

Short Note

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Reproductive data of a threatened bat, *Myotis ruber* (É. Geoffroy, 1806) (Chiroptera, Vespertilionidae) in a southern Brazilian deciduous seasonal forest

Abstract: *Myotis ruber* is a widely distributed bat in South America, but it is considered rare and its natural history is virtually unknown. These factors contribute to the classification of the species as vulnerable regionally and near-threatened globally. In this context, the aim of this note is to present new data about the reproductive biology of *M. ruber*, thus expanding the knowledge about its natural history and, consequently, contributing to the conservation of the species. After an extensive effort to capture bats in southern Brazil, we captured 40 individuals of *M. ruber*. Pregnant females (n=17) were observed mainly in October in different years. In addition, seven immature individuals were captured. Based on our results, it is expected that the species will fit the general pattern for bats determined by climate and food resources, but our data do not allow us to assign conclusive reproductive patterns. Although not conclusive, the information presented in this note represents the first opportunity to gather breeding information about this rare and threatened species.

Keywords: Neotropical bat; Red myotis; reproduction; threatened species.

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Among the genera of bats, *Myotis* Kaup, 1829 is the most complex, with 103 species worldwide according to Simmons (2005); of these species, 14 are found in South America (Wilson 2008, Moratelli et al. 2011) and 9 occur in Brazil (Paglia et al. 2012). *Myotis ruber* (É. Geoffroy, 1806) is distributed across southeastern Paraguay, northeastern Argentina, west Uruguay and southern, southeastern and northeastern Brazil (Barquez et al. 1999, López-González et al. 2001, Simmons 2005, Wilson 2008, Weber et al. 2010). Despite this relatively wide distribution, it seems to be a rare species (LaVal 1973, Silva 1994, Barquez et al. 1999, López-González et al. 2001), usually represented in inventories by only a few specimens (e.g., Wallauer and Albuquerque 1986, Passos et al. 2003, Weber et al. 2007). Because of these factors, the biology and ecology of this species are virtually unknown (Barquez et al. 1999, Wilson 2008).

Among the scarce information recorded in the literature about the reproductive biology of *Myotis ruber*, one male was noted with an apparent scrotum in December in Argentina (Mares et al. 1995) and another in February in Paraná state, Brazil (Bianconi and Pedro 2007). However, there is no correlation between the position of the testes and sperm production (Fazzolari-Corrêa 1995), and, according to Biggers (1966), only the presence of spermatozoa in the light seminiferous tubules is an indication of reproductive ability in males. The only relevant information about the reproductive biology of *M. ruber* is the record of a lactating female in early November in the Mata dos Godoy State Park in northern Paraná state, Brazil (Reis et al. 2003).

Myotis ruber is listed as ‘vulnerable’ according to the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) (Chiarello et al. 2008), and categorised as ‘near threatened’ at the global level according to the International Union for Conservation of Nature (IUCN) criteria (Barquez and Diaz 2008). Among the recommended measures for its conservation are the protection of its habitat and research involving biology, ecology and geographic distribution (Pacheco and Freitas 2003, Miranda et al. 2009). Thus, the aim of this note is to provide information about the reproductive activity of *M. ruber* to fill some gaps in knowledge of the biology of this threatened species.

This study was conducted in the municipality of Frederico Westphalen (27°21’S and 53°23’W, 522 m), located in the Upper Uruguay River region, northwestern Rio Grande do Sul state, southern Brazil. The region is within the deciduous seasonal forest domain. The climate is classified as subtropical humid temperate (Cfa according to the Köppen classification), and the annual average temperature is around 18°C, with summers being higher than 41°C and winters lower than 0°C. The annual average precipitation is high, generally between 1800 and 2100 mm, and well-distributed throughout the year (Bernardi et al. 2007).

From October 2004 to April 2007, we randomly sampled bats in 11 sites in the municipality of Frederico Westphalen (Bernardi et al. 2009). Bats were captured with mist nets (7×2.5 m) placed 0.5 m above the ground in trails, clearings and forest edges, as well as perpendicularly above streams. Specimens of *Myotis ruber* captured were marked on the forearm with a colored plastic ring and released at the capture site. As *M. ruber* is an easily identified species in field conditions, and due to its legally threatened status, only two specimens were collected and are currently deposited in the Coleção Científica do Departamento de Zoologia, Universidade Federal do Paraná, Sessão de Mastozoologia (DZUP/CCMZ 696 and 697).

To determine the development class (adult or juvenile) of each captured individual, we analyzed the degree of ossification of the epiphyses phalanges and the color and texture of the coat, as well as tooth wear (Kunz 1988). The reproductive status of females was determined by observation and abdominal palpation.

During the sampling, 40 specimens of *Myotis ruber* were captured, 16 males (13 adults and 3 juveniles) and 24 females (20 adults and 4 juveniles) (Figure 1). All captures were obtained in just one of the 11 sampled areas (a secondary forest fragment of approximately 35 ha covering the Tunas stream), which highlights the rarity of this species in the landscape.

Pregnant females (n=17) were captured in October 2004 (n=4), October 2005 (n=6), November 2005 (n=1), June 2006 (n=1), September 2006 (n=2) and October 2006 (n=3). The single recaptured female was pregnant in October 2004 and also in October 2005, October 2006 and April 2007. No reproductive activity was detected in adult females captured in September 2005 (n=2) and in April 2007 (n=1), and no captured female was lactating or post-lactating. Juveniles were captured in October 2004 (n=4), June 2005 (n=2) and October 2005 (n=1).

Four basic reproductive patterns have been proposed for Neotropical bats: 1) seasonal monoestry – a single reproductive peak annually; 2) bimodal seasonal polyestry – two reproductive peaks annually; 3) continuous polyestry – a long reproductive period, with a small period of inactivity; and 4) non-seasonal polyestry – reproduction throughout the year (Fleming et al. 1972, Willig 1985). Despite the highest number of individuals ever captured when compared to other studies (Wallauer and Albuquerque 1986, Passos et al. 2003, Weber et al. 2007), our data do not allow *Myotis ruber* to be assigned to any of these reproductive patterns, as we did not record any captures in several months, particularly in July and August (Figure 1). However the pregnancy of one female at a 6-month interval suggests polyestry.

The reproductive cycle of bats is apparently related to food availability (Tuttle and Stevenson 1982), as reproduction and lactation are costly physiological processes in terms of energy requirements (Loudon and Racey 1987). In turn, food availability is primarily influenced by seasonality and rainfall, with the warmer and rainy periods exhibiting greater resource availability (Tuttle and Stevenson 1982, Racey and Entwistle 2000). Therefore, in low latitudes, where seasonality is weak and food resources are available for a longer period of time, bat species tend to have longer reproductive cycles; at high latitudes, with marked seasonality, the reproduction period seems to be concentrated in warmer and rainy months (Tuttle and Stevenson

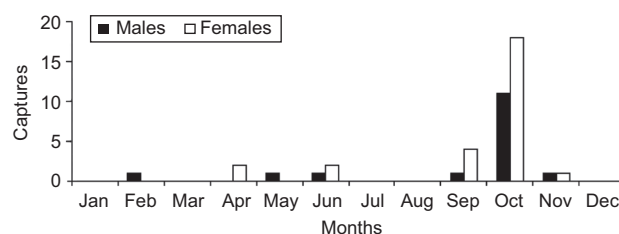


Figure 1 Total number and monthly distribution of male and female captures of *Myotis ruber* in Frederico Westphalen, state of Rio Grande do Sul, Brazil. Monthly data from various years were used.

1982, Happold and Happold 1990, Krutzsch 2000). Thus most vespertilionid bats of temperate habitats exhibit monoestry (Krutzsch 2000), and at intermediate latitudes some species present intermediate reproductive patterns, e.g., *Myotis austroriparius* (Rhoads, 1897, Rice 1957) and *M. albescens* (É. Geoffroy, 1806) (Myers 1977). Our study region has a marked seasonality regarding temperature but no distinction between dry and rainy seasons. Therefore, a longer reproductive cycle is expected for *M. ruber*.

Myotis albescens, *M. nigricans* (Schinz, 1821) and *M. riparius* Handley, 1960 occur in sympatry with *M. ruber* (Bernardi et al. 2009); however, there exist few data about the reproduction of these species at the latitudes of the study region (Barquez et al. 1999). Information about *M. nigricans* is the most robust. In Paraguay, pregnant females were recorded in all months, and all females captured in September were pregnant (Myers 1977, López-González et al. 2001), which suggests a non-seasonal polyestry pattern with a peak in early spring, similar to our large number of pregnant females recorded in October. A polyestry cycle was also reported for *M. nigricans* (Wilson and LaVal, 1974, Willig 1985, Barclay and Harder 2003). In *M. albescens*, pregnancy was detected in late July and may be followed by one or two postpartum oestrus (Myers 1977). For *M. riparius*, González

(2001) reported reproductive activity in late November in Uruguay. However, these data are inconsistent and do not allow further comparisons.

Although the information collected on the reproduction of *Myotis ruber* does not allow the assignment of a reproductive pattern to the species, it is expected that the species fits the general pattern for insectivorous bats that is determined by climate and food resources. Although not conclusive, this information represents the first opportunity to gather breeding information about this rare and threatened species. Finally, we highlight the need for further research about *M. ruber* reproduction to corroborate the results presented here and/or finally establish the reproductive pattern of this species.

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