Aspects of the activity rhythm and population size of troglophilic mygalomorph spiders (Trechona sp., Dipluridae) in a quartzite cave in Minas Gerais, Brazil

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Records of mygalomorphs inhabiting caves have increased in the past years. We present data on a population of Trechona sp. spiders, found in a quartzite cave in Diamantina, Minas Gerais, Brazil. The spiders and their retreats were marked, and this population was followed for 17 months. The population consisted of up to 100 individuals, comprising the world’s largest known cave-dwelling population of mygalomorphs. The estimated population size (Jolly-Seber model) varied from 50.36 to 853.43, the latter considered much overestimated. We did not find individuals of Trechona sp. in the surrounding epigean areas. The number of spiders was higher in the entrance zone than in the other two zones (twilight and dark zones). We found that individuals at the entrance zone showed similar activity to a nocturnal spider, whereas the other two groups showed conspicuous differences from this pattern, spending longer periods without rest, on the sheet-web as a sit-and-wait predator.

Keywords: subterranean; circadian cycle; sheet-web; mygalomorphs

Introduction
Spiders of the infraorder Mygalomorphae, which includes tarantulas, trapdoor spiders and other less-known groups, are mostly sedentary, ground-dwelling and relatively large sized (Hedin and Bond 2006). They may shelter underneath rocks and trunks, in caves (Pinto-da-Rocha 1995; Bernardi et al. 2007), and in some cases build their retreats (trapdoors or sheet-webs). Recent data have compiled a considerable number of records of mygalomorph spiders in caves (Ferreira et al. 2011). However, numerous populations of mygalomorph spiders inside caves are rarely witnessed, and only one publication (Bernardi et al. 2007) reported a estimated population of 21 individuals of cave-dwelling spiders of the genus Lasiodora (Theraphosidae) in an arenitic cave in the municipality of Ataléia, north-eastern state of Minas Gerais.

The family Dipluridae comprises spiders with very long posterior lateral spinnerets that spin great amounts of silk. They commonly build sheet-webs or deposit some web on the entrance of their funnel retreat. There are five genera in Brazil: Diplura, Linothele and Trechona (Diplurinae); Ischnothele (Ischnothelinae) and Masteria (Masteriinae) (Raven...
Spiders of the genus *Trechona* are large (up to 50 mm body length) and may live inside burrows that they dig or occupy underneath logs or stones in the forest ground (Pedroso and Cerqueira-Baptista 2004). According to Pedroso and Cerqueira-Baptista (2004), they usually cover the hole with a silk veil and no sheet-web is built. This web architecture differs from those of other diplurid genera, that build a web composed of two functionally distinct parts, a tubular retreat in an enclosed space and an exposed capture web (sheet-web) (Coyle 1995; Eberhard and Hazzi 2013). Spiders of the genus *Trechona* have been recorded in the Atlantic Forest, in Brazil, from the states of Bahia to Rio Grande do Sul (Pedroso 2009; Azevedo and Pedroso 2010). During an inventory of arachnids in a quartzite cave in Diamantina, Minas Gerais, Brazil, carried out during 2010–2011, we found a population of *Trechona* sp. spiders. These spiders were found in all parts of the cave: at the entrance, which is considered the transition between the hypogean and epigean environments and where the amount of light and humidity is very similar to the epigean environment; at the twilight zone, where there is still some light, but temperature and humidity vary less than at the entrance zone; and at the dark zone, characterized by the complete absence of light and stability of temperature and humidity (Poulson and White 1969). The great number of spiders found in this cave drew our attention and led us to conduct a survey regarding some biological aspects of this population. The objectives of the present study were (1) to evaluate the size of the population and the occupation of distinct parts of the cave; (2) to investigate whether these spiders change the location of the web; and (3) to evaluate whether there is any difference of activity rhythm among spiders of distinct cave regions.

**Materials and methods**

**Study site**

The cave, named Monte Cristo (18°17′49.79″ S; 43°33′30.5″ W) is located at the Serra do Espinhaço, Diamantina Plateau, approximately 10 km from Diamantina city centre, Minas Gerais, Brazil. The epigean environment presents a typical phytophysionomy called ‘*Campos Rupestres*’, which means ‘rocky fields’, that belongs to the Cerrado domain and is characterized mainly by the presence of plants belonging to the families Asteraceae, Melastomataceae, Gramineae, Cyperaceae, Cactaceae, Eicaceae, Leguminosae, Velloziaceae, Eriocaulaceae, and Xyridaceae (Silva et al. 2005). This quartzite cave extends to 250 m of length, predominately horizontal and with two distinct entrances. The main entrance (Figure 1) extends for approximately 30 m of width. The second entrance has approximately 40 cm of diameter creating a dim environment in the cave. Inside the cave, rocks of different sizes are found scattered on a sandy soil.

The cave was divided into three regions, traditionally separated by the amount of light and variation in temperature and humidity (Poulson and White 1969): entrance zone (EZ – mean temperature of 20.8°C and 80.5% of humidity), twilight zone (TZ – mean temperature of 19.4°C and 81.8% of humidity) and dark zone (DZ – mean temperature of 19.1°C and 84.5% of humidity). This division, although arbitrary in many cases, followed specific characteristics of the cave: the transition between EZ and TZ is marked by a small passage followed by a steep slope, and the transition between TZ and DZ is a very narrow passage, where it becomes totally dark. The whole area considered as entrance zone, in this particular cave, is approximately twice as large as the other two zones.
Fieldwork

The study took place from January 2010 to May 2011, through monthly visits to the cave, except for July 2010, August 2010, February 2011 and April 2011. We started the observations two hours before dusk, extending until we had surveyed the maximum number of spiders for the night, and no more additional individuals were observed. For the first three months we focused only on marking spiders and their respective webs. We individually marked the carapace of the spiders with nontoxic paint (Acrilex™ paint; Acrilex, São Bernardo do Campo, São Paulo, Brazil) and their webs were marked with a numbered adhesive tape, with only webs that had spiders being marked.

In order to estimate the population size, we used the Jolly-Seber model (Model A, allowing both death and immigration), which provides an estimation for each occasion, except the first and last ones. We used the software JOLLY (Pollock et al. 1990) to estimate population size.

After the fourth month, we started to investigate the activity of the spiders in different parts of the cave. Three observers, each one located in a different zone (EZ, TZ and DZ), took shifts every 30 minutes, starting before night (dusk – first shift) and at the beginning of the day (dawn – second shift), and checked whether the spiders were active (located on the sheet-web or at the entrance of the funnel with the legs spread – Figure 2). We considered the spider as active following Coyle’s (1995) observations of prey capture by Ischnothelinae spiders, which are diplurids with similar web architecture. According to Coyle (1995), these spiders tend to rest deep in the retreat during the day and respond less quickly to prey than at night, when they stay at the entrance on the sheet-web. On three occasions we spent 24 hours observing the presence of the spiders at their webs, in order to complete the whole daily cycle.

We also conducted collections in the surrounding areas of the cave using two methods: active search and pitfall traps. Active search consisted in searching for sheet-webs and/or individuals of Trechona sp. under stones and fallen trunks, among low vegetation, tree trunks and roots. The total amount of active search was 20 hours (one hour searching × four collectors × five distinct dates) and took place after nightfall. For
pitfall traps, with the objective of collecting wandering males, we used plastic recipients of 500 ml and buckets of 30 l. For the 500 ml recipients, we installed 100 units, in a straight line in two different sets (50 each). These recipients were half filled with 80% ethanol and were left opened for five nights. For the 30 l buckets, we installed three sets of four recipients each, with a plastic fence between two buckets, which were approximately 2 m from each other. These sets were left open for five nights, and we did visits in the subsequent morning. Collecting with pitfall traps (both types) took place in November 2011, January 2011, June 2011 and July 2011.

Results
After 17 months, we had marked a total of 100 individuals of *Trechona* sp., including females and juveniles. Despite the searching and collecting efforts, including the pitfall traps, no males were collected during the survey. The examination of two voucher specimens (two females, from Monte Cristo Cave, Diamantina, Minas Gerais, J.P.L. Guadanucci *leg.*, September 2009, deposited at Arachnological Collection in Diamantina, CAD 028) revealed distinct spermathecae morphology when compared to the remaining valid species, therefore representing an undescribed species (pers. obs.). The description of this new species, which will be dealt with elsewhere, is pending the finding of a male specimen and spiders from other nearby regions. Other individuals of the same species were collected in another cave, namely Salitre cave, which is approximately 3 km from Monte Cristo cave.

Dates of marking, last recapture and times of recaptures of each individual are shown in Table 1. Of the 100 individuals marked, we recaptured 77% of the spiders at least once, and they were in the same web that was previously marked, except for individual number 20, which moved from the entrance zone into the twilight zone (Table 1). This spider was first marked in January 2010 in EZ, recaptured in the two subsequent visits in the same web, and then recaptured in TZ in September 2010, where it established a new web and was last recaptured in May 2010. The webs (Figure 2) consisted in a tubular retreat under a stone or at corners of the cave, and a sheet-web.

The estimations of population size are shown in Table 2. The size of the population, which is calculated for each occasion, varied from 50.36 ± 15.43 in February
Table 1. List of all individuals of *Trechona* sp. marked and recaptured (grey cells) per monthly visit. EZ = entrance zone; TZ = twilight zone; DZ = dark zone. Individuals marked with an asterisk (*), are those never recaptured. Grey cells with ‘X’ are the date of the first marking of each spider. Spider number nine had only its exuvia found in May 2010 and the marking was lost. Spider number 20 moved from EZ to TZ in September 2010.

| Zone   | 2010 | 2011 |
|--------|------|------|
|        | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Sep  | Oct  | Nov  | Dec  | Jan  | Mar  | May  |
| 1* EZ  | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 4 EZ   | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 5 EZ   | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 6 EZ   | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 7 EZ   | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 9 EZ   | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 10 EZ  | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 15 EZ  | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 16 EZ  | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 19 EZ  | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 20 EZ/TZ | X |      |      |      |      |      |      |      |      |      |      | Moved |      |
| 21 TZ  | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 22 TZ  | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 23* TZ | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 13 EZ  | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 17 EZ  | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 25 TZ  | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 26 DZ  | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 27 DZ  | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| 28 DZ  | X    |      |      |      |      |      |      |      |      |      |      |      |      |
| Zone | 2010 | 2011 |
|------|------|------|
|      | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |
| 29   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 30   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 31   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 32   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 33   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 34   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 35   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 36   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 37   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 38   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 39   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 40   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 41   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 42   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 43   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 44   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |
| 45   | EZ   | X    | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   | EZ   |

(Continued)
Table 1. (Continued).

|    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 46 | EZ | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 47 | EZ | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 48 | TZ | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 49 | TZ | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 50 | TZ | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 51 | TZ | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 52 | TZ | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 53 | DZ | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 54*| DZ | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 55 | DZ | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 24 | EZ |   | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 56 | EZ |   | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 57 | EZ |   | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 58 | TZ |   | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 59 | TZ |   | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 60 | TZ |   | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 61*| TZ |   | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 62 | TZ |   | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 63*| DZ |   | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 11 | EZ |   | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 64*| DZ |   | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 65 | DZ |   | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 66 | DZ |   | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 67*| DZ |   | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

(Continued)
| Zone | 2010 | 2011 |
|------|------|------|
|      | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |
| 88   | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 69   | DZ   | DZ   | DZ   | DZ   | DZ   | DZ   | DZ   | DZ   | DZ   | DZ   | DZ   | DZ   |
| 70*  | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 71   | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 72   | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 73   | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 74   | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 75   | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 76   | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 77   | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 78   | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 79*  | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 80   | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 81   | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 82   | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 83*  | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 84   | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 85*  | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 86*  | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 87   | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |
| 88   | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    | X    |

(Continued)
Table 1. (Continued).

|   |   |
|---|---|
| 89* | TZ |
| 90* | EZ | X |
| 91  | EZ | X |
| 92  | EZ | X |
| 93  | EZ | X |
| 94* | EZ | X |
| 95  | EZ | X |
| 96* | EZ | X |
| 97* | EZ | X |
| 98* | DZ | X |
| 99  | EZ | X |
| 100 | EZ | X |
Table 2. Mark-and-recapture matrix of *Trechona* sp., for each visit, used for the Jolly-Seber model to estimate population size ($n \pm SE$).

| Days (month year) | 1 (Jan 2010) | 48 (Feb 2010) | 60 (Mar 2010) | 102 (Apr 2010) | 130 (May 2010) | 158 (Jun 2010) | 241 (Sep 2010) | 276 (Oct 2010) | 310 (Nov 2010) | 333 (Dec 2010) | 366 (Jan 2011) | 430 (Mar 2011) | 499 (May 2011) |
|-------------------|--------------|---------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Marked ($m_t$)    | 0            | 3             | 15            | 15             | 22             | 21             | 28             | 38             | 38             | 37             | 40             | 29             | 24             |
| Unmarked ($u_t$)  | 13           | 8             | 16            | 15             | 8              | 1              | 16             | 1              | 0              | 6              | 5              | 2              | 9              |
| Total ($n_t$)     | 13           | 11            | 31            | 30             | 30             | 22             | 44             | 39             | 38             | 43             | 45             | 38             | 26             |
| Total released ($s_t$) | 13          | 11            | 31            | 30             | 30             | 22             | 44             | 39             | 38             | 43             | 45             | 38             | 26             |
| $Nn$ ($\pm SE$)   | —            | 5.36          | 125.44        | 142.02         | 238            | —              | 350.69         | —              | 336.77         | 853.43         | —              | 240.5          | —              |
|                   | (±15.43)     | (±13.44)      | (±12.83)      | (±20.64)       | (±46.21)       | —              | (±80.19)       | (±577.65)      | (±108.68)      | —              | —              | —              | —              |
2010, to $853.43 \pm 577.65$ individuals in January 2011. In June, October and November 2010, the estimated population size could not be calculated because the spiders marked in these occasions were never recaptured again.

Regarding the distribution of spiders in the cave, 50 individuals were present in the entrance zone, 25 in the twilight zone and 25 in the dark zone. All 50 retreats at the entrance zone were built so that the direction of the opening of the retreat was opposite to the entrance of the cave. In the other two zones, we did not find any pattern regarding the position of the retreat. All collecting efforts in the surroundings of the cave did not yield any representatives of *Trechona* sp. spiders.

The observations regarding the activity of the spiders in the three zones of the caves resulted in the recognition of three distinct patterns (Figures 3–5). The individuals in the entrance zone were active during the night (Figure 3) and resting during the day. In the dark zone, the spiders remained active for longer periods (Figure 4). On the three occasions that we spent 24 hours checking the spiders’ activity rhythms, the individuals in the dark zone spent the whole day on the sheet-web, and thus were considered as active. In the twilight zone, we found an intermediate pattern, where most of the spiders were already active before dusk, and half of them entered back into the retreats after dawn (Figure 5).

Discussion

The population of *Trechona* sp. found in Monte Cristo Cave comprises the largest cavernicolous population of mygalomorph spiders registered to date. The greater concentration of individuals in EZ, compared to TZ and DZ, is probably related to a higher number of microhabitats for the spiders to establish their webs, since it comprises a much larger area. Mygalomorph spiders are sedentary, while adult males wander after females (Bradley 1996; Janowski-Bell and Horner 1999; Pérez-Miles Figure 3. Percentage of *Trechona* sp. spiders (mean of 10 observations) found active in the entrance zone during dawn and dusk. The hours in the graph corresponds to actual time, without daylight saving time (DST) correction.
Therefore, the fact that all individuals recaptured, except for a single one, were found in the same retreat was expected. Concerning spiders of the family Dipluridae, which invest a lot of silk in their web, the data herein suggest that besides sedentary and sit-and-wait predators, they tend to spend long periods in the same spot. The amount of exuvia left in the retreat also suggests this long-term establishment. The webs (Figure 2), composed of a tubular retreat and a
sheet-web, named capture webs by Coyle (1995), differ from the one described by Pedroso and Cerqueira-Baptista (2004), which does not have sheet-web structure.

Regarding the size of population, in January 2011 we obtained the highest estimation, with 853.43 ± 577.65 individuals. However, of the 40 spiders marked on this occasion, we only recaptured two on the following occasion (March 2011). We believe that this value is overestimated, due to the low recapture rate on the following occasion. We consider this to be an artefact of the model, based on the extreme high value of standard error and the values obtained for the other occasions, which reached 350.69 ± 46.21 individuals.

We had a higher recapture rate than that of a survey of a population of Lasiodora spiders in an arenitic cave in Ataléia, Minas Gerais (Bernardi et al. 2007). In the present study, only 23 marked spiders (23%) were never recaptured on subsequent visits. Lasiodora spiders are common inhabitants of arenitic caves, especially in northeastern and northern Brazil (Trajano and Bichuette 2010), and they do not spin great amounts of web to build retreats; they tend to move more after prey and show territorial behaviour (Bernardi et al. 2007). The differences in the density and size of these two cave-dwelling mygalomorph populations are probably related to these biological aspects. It is more likely for these sedentary spiders to establish dense populations, as they rarely leave their sheet-web and the competition for a spot to build the retreat would be less intense, resulting in a high recapture rate. Populations of Lasiodora would be more widely spread, because of their territoriality and mobility for catching prey, making the population less dense.

Spiders are common cave dwellers, and at least 16 species are considered as troglobitic (Trajano and Bichuette 2010; Willemart and Taques 2013). The study of biological clocks in cave adapted species has mainly focused on three aspects (Friedrich 2013): identity of zeitgebers (environmental or any external cues to an organism concerning the day/night cycle); clock output in the form of rhythmic patterns in behaviours; and evolution of non-circadian clocks due to lack of zeitgebers, especially light. The species Trechona sp. can be considered to be a troglophilic (a cave-dwelling animal that may complete its life cycle in a cave, but also lives in epigean habitats) spider, which opportunistically occupies this subterranean environment and has managed to establish this dense population. Although we did not collect any specimens outside the cave, their congeneric species are very common in the epigean environment. The high concentration of spiders in EZ, the maintenance of their circadian cycle, which is similar activity rhythm to that expected in nocturnal spiders (Coyle 1995; Foelix 2010), and the absence of morphological adaptations to troglobitic habits could suggest a recent occupation of such environment. Their continuous position on the sheet-web in the dark zone suggests the modification of the typical circadian cycle of spiders, since they do not follow the day/night periods. The loss of a circadian cycle is supposedly more common in troglobitic species, while some other cave-adapted species maintain their circadian cycles (Hoenen and Gnaspini 1999). Such cycling, maintained by internal temporal organization (Oda et al. 2000), is important in coordinating metabolic processes. Moreover, the existence of some kind of synchronization with the epigean cycles in non-troglobiotic species would guarantee the time adjustments for leaving and entering the cave. The activity rhythm recognized here for Trechona sp. is in agreement with that suggested by Hoenen and Gnaspini (1999), and may vary depending on the cave zone they inhabit. According to Saunders (1982), the loss of rhythmicity in insects due to the absence of
an environmental clue may vary according to their ecological relation to the subterranean environment. It is difficult to determine a single reason that led to this dense concentration of spiders and to the differences in activity among individuals in distinct cave zones. The scarcity of food and the lack of light could both contribute to the continuous activity in DZ. The spiders are able to spend longer periods on the sheet-web, ready to prey, because of the lack of light; in addition they need longer times of activity to catch their prey, as it is scarce. Meanwhile, the availability of food and presence of day/night cycles in EZ may keep these spiders in their circadian cycle. The spiders may also be more exposed to predators with access to the entrance zone. In a recent study of circadian locomotor activity in species of the families Ctenidae and Dipluridae (Sara Soriano-Morales et al. 2013), carried out under laboratory conditions, the spiders presented circadian rhythm in the ‘free-running’ (without environmental time clues), while ‘light/dark’ cycles induce changes in the circadian period, showing the importance of light in this behaviour. Further experiments such as reaction to light, ‘free running’ behaviour in the absence of temporal clues, as well as predatory and reproductive behaviour of these spiders may shed light on questions concerning the spider’s ecological preferences and the selection pressures that may be acting on these spiders.

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