Squamate Reptiles of the central Chapada Diamantina, with a focus on the municipality of Mucugê, state of Bahia, Brazil

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Abstract: We present the first species list of squamate reptiles for the central region of the Chapada Diamantina, with a focus on the municipality of Mucugê, state of Bahia Brazil. The data provided were mostly collected in the Caraíbas estate, during vegetation clearing operations for agriculture. The remnant records were collected from roadkills encountered in Mucugê and neighboring municipalities. We found 64 species of squamate reptiles including 35 species of snakes, 25 of lizards and four of amphibiaenians. These records have already yielded three species descriptions with others likely to follow. This is evidence of the poorly documented herpetological diversity of the Chapada Diamantina. The present work highlights the need for further research and the potential of less traditional data sources such as roadkills to improve the knowledge of the herpetofauna of extensive and megadiverse countries like Brazil.

INTRODUCTION

The Chapada Diamantina, the local name of the northern segment of the Serra do Espinhaço mountain ridge, is a mountainous region located within the Caatinga biome, crossing the state of Bahia from north to south (Ab’ Saber 1977). Although dominated by semi-arid environments, the Chapada Diamantina has a wide range of ecosystems, a result of the topographic diversity, the distribution of water sources and drainages, and the present and past contacts with the Cerrado, Caatinga and the Atlantic Forest biomes (Queiroz et al. 2008).

The Chapada Diamantina has been targeted by a few studies of its flora (e.g. Queiroz et al. 2008; Giulietti and Wanderley 1995), insects (e.g. Lopes and Louzada 2008), mammals (e.g. Oliveira and Pessoa 2005), fish (e.g. Santos and Caramaschi 2008) and birds, which have had the most consistent surveying (e.g. Carvalhaes and Machado 2008). Nonetheless, its biodiversity remains greatly unknown, which explains its selection as a priority area for research on biodiversity in Brazil (Rodrigues 2003).

The herpetofauna of the Chapada Diamantina has only recently received attention from the scientific community, with a few surveys attempting to document the reptile and amphibian species present in the region. These studies have resulted in the description of several new species (Freitas 1999; Argólo and Freitas 2000, 2002; Juncá 2005; Rodrigues et al. 2006, 2009a, b; Freitas et al. 2007a, b, 2010; Lugli and Juncá 2008; Mott et al. 2008).

Material and Methods

Study site

The majority of the records were gathered at the Caraíbas estate (13°09’ S, 41°24’ W), district of Cascavel, municipality of Mucugê, state of Bahia, northeastern Brazil (Figure 1). This 5200 ha estate is situated on a relatively flat upland plateau, at around 1100 m altitude, on the west side of the escarpments of the Serra do Sincorá, a section of Chapada Diamantina (Rodrigues et al. 2006). The vegetation of the estate includes semi-decidual seasonal forest (locally known as carrasco) and gallery forest along the river valleys (Rodrigues et al. 2006). The remaining records were gathered opportunistically from roadkills found along the BA 142 and BR 242 roads, in the municipalities of Mucugê, Andaraí, Lençóis, Ibicoara and Palmeiras.

Data collection

Data collection for the present study began opportunistically in 2000, mostly through records of...
snakes found as roadkills when the authors traveled through the region as part of consultancy work. This work was intensified from November 2004 to October 2008 through the fauna inventories conducted as part of the legally imposed mitigation measures for vegetation clearing, associated with land use changes in the Caraíbas estate, namely agriculture. At these field sites, the team followed the machinery clearing the vegetation to inventory the fauna being displaced during the process or killed by it. The surveys were conducted yearly by a team of 10 people, for approximately eight daily hours and for periods of 10 days at each stage of vegetation clearing. This totals a minimum of 32,000 man hours of survey effort. The surveys accompanied the clearing of 240 ha per year of native vegetation from 2005 to 2008, leading to a total of 960 ha. During these surveys 820 vertebrates were found, 74% of which were reptiles. From these individuals a proportion of those thought to represent undescribed species or otherwise relevant records were collected (NUFAU/IBAMA 021/2005), initially preserved in 10% formalin and afterwards moved to 70% alcohol. The specimens found as roadkills (IN-154/2007/IBAMA art-26) were initially preserved in 20% formalin and then moved to 70% alcohol. All the specimens were deposited in six referenced collections: the Zoology Museum of the São Paulo University (MZUSP), Zoology Museum of the Santa Cruz State University (MZUESC), Gregório Bondar Zoological Collection (CZGB), Laboratory of Venomous animals and Herpetology of the Feira de Santana State University (LAPH/UEFS), Science Museum of the Pontifical Catholic University of Porto Alegre (MCP), Zoology Museum of the Bahia Federal University (MZUFBA). For the species that were recorded during the surveys but for which it was not possible to collect any specimens, we used the relevant literature to provide support for their presence in the study area.

RESULTS AND DISCUSSION

We recorded 64 species of squamate reptiles, belonging to 45 genera and 17 families. Snakes accounted for 35 species, 27 genera and six families, lizards for 25 species, 18 genera and 10 families, while amphisbaenians accounted for four species in a single genus (Table 1). The work from which this species list originated has greatly contributed to increase the knowledge of the herpetofauna in the Chapada Diamantina region. Three species have already been described based on specimens collected during this research: the amphibisenian *Amphibiaena uroxena* (Figure 2A) and the lizards *Heterodactylus septentrionalis* (Figure 2B), *Acratosaurus spinosa* (Figure 2C) and *Enyalius erythroceus* (Figure 2D). Furthermore, it is possible that the lizards *Psilophthalmus* sp. (Figure 3A), *Mabuya* sp. (Figure 3B) and *Eurolophosaurus* sp. (Figure 3C), and the snakes *Chironius aff. flavolineatus* (Figure 3D), *Tantilla* sp. (Figure 3E) and *Taeniophallus gr. occipitalis* (Figure 3F), are also undescribed species (Dixon et al. 1993; Adriano. Lima pers. comm. 2010; Alfredo Jr pers. comm. 2010; Freitas 2011). Further studies will be needed to assess the taxonomy of these groups and their geographic distribution and conservation status.

The present work extends the geographic distribution of the snake *Trilepida koppeisi* (Figure 3G) to the northeast of Brazil and the distribution of the snakes *Sibynomorphus newiwi* (Figure 3H), *Siphlophis leucocephalus* (Figure 4A), *Oxyrhopus guiebi* (Figure 4B) and *Philodryas patagoniensis* (Figure 4C) to the Chapada Diamantina (Freitas and Silva 2007). For this last species this is also the record furthest away from the coast (Freitas 1999; Freitas 2003; Juncá 2005; Lugli and Juncá 2008). Also worth mentioning are the second record for the northeast of Brazil of the snake *Chironius quadricarinatus* (Figure 4D), and the third record for that same region of the snake *Philodryas aestivalis* (Figure 4E) (Argôlo 1998; Argôlo and Freitas 2002). This species list also contains records of the narrowly distributed lizards *Gymnodactylus vanzolinii* (Figure 4F), a recently described species, and *Tropidurus m ucujensis* (Figure 4G), both of which are yet to be recorded outside the Mucugê municipality (Rodrigues 1987; Cassimiro and Rodrigues 2009). Finally, this species list also presents the highest altitude recorded for the snake *Bothropoides erythromelas* (Figure 4H), at 1100 m above sea level.

Having basic knowledge of the vertebrate species composition for a given area is crucial if effective conservation strategies are to be designed (Heyer et al. 1994). The number of endemic species and the number of recently described species along with the high probability that other species remain undescribed, support the need for further research on the herpetofauna of the Chapada Diamantina.

In this light, the inventory of the squamate reptiles of the central Chapada Diamantina is an important contribution not only to the knowledge of the region biodiversity but also to its sustainable management. The focus on Mucugê is important given that this municipality makes up more than 60% of the Chapada Diamantina National Park, a conservation unit for which detailed information on herpetofauna is scarce. Nonetheless, it is also important that further attention is devoted to the management of the areas outside protected areas, as the pressure for land use change, namely for agriculture, is increasing.

Finally, this work, the first publication using data collected during fauna inventories undertaken as part of the mitigation measures imposed by the ICMBio, highlights how this and other (e.g. roadkills) less traditional data sources can provide important information on the herpetofauna of a region. The use of these sources could prove to be a cost-effective complement to more traditional survey methods, something of special importance especially in the case of megadiverse countries like Brazil where large areas are yet to be studied and little is known about many species (Freitas et al. 2011).
**Table 1.** List of Squamate reptiles of the central Chapada Diamantina with a focus on the municipality of Mucugê, state of Bahia, Brazil.

| TAXA | TYPE OF RECORD |
|------|----------------|
| **Amphisbaenidae** | |
| Amphisbaena alba Linnaeus, 1758 | Collected specimen |
| Amphisbaena pretrei Duméril and Bibron, 1839 | Collected specimen |
| Amphisbaena sp. | Lugli and Juncá (2008) |
| Amphisbaena uroxena Mott, Rodrigues, Freitas and Silva 2008 | Collected specimen |
| **Gymnophthalmidae** | |
| Acratosauna mentalis (Amaral, 1933) | Collected specimen |
| Acratosauna spinosa Rodrigues, Cassimiro, Freitas and Silva 2009 | Collected specimen |
| Heterodactylus septentrionalis Rodrigues, Freitas and Silva, 2009 | Collected specimen |
| Micrablepharus maximiliani (Reinhardt and Luetken, 1862) | Lugli and Juncá (2008) |
| **Polioptilus sp.** | Collected specimen |
| **Sphaerodactylidae** | |
| Coleoactylus meridionalis (Boulenger, 1888) | Lugli and Juncá (2008) |
| **Phylophactylidae** | |
| Gymnodactylus vanzolinii Cassimiro and Rodrigues, 2009 | Cassimiro and Rodrigues (2009) |
| Phyllopezus pilocaris (Spix, 1825) | Lugli and Juncá (2008) |
| **Gekkonidae** | |
| Hemidactylus brasiliensis (Amaral, 1935) | Collected specimen |
| **Leiothyrinae** | |
| Enyalius bibroni Boulenger, 1855 | Lugli and Juncá (2008) |
| Enyalius erythroceus Rodrigues, Freitas, Silva and Bertolotto, 2006 | Collected specimen |
| **Polychrotidae** | |
| Polyurus acutirostris Spix, 1825 | Collected specimen |
| **Scincidae** | |
| Mabuya aff. dorsivittata Cope, 1862 | Lugli and Juncá (2008) |
| Mabuya heathi | Collected specimen |
| Mabuya sp. | Collected specimen |
| **Teiidae** | |
| Ameiva aequalis (Linnaeus, 1758) | Collected specimen |
| Cnemidophorus ocellifer (Spix, 1825) | Collected specimen |
| Tupinambis merianae (Duméril and Bibron, 1839) | Lugli and Juncá (2008) |
| **Tropiduridae** | |
| Eurolophosaurus sp. | Collected specimen |
| Tropidurus cocorhensis (Rodrigues, 1987) | Lugli and Juncá (2008) |
| Tropidurus hispidus (Spix, 1825) | Lugli and Juncá (2008) |
| Tropidurus mucujensis Rodrigues, 1987 | Rodrigues (1987) |
| Tropidurus semitaeniatus (Spix, 1825) | Lugli and Juncá (2008) |
| **Anguidae** | |
| Ophiodes sp. | Lugli and Juncá (2008) |
| **Leptotyphlopidae** | |
| Epicrates asili Machado, 1945 | Collected specimen |
| Trilopida koppesi (Amaral, 1955) | Collected specimen |
| **Boiidae** | |
| Boa constrictor (Linnaeus, 1758) | Collected specimen |
| Epicrates asili Machado, 1945 | Collected specimen |
| **Colubridae** | |
| Chironius aff. flavolineatus | Collected specimen |
| Chironius quadricarinatus (Boie, 1824) | Collected specimen |
| Drybranchus corais (Boie, 1827) | Collected specimen |
| Drybranchus aeneus (Wagler, 1824) | Collected specimen |
| Spilotes pullatus (Linnaeus, 1758) | Collected specimen |
| Tantilla sp. | Collected specimen |
| **Dipsadidae** | |
| Apostolepis cearensis Gomes, 1915 | Collected specimen |
### Table 1. Continued.

| TAXA                          | TYPE OF RECORD          |
|-------------------------------|-------------------------|
| Boiruna sertaneja Zaher, 1996 | Collected specimen      |
| Leptodeira annulata (Linnaeus, 1758) | Juncá (2005)           |
| Liophis maryellenae Dixon, 1985 | Collected specimen      |
| Liophis poecilogyrus (Wied, 1825) | Collected specimen      |
| Liophis viridis (Günther, 1862) | Juncá (2005)           |
| Oxyrhopus guiebi Hoge and Romano, 1978 | Collected specimen      |
| Oxyrhopus trigeminus Dumeril, Bibron and Dumeril, 1854 | Collected specimen      |
| Oxyrhopus rhombifer Dumeril, Bibron and Dumeril, 1854 | Collected specimen      |
| Philodryas aestival (Duméril, Bibron and Dumeril, 1854) | Collected specimen      |
| Philodryas ocellatae (Lichtenstein, 1823) | Collected specimen      |
| Philodryas patagoniensis (Girard, 1858) | Collected specimen      |
| Phimophis guerini (Duméril, Bibron and Dumeril, 1854) | Juncá (2005)           |
| Pseudobra nigra (Duméril, Bibron and Dumeril, 1854) | Collected specimen      |
| Sibynomorphus neuwiedi (Ihering, 1911) | Collected specimen      |
| Siphlophis leucocephalus (Gunther, 1863) | Collected specimen      |
| Taeniophallus gr. occipitalis | Collected specimen      |
| Thamnodynastes sp.            | Collected specimen      |
| Tropidodryas striaticeps (Cope, 1869) | Collected specimen      |
| Xenodon merremii (Wagler, 1824) | Collected specimen      |

**Elapidae**

| Micrurus sp. | Collected specimen |

**Viperidae**

| Bothropoides erythromelas (Miranda-Ribeira, 1915) | Collected specimen |
| Bothropoides jararaca (Wied, 1824) | Collected specimen |
| Bothrops leucurus Wagler, 1824 | Collected specimen |
| Crotalus durissus Linnaeus, 1758 | Collected specimen |

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![Image A](image1.png)

**Figure 2.** Some squamate reptiles found in the Caraíbas estate, municipality of Mucugê, state of Bahia Brazil: A) *Amphisbaena uroxena*; B) *Heterodactylus septentrionalis*; C) *Acratosaura spinosa*; D) *Enyalius erythroceneus*. 
Figure 3. Some squamate reptiles found in the Caraíbas estate, municipality of Mucugê, state of Bahia Brazil: A) *Psilophtalmus* sp.; B) *Mabuya* sp.; C) *Eurolophosaurus* sp.; D) *Chironius* aff. *flavolineatus*; E) *Tantilla* sp.; F) *Taeniophallus* gr. *occipitalis*; G) *Trilepida* koppesi; H) *Sibynomorphus* neuwiedi.
Figure 4. Some squamate reptiles found in the Caraíbas estate, municipality of Mucugê, state of Bahia, Brazil: A) Siphlophis leucocephalus; B) Oxyrhopus guibe; C) Philodryas patagoniensis; D) Chironius quadricarinatus; E) Philodryas aestiva; F) Gymnodactylus vanzolini (Photo by M. Rodrigues); G) Tropidurus mucujensis; H) Bothropoides erythromelas.
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