).

These samples were collected during 12 h for two days (n = 24 h) in six different periods: H1 (5 h-7 h), H2 (7 h-9 h), H3 (9 h-11 h), H4 (11 h-13 h), H5 (13 h-15 h) and H6 (15 h-17 h).

Was used the playback method to incite the birds vocal response or approach and facilitate visual

observation. This method consists in reproducing the song and/or calling of one specific specie using a sound source (e.g. loudspeaker) (Grazinoli and Motta-Junior, 2010). The goal was to quantify the vocal response of *T. musculus* during the different periods.

Statistical analysis

To analyze the period of *T. musculus* individual's activity was used the Kruskal-Wallis Non-Parametric Test and the Manna-Whitney Test, with Corrections of Bonferroni. The purpose was to identify differences between the sample periods. The data was submitted to the Shapiro-Wilk Normality Test and Levene Homoscedasticity Test.

In order to identify groups in relation of sample periods, Cluster's multivariate analyses and non-metric multidimensional scheduling were performed, both using Bray-Curtis Similarity Index. All analyses were performed in Past software.

Results

A total of 2,421 vocalizations (Figure 2) were recorded, being 2,299 in the morning (H1 to H3) and 122 (H4 to H6) in the afternoon (Figure 3).

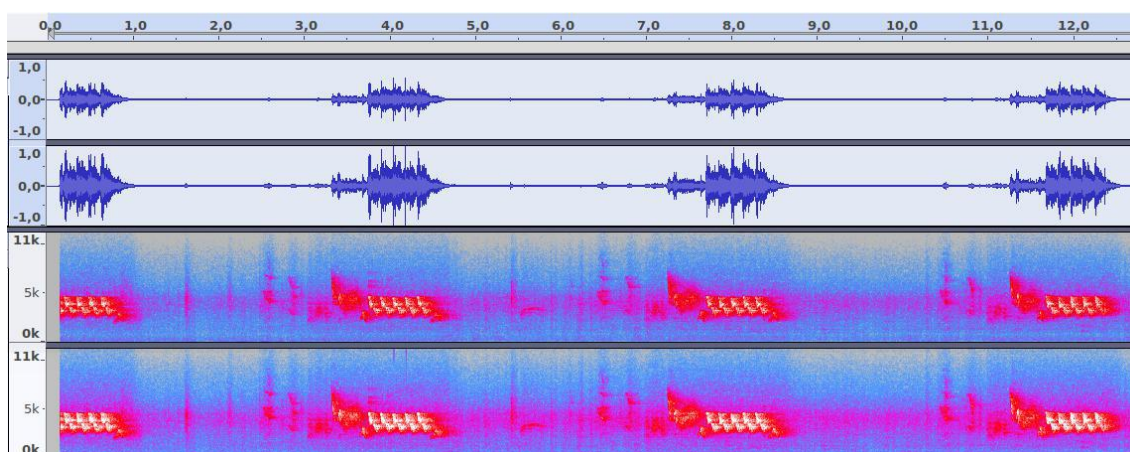


Figure 2. Southern house wren vocalization sonogram collected at sampling point P1 (next to Mata do Buraquinho Wildlife Refuge). Time (seconds) x Frequency (KHz). The colors represent the height of the vocalization, with light tones (blue) representing the sharp sound and dark tones (red) representing the bass sound.

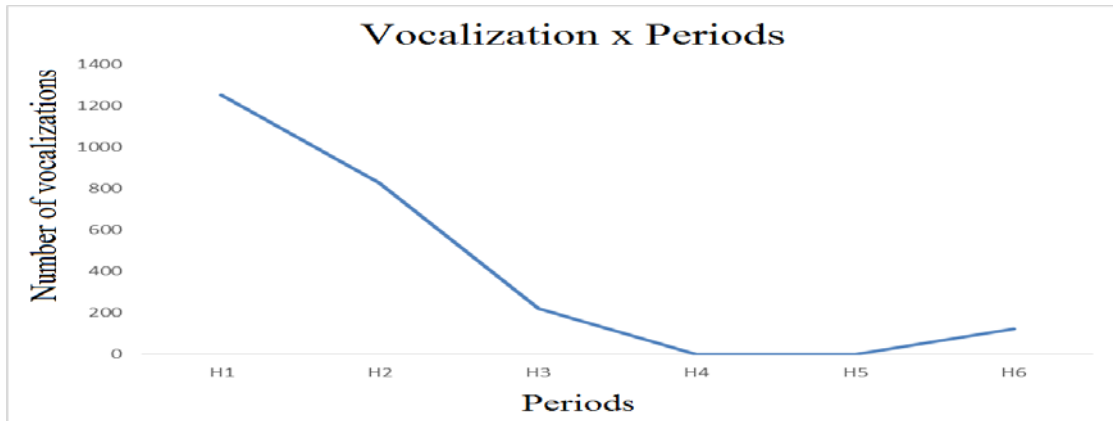


Figure 3. Number of vocalizations x sample period of Southern house wren individuals.

In face of non-normality and heteroskedasticity of the data, the Kruskal-Wallis Test indicated that there are differences in periods of activity of *T. musculus* ($p = 0.0008171$). The posteriori test showed that individuals of Southern House Wren presented a pattern in the species activity period, with the first hours of the morning (H1 and H2) not differing between them

($p = 0.183$), but were distinct from the others. The H3 and H6 periods also showed differences ($p = 0.784$), but were significantly different from H4 and H5, which did not present any vocalization record ($p = 1$).

Cluster analysis indicates the clustering of H1 and H2 (80% of similarity) and the isolation of H4 and H5 (Figure 4).

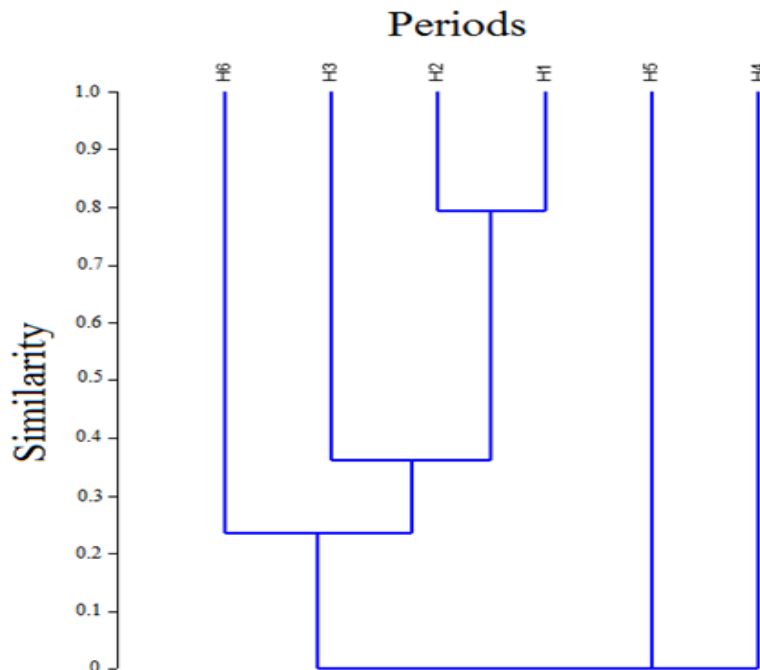


Figure 4. Cluster analysis of the sample periods of Southern house wren individuals.

The non-metric multidimensional scheduling (nMDS) analysis also indicate the formation of 3 groups: Group 1: H1 and H2, with the highest vocalization

values; Group 2: H4 and H5, with the lowest values; Group 3: H3 and H6, that presented the intermediated values between the other groups (Figure 5).

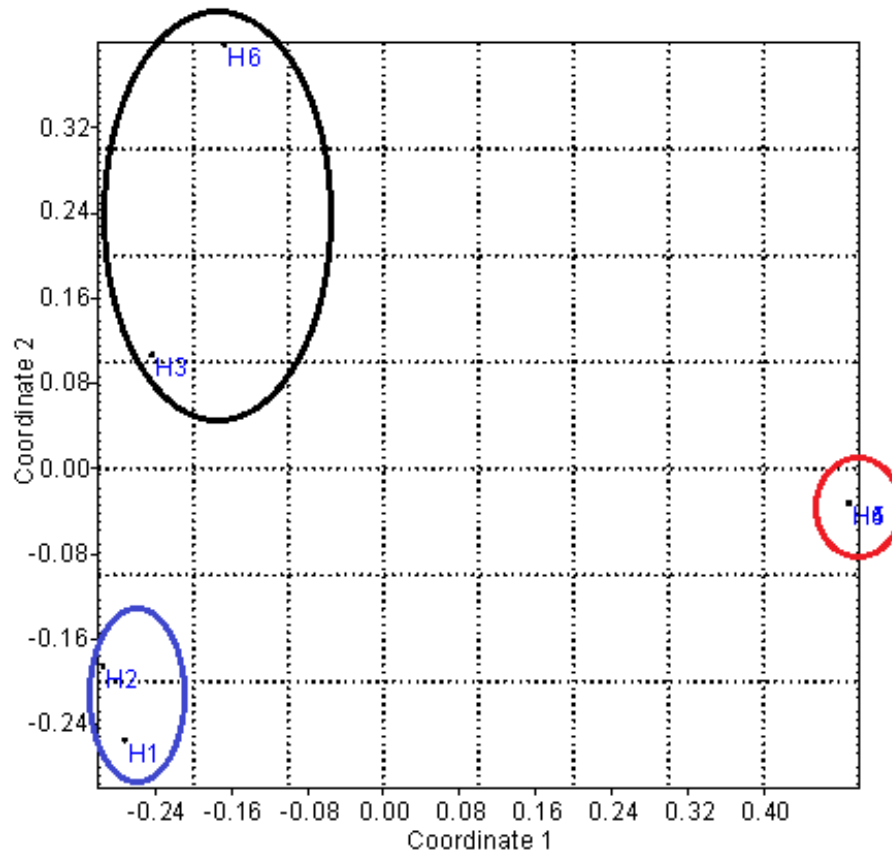


Figure 5. Non-metric multidimensional scheduling (nMDS) analysis. Group 1 (H1 and H2) in blue, Group 2 (H4 and H5) in red, and Group 3 (H3 and H6) in black.

Discussion

Bird songs requires muscle and neural activities, expending a considerable amount of energy. Southern House Wren sing more when body reserve is high, foraging success has been satisfactory or when environmental conditions are not metabolically demanding (Thomas, 2002). In other words, the periods with the highest singing frequencies (H1 and H2) may represent the periods with more favorable conditions for the vocalization.

Several hypotheses attempt to explain why the frequency of bird song is higher at dawn (Mace, 1987). According to Kacelnik and Krebs (1982) there are three possible explanation: 1) The transmission of sound is particularly more effective at this time of day, because certain microclimatic conditions are favorable for the sound transmission, such as low wind intensity and air turbulence; 2) The low level of light found at these times make it impossible for most of the birds to forage, as it makes it difficult to locate prey visually.

In addition, insectivorous species as *T. musculus* have greater difficulty in locating prey at dawn due to the mild temperature recorded during this period reduce the activities of invertebrates. Birds do not overlap their daily activities (Thomas, 2002), population of Southern House Wren can reserve this time of day for the emission of songs; 3) Due to the availability of territory at dawn, due to mortality at night. With this, newly arrived males seek the invasion of territory, and singing is an important tool for such activity. Southern House Wren are rather territorialist (Pereira, 2015), with several reports of elimination of competitors intra and interspecifically from their territories. It is also known that Southern House Wren invade other birds nest to destroy their eggs without even feeding on them (Santiago, 2009).

The morning choir is also related to reproduction, affecting the frequency of singing in birds. Males tend to increase it to attract a female (Dias, 2013), to ensure paternity through guarding female, chasing away rivals and attempting extra-pair copulation (Mace 1986, 1987) or by combining all these functions in their songs (Catchpole and Slater, 2008).

The periods with the highest temperatures and luminosity values are recorded during and close to noon in the city of João Pessoa (Santos et al., 2012), including sample periods (H4 and H5). No vocalization of *T. musculus* was recorded in these periods representing periods of the day that was unfavorable to the practice of singing activity. According to Henwood and Facrick (1979) model, the transmission at dawn could be up to 20 times more effective than at noon. Considering the Kacelnik and Krebs (1982) explanations mentioned above, the high temperature and luminosity found during the periods around noon (H4 and H5) in João Pessoa,

increase the detection of preys by birds. In this way, they concentrate their energetic reserves for the practice of foraging in these periods.

According to Siciliano and Tavares (2011), the periods with highest activity of birds are in the early hours of the day, until 10am, or in the late afternoon, from 3pm to sunset. The H3 and H6 periods comprise the end of the vocalization activity in the dawn and dusk, respectively. These periods represent a expensive energetic cost to vocalize due the lowest success in a effective communication. Santos (2014) states that the most bird species have peak of vocalization in the late afternoon, when they begin to look for places to stay overnight. That means that singing serves as a form of communication and possession of territory.

Conclusion

The individuals of *Troglodytes musculus* evaluated sing more frequently in the early morning and less frequently at dusk, with an intercalated period without vocal record. The dawn is the period with greater activity of Southern House Wren to present the greatest records of marking or invasion of territory (favorable environmental conditions to the dissipation of vocals) and less successes in foraging, reserving this period to the emission of songs.

The periods nearly to midday were less effective for the transmission of songs in relation to the dawn and the resumption of acoustic records at dusk due to the search and demarcation of places to stay overnight.

Supplementary material

Supplemental material including one sound file can be found with this article online at <https://doi.org/10.21472/bjbs.050914-s>.

Conflict of interests

The authors declare that there are no conflicts of interest.

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