

## Reptiles of the municipality of Juiz de Fora, Minas Gerais state, Brazil

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**Abstract:** The Atlantic Forest of the state of Minas Gerais, as well as the remnants of this domain in the rest of Brazil, suffers a marked reduction in size and anthropogenic alteration. This habitat degradation is directly reflected in the decrease of species richness within these natural environments. In this sense, the inventory of extant species is necessary to understand the species composition of regions under threat. Despite the great richness of existing reptile species in Minas Gerais, the level of knowledge about the fauna in this state is considered unsatisfactory and very fragmented. The aim of this study was to record the composition of the reptile fauna of the municipality of Juiz de Fora through the revision of specimens housed at the Herpetological Collection of the Federal University of Juiz de Fora (CHUFJF-Reptiles) and published papers. Better documentation of the reptilian fauna for the region not only expands the knowledge of the herpetofauna of Minas Gerais, but also contributes to regional conservation planning, such as “Biota Minas” program in the states of the Minas Gerais, Brazil. A total of 41 reptile species (two freshwater turtles, two amphisbaenians, 13 lizards and 24 snakes) belonging to 12 families were recorded. We highlight the record of the freshwater turtle *Hydromedusa maximiliani*, which is considered a species sensitive to anthropogenic impact and currently is seen only in protected areas in Juiz de Fora, as well as *Ecleopopus gaudichaudii*, *Enyalius brasiliensis*, *Heterodactylus imbricatus*, *Placosoma glabellum* and *Micrurus corallinus*, that are dependent on well-preserved forest areas. The reptile composition is more similar to Viçosa and other surrounding regions, despite the presence of many species that are not shared between these locations. This fact demonstrates the importance of the collection in terms of representativeness of the local and regional fauna as well as providing a valuable source of information for future studies of Brazilian herpetofauna in general.

**Keywords:** *testudines, squamata, Atlantic Forest, zona da mata mineira, Minas Gerais.*

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**Resumo:** A Mata Atlântica da Zona da Mata mineira, assim como os remanescentes deste domínio no restante do Brasil, sofre com a acentuada redução de área e antropização dos ambientes naturais. Essa degradação dos habitats reflete diretamente na riqueza de espécies que os compõe. Neste sentido, o inventário das espécies existentes torna-se necessário para conhecer e entender a composição de espécies ao longo deste bioma que é considerado um Hotspot de biodiversidade. Apesar da grande riqueza de espécies de répteis existentes em Minas Gerais, o nível de conhecimento sobre essa fauna no Estado é considerado insatisfatório e muito fragmentado. Nesta perspectiva, pretendeu-se com o presente estudo listar a composição da fauna de répteis do município de Juiz de Fora através de registros contidos na Coleção Herpetológica da Universidade Federal de Juiz de Fora (CHUFJF-Répteis) e de trabalhos publicados. Adicionalmente, propõe-se que a composição da fauna reptiliana documentada neste estudo, não apenas amplie o conhecimento sobre a herpetofauna de Minas Gerais, mas que também contribua para o planejamento futuro de projetos de conservação da biodiversidade do Estado, como o programa Biota Minas. Um total de 41 espécies de répteis (duas de cágados, duas de anfisbenas, 13 de lagartos e 24 de serpentes) pertencentes a 12 famílias foi registrado. Destaca-se o registro do cágado *Hydromedusa maximiliani*, que é considerado sensível aos processos de impacto antrópico e atualmente só é encontrado em áreas protegidas

do município, bem como as espécies *Ecpleopus gaudichaudii*, *Enyalius brasiliensis*, *Heterodactylus imbricatus*, *Placosoma glabellum* e *Micrurus corallinus*, que são dependentes de habitats florestais pouco impactados. A composição de répteis do município de Juiz de Fora é mais similar à da região de Viçosa e outras regiões circunvizinhas, apesar de apresentar muitas espécies que não são compartilhadas entre essas localidades, o que demonstra a importância da coleção em termos de representatividade da fauna local e regional, além de ser uma fonte inestimável de informações para estudos que abranjam a herpetofauna brasileira.

**Palavras-chave:** *testudines, squamata, Mata Atlântica, zona da mata mineira, Minas Gerais.*

## Introduction

The Brazilian Atlantic Forest is considered one of the most important “hotspots” on the planet in terms of biodiversity, which means that it is a place with high concentration of endemic species, but one that is suffering an accelerated process of degradation and loss of habitat (Myers et al. 2000, Mittermeier et al. 2004). Most of the remaining Brazilian Atlantic Forest is in the form of small fragments, which are mostly embedded in arrays of pastures and urban areas and suffer from all kinds of anthropic intervention (Ribeiro et al. 2009b).

The main factor indicated for the 82% decline of threatened fauna in Minas Gerais is the loss of habitat, and approximately 60% of this fauna is associated with the Atlantic Forest (Antonini & Drummond 2006). Analysis of satellite images has shown that the replacement of large areas of forests by farming, infrastructure and urban sprawl continues to occur at an accelerated pace (Antonini & Drummond 2006). The Atlantic Forest originally covered 41% of the surface of the State area and now is restricted to only 4% of this area (Drummond et al. 2009). Although deforestation has fallen 58% in Atlantic Forest area in 2011, about half of 13,300 hectares deforested in this domain is in the state of Minas Gerais state (Instituto... 2012). The Juiz de Fora municipality, which had 16% of the remnants of Atlantic Forest area in 2010, presented a rate of 16% of deforestation between 2008 and 2010 (Fundação... 2011). The Atlantic Forest domain in Minas Gerais state had only 5 to 6% native forest in the 1980s according to Fonseca (1985). Currently, many typical forest species in this region are restricted to only a few conservation units or remnants (Bertoluci 1998) and much of the local biodiversity is unlikely to still exist in the region (e.g., Ribon et al. 2003) as a result of this high degree of devastation.

Although Minas Gerais harbors 32% of the total richness of existing reptiles in Brazil (Bérnils et al. 2009), the level of knowledge about the reptilian fauna in the state is still unsatisfactory and very fragmented (Drummond et al. 2005). Studies that characterize the composition of reptiles in Minas Gerais are scarce, and there is little information on the biology and current state of conservation of this group (Brites & Bauab 1988, Assis 1999, Feio & Caramaschi 2002, Recoder & Nogueira 2007, Bertoluci et al. 2009, Costa et al. 2009, 2010, Palmuti et al. 2009, São Pedro & Pires 2009, Sousa et al. 2010). This lack of information on the reptile fauna of Minas Gerais consequently hinders the establishment of conservation areas that can preserve the herpetofauna (Drummond et al. 2005).

In this respect, our aim here is to record the composition of the reptile fauna of the municipality of Juiz de Fora using data from the Herpetological Collection of the Federal University of Juiz de Fora and published works, aiming to increase knowledge of the herpetofauna of Minas Gerais and to contribute to the planning and development of projects for biodiversity conservation in the state.

## Materials and Methods

### 1. Study area

The study was conducted in the municipality of Juiz de Fora (21° 41' 20" S and 43° 20' 40" W) in the Atlantic Forest zone of the state

of Minas Gerais, southeastern Brazil, which is part of the Atlantic Forest morphoclimatic domain (Figure 1). The climate is Cwa type on the Köppen scale (“tropical de altitude”) with two defined seasons: a hot and rainy summer (October to April) and a cooler and dryer winter (May to September). The average annual rainfall is 1,536 mm and average annual temperatures is 19.4 °C. The hottest month is February, averaging close to 23.6 °C, and the coldest months are July and August, with an average of 15.8 °C (Juiz de Fora 2004). Forest fragments in Juiz de Fora are classified as semi deciduous forest, and the matrix is composed primarily of urban areas and pastures, with elevation ranging from 467 to 1,104 m (Pifano et al. 2007).

### 2. Data collection

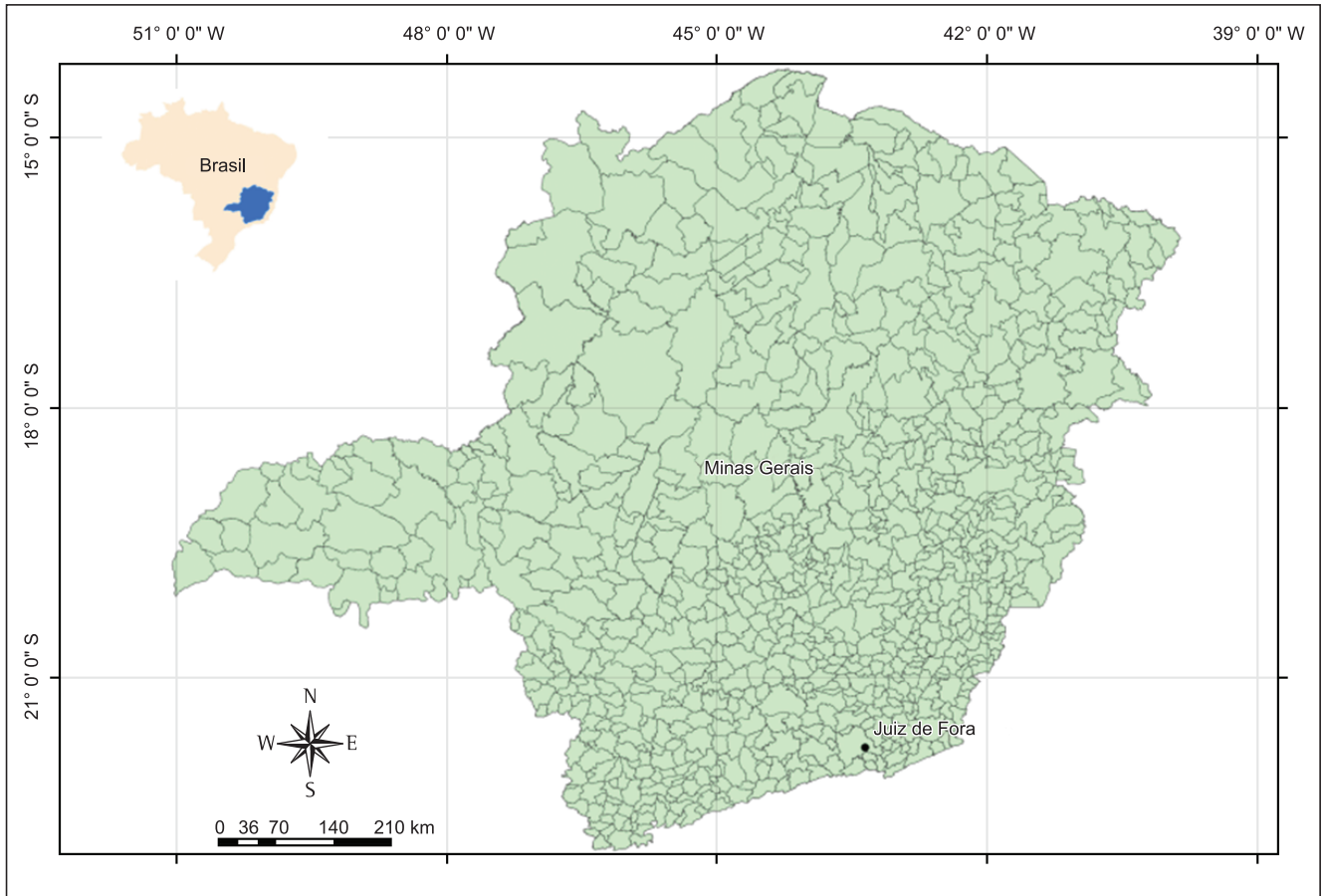
The data on the reptile fauna of Juiz de Fora in this study come from specimens deposited in the Herpetological Collection of Juiz de Fora Federal University (CHUFJF-Reptiles). These specimens were collected in urban and rural areas of the city between 2000 and 2011, mainly by university researchers, although some were delivered by the public or sent by public agencies. We also gathered secondary data from the literature. However, we have only included specimens for which we could confirm locality data.

Taxonomic and systematic discussions are continually changing the classification of some groups of herpetofauna, due to the use of modern techniques relying on molecular data to complement the traditional method of using morphological characters. This has generated a series of discussions and has clarified many questions about the taxonomy of various species (e.g., Di-Bernardo 1992, Wüster et al. 2002, Schargel et al. 2005, Curcio et al. 2009, Fenwick et al. 2009, Hoser 2009, Zaher et al. 2009, Vidal et al. 2010). To standardize the results, here we used the taxonomy recommended by the Brazilian Society of Herpetology (Bérnils & Costa 2011), and some updates provided by Carrasco et al. (2012) and Ribeiro et al. (2011).

To compare the reptilian fauna of Juiz de Fora with other remnant Atlantic Forest areas in Minas Gerais, we used the works of Feio & Caramaschi (2002), Palmuti et al. (2009), Costa et al. (2009, 2010) and Gomides & Sousa (in press). We also included in the analysis work done in transitional areas between Cerrado (savanna) and Atlantic Forest domains, as reported by Bertoluci et al. (2009); São Pedro & Pires (2009) in a transition area with the occurrence of Campos Rupestres formation, and in a transition area in Campos das Vertentes region (Sousa et al. 2010). In addition, we included data from Recoder & Nogueira (2007) for a Cerrado area of the state (Table 2).

The reptilian fauna composition was analyzed and compared by applying the Jaccard similarity coefficient (Magurran 1988) and subsequent cluster analysis by the unweighted average method (UPGMA) (Krebs 1999). To evaluate the loss of information in the construction of dendrograms, we calculated the cophenetic correlation coefficient ( $r$ ) (Romesburg 1984), obtained by correlating the original similarity matrix with the matrix obtained from the dendrogram, and the value of  $r > 0.9$  was considered a very good fit,  $0.8 < r < 0.9$  was

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**Figure 1.** Location of the municipality of Juiz de Fora, Minas Gerais state, Brazil.

**Figura 1.** Localização do município de Juiz de Fora, Minas Gerais, Brasil.

considered a good fit,  $0.7 < r < 0.8$  was considered a poor fit and  $r < 0.7$  was considered a very poor fit.

The data were compiled into a binary matrix representing the presence/absence of 123 species. To minimize taxonomic problems among the original lists, were removed from the matrix the species with uncertain identification (e.g., “gr.” and “aff.”) or without specific identification (e.g., “sp.”), due to the impossibility of examining the all voucher specimens from other authors. The species cited as “cf.” by other authors were kept. The species recorded through secondary means (such as photographs, were not counted).

## Results

In total we recorded 41 species of reptiles (two freshwater turtles, two amphisbaenians, 13 lizards and 24 snakes) belonging to 12 families. Of these, 36 were deposited in the CHUFJF. Only one family of turtle was recorded (Chelidae), with two species, and only two species of Amphisbaenia. For the lizards, there were 13 species in seven families included. Finally, there were 24 species of snakes, belonging to three families (Table 1).

The similarity dendrogram (cophenetic correlation coefficient = 0.9088) (Figure 2) showed that the reptile fauna of Juiz de Fora is more similar to the region of Viçosa (Costa et al. 2009, 2010). These two locations have in common 30 species, and in contrast, 41 different species, which helps to confirm the high diversity between the regions of the state of Minas Gerais, which provides a high gamma diversity for the state as a whole. The other regions showed low similarity in species composition. Areas less

similar in the present study, as one would expect, are the northern localities in the state, one of which is a typical Cerrado area.

## Discussion

The number of reptile species recorded in this work represents 18.5% of the total estimate for the state of Minas Gerais according to Bérnils et al. (2009), and about 5.7% of the Brazilian reptile fauna (Bérnils & Costa 2011). We recorded in Juiz de Fora, 17.2% of the known snake fauna in Minas Gerais, and for lizards, 22.8% of the total richness in Minas Gerais (Bérnils et al. 2009). These numbers are relevant, since “Zona da Mata” region is in an advanced devastation situation and very few natural areas still exist to house the native fauna.

However, the list presented here is likely underestimated, since many species expected to occur in the region were not recorded, and we expect that, with additional sampling efforts directed mainly at cryptic species such as fossorial snakes and amphisbaenians, this list will increase. Another fact that must be taken into consideration is the time of operation of the CHUFJF-Reptile collection (active since 2000), making this collection much more recent than that of the João Moojen Zoology Museum (in operation since 1933) in Viçosa, for example. The latter is an important source of information on regional diversity, since the region is under represented in other Brazilian reference collections (Costa et al. 2010), such as the herpetological collections of the National Museum of Rio de Janeiro Federal University and the Zoology Museum of the University of São Paulo, which are the largest collections of reptiles in the Neotropical Region

**Table 1.** List of reptile species recorded in the municipality of Juiz de Fora, Minas Gerais, Brazil, between 2000 and 2011, with notes on habitat and distribution.  
**Tabela 1.** Lista das espécies de répteis registradas para o município de Juiz de Fora, Minas Gerais, Brasil, no período entre os anos de 2000 e 2011, com notas sobre habitat e distribuição.

Species	Habitat	Distribution	References
<b>TESTUDINES</b>			
<b>Chelidae</b>			
<i>Hydromedusa maximiliani</i> (Mikan, 1820)	Streams and water bodies associated with regions of mountains of the Atlantic Forest	Minas Gerais, São Paulo, Rio de Janeiro, Espírito Santo and southern Bahia	Ernst & Barbour (1989), Argôlo & Freitas (2002), Souza et al. (2003), Souza (2004), Novelli & Sousa (2007)
<i>Phrynops geoffroanus</i> (Schweigger, 1812)	Lakes, ponds, streams and rivers and disturbed environments, such as reservoirs	Colombian Amazon to the state of Rio Grande do Sul, and also parts of Uruguay and northern Argentina	Ernst & Barbour (1989), Lema & Ferreira (1990), McCord et al. (2001), Souza & Abe (2001)
<b>SQUAMATA – AMPHISBAENIA</b>			
<b>Amphisbaenidae</b>			
<i>Amphisbaena cf. alba</i> Linnaeus, 1758	Fossorial species in Atlantic Forest areas, Cerrado and Caatinga regions	South America as far south as Paraguay	Vanzolini 2002
<i>Leposternon microcephalum</i> (Wagler, 1824)	Fossorial species in Atlantic Forest areas, Cerrado and Caatinga regions	Wide distribution in Brazil and also occurs in Bolivia, Paraguay, Argentina and Uruguay	Perez & Ribeiro (2008), Costa et al. (2009), Sousa et al. (2010)
<b>SQUAMATA – LIZARDS</b>			
<b>Leiosauridae</b>			
<i>Enyalius bilineatus</i> Duméril & Bibron, 1837	Impacted and altered areas or forest borders in the Atlantic Forest, areas of coffee plantations and Cerrado	Central and Southeastern Brazil	Jackson (1978), Nogueira (2001), Zatz (2002), Teixeira et al. (2005), Sousa et al. (2010)
<i>Enyalius brasiliensis</i> (Lesson, 1828)	Dense Atlantic Forest areas	Minas Gerais, Rio de Janeiro and Espírito Santo	Jackson (1978), Van Sluys et al. (2004), Teixeira et al. (2005), Costa et al. 2009, Gomides et al. (2010)
<i>Enyalius perditus</i> Jackson, 1978	Atlantic Forest and urban forest fragments	Rio de Janeiro, São Paulo and Minas Gerais	Jackson (1978), Sousa & Cruz (2008), Dixo & Metzger (2009), Gomides et al. (2010)
<i>Urostrophus vautieri</i> Duméril & Bibron, 1837	Forested areas like the Cerrado and semideciduous forest	Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo and southern Brazil	Etheridge & Williams (1991), Marques et al. (1998), Santos et al. (2009), Ribeiro & Sousa (2006)
<b>Tropiduridae</b>			
<i>Tropidurus torquatus</i> (Wied, 1820)	Open areas, such as rock outcrops and in environments altered by human action, occurring abundantly even in urban areas	Midwest, Northeast (south of Bahia), Southeast and South regions of Brazil	Araújo (1987), Rodrigues (1987), Rocha (2000), Ribeiro et al. (2008, 2009a)
<b>Gekkonidae</b>			
<i>Hemidactylus mabouia</i> (Moreau de Jonnés, 1818)	Disturbed and natural areas	Colonized all of the Americas	Carranza & Arnold (2006)
<b>Anguidae</b>			
<i>Ophiodes striatus</i> (Spix, 1825)	Campos de Altitude formation in the Atlantic Forest, Cerrado areas and Araucaria Forest	Southeastern and central Brazil	Martins (1998)
<b>Teiidae</b>			
<i>Tupinambis merianae</i> (Duméril & Bibron, 1839)	All types of environments from human-altered (deforested areas) to forest borders	Northern Argentina, Uruguay, a large portion of Brazil's Amazon and in southern Atlantic Forest regions	Vanzolini et al. (1980), Ávila Pires (1995), Marques & Sazima (2004)
<b>Gymnophthalmidae</b>			
<i>Ecleopopus gaudichaudii</i> Duméril & Bibron, 1839	Leaf litter of forests in the Atlantic Forest	Southern and southeastern Brazil	Uzzell Junior (1969), Dixo & Metzger (2009)

Table 1. Continued...

Species	Habitat	Distribution	References
<i>Heterodactylus imbricatus</i> Spix, 1825	Cryptozoic habits in forest litter at high altitudes of the Atlantic Forest and in areas of Cerrado gallery forest	Southeastern Brazil (Minas Gerais, Rio de Janeiro, São Paulo, Espírito Santo)	Dixo & Metzger (2009), Novelli et al. (2011)
<i>Placosoma glabellum</i> (Peters, 1870)	Inhabits forest litter in the Atlantic Forest	Southern and southeastern Brazil	Uzzell Junior (1959), Condez et al. (2009), Forlani et al. (2010)
<b>Scincidae</b>			
<i>Mabuya dorsivittata</i> Cope, 1862	Open areas in Cerrado and Atlantic Forest with dense grasses	Minas Gerais to Rio Grande do Sul	Recoder & Nogueira (2007), Forlani et al. (2010)
<i>Mabuya frenata</i> (Cope, 1862)	Open areas in Cerrado, Chaco and forest borders in the area between the Atlantic Forest and transitional areas	Midwest, southeast and south regions of Brazil in addition to Bolivia, Paraguay and Argentina	Peters & Donoso-Barros (1986), Norman & Naylor (1994), Vrcibradic et al. (2006), Sousa et al. (2010)
SQUAMATA – SNAKES			
<b>Colubridae</b>			
<i>Chironius bicarinatus</i> (Wied, 1820)	Areas of rainforest along the coast, tropical seasonal forest in the hinterland and riparian forests of the Cerrado	Bahia to Rio Grande do Sul, and can be found in Argentina and Uruguay	Dixon et al. (1993), Cicchi et al. (2007), Costa et al. (2010), Forlani et al. (2010), Nogueira et al. (2011)
<i>Chironius exoletus</i> (Linnaeus, 1758)	Forested areas, with records in the Amazon, Atlantic Forest, Pantanal and Cerrado. It can also be found in open areas	Southern portion of Central America to the Atlantic region of the southern state of Santa Catarina and the province of Misiones in Argentina	Dixon et al. (1993), Morato (1995), Argôlo (2004), Kawashita-Ribeiro (2007), França et al. (2008)
<i>Elapomorphus quinquelineatus</i> (Raddi, 1820)	Fossorial species that is commonly found in forested and altered environments	Endemic to the Atlantic Forest of southeastern and southern Brazil	Lema (1992), Ferrarezzi (1993), Pontes & Rocha (2008)
<i>Erythrolamprus aesculapii</i> (Linnaeus, 1766)	Forested areas and in open areas	Occurs from the Amazon to the southernmost part of Brazil and is very common in the southeastern Atlantic Forest	Marques (1996), Curcio (2008)
<i>Liophis miliaris</i> (Linnaeus, 1758)	Forested areas and in open formations in the Amazon, Atlantic Forest, Caatinga and Cerrado	Occurs from the Amazon basin to states of Rio Grande do Norte to Rio Grande do Sul	Dixon (1989), Argôlo (2004), Marques & Sazima (2004)
<i>Liophis poecilogyrus</i> (Wied, 1825)	Inhabits forests and anthropogenic areas	Distribution throughout South America, from the Amazon basin to Argentina	Pontes & Rocha (2008)
<i>Liophis typhlus</i> (Linnaeus, 1758)	Inhabits the Atlantic Forest, Cerrado and Caatinga, even in anthropic environments	Widely distributed in Brazil	Marques et al. (2009), Sousa et al. (2010)
<i>Oxyrhopus clathratus</i> Duméril, Bibron & Duméril, 1854	Inhabits forests and anthropic environments	Distributed from northeastern to southern Brazil, from Bahia to Rio Grande do Sul, also occurring in Misiones, Argentina	Peters & Orejas-Miranda (1986), Argôlo (2001), Morato (2005), Marques et al. (2009)
<i>Oxyrhopus guibeii</i> Hoge & Romano, (1978)	Very common in open areas and forest borders, as well as the Cerrado	Occurs from the Northeast, Midwest and South regions of Brazil as well as Bolivia, Paraguay, Uruguay and northern and northeastern Argentina	Hoge & Romano (1976), Andrade & Silvano (1996), Freire (1999), Sawaya et al. (2008), Forlani et al. (2010)
<i>Philodryas olfersii</i> (Lichtenstein, 1823)	Forested areas and in open areas	Distributed from southern Argentina, Paraguay, Uruguay and Bolivia to central Brazil	Thomas (1976), Argôlo (2004), Hartmann & Marques (2005), Pontes & Rocha (2008)
<i>Philodryas patagoniensis</i> (Girard, 1858)	Occurs mainly in open areas, forest borders and areas of Cerrado and Atlantic Forest of Brazil	Argentina, Chile, Uruguay, Paraguay, Bolivia. In Brazil it occurs from Rio Grande do Norte to Rio Grand to Sul	Hartmann & Marques (2005), Sawaya et al. (2008), Costa et al. (2010), Uetz & Hallermann (2011)

Table 1. Continued...

Species	Habitat	Distribution	References
<i>Sibynomorphus mikanii</i> (Schlegel, 1837)	Atlantic Forest regions, as well as in areas of Cerrado and semideciduous forest and disturbed areas	Distributed from the North and Northeast regions of Brazil to Argentina	Franco (1994), Albuquerque & Ferrarezzi (2004), Sawaya et al. (2008), Forlani et al. (2010),
<i>Sibynomorphus newwiedi</i> (Ihering, 1911)	Atlantic Forest areas, as well as in altered environments	Occurs from Bahia to Rio Grande do Sul	Marques & Sazima (2004), Morato (2005), Forlani et al. (2010)
<i>Spilotes pullatus</i> (Linnaeus, 1758)	Forested environments and in open and changed fields	Central and South America, from Costa Rica to Argentina	Cunha & Nascimento (1978), Argôlo (2004), Forlani et al. (2010)
<i>Taeniophallus affinis</i> (Günther, 1858)	Endemic to Atlantic coastal areas, occurring in forested and open areas	Distributed from the Northeast to the South of Brazil	Di-Bernardo (1992), Freire & Silva (2000), Loebmann (2008)
<i>Thamnodynastes cf. nattereri</i> (Mikan, 1828)	Found in areas of Cerrado and Atlantic Forest, being more abundant in dense rainforests and less abundant in semideciduous forest and Cerrado areas	Wide geographical distribution in Brazil, from Bahia to Mato Grosso do Sul, as well as in Uruguay	Franco & Ferreira (2002), Franco & Ferreira (2003)
<i>Tropidodryas striaticeps</i> (Cope, 1869)	Occurs in forests and disturbed areas	Endemic to Atlantic coastal regions, especially at higher altitudes	Thomas & Dixon (1977), Sazima & Puerto (1993), Stender-Oliveira (2008), Guedes & Marques (2011)
<i>Xenodon merremii</i> (Wagler, 1824)	Commonly found in open areas	Widely distributed throughout Brazil	Perters & Orejas-Miranda (1970), Vanzolini et al. (1980), Forlani et al. (2010)
<i>Xenodon newwiedii</i> Günther, 1863	Inhabits forested regions (although it can also be found in open areas)	Occurs from the Midwest, Southeast and South regions of Brazil	Argôlo & Jorge (1999), Forlani et al. (2010)
<b>Elapidae</b>			
<i>Micrurus corallinus</i> (Merrem, 1820)	Occurs in forests and altered environments	Distributed throughout the Atlantic Forest domain, from Bahia to Uruguay	Roze (1996), Campbell & Lamar (2004), Argôlo (2004)
<b>Viperidae</b>			
<i>Bothrops alternatus</i> (Duméril, Bibron & Duméril, 1854)	Found in swamps and marshes as well as in dry areas such as sugarcane fields and coffee groves	Occurs to southern and central Brazil (southern Goiás, Mato Grosso, Minas Gerais, São Paulo, Parana, Santa Catarina, Rio Grande do Sul), Paraguay, Uruguay and Argentina	Lema (1987), Mesquita & Brites (2003), Campbell & Lamar (2004), São Pedro & Pires (2009)
<i>Bothrops jararaca</i> (Wied, 1824)	Common in areas of Atlantic Forest, occurring both in open areas and in forested areas, as well as in forest borders and disturbed areas	Distributed from the states of Bahia to Rio Grande do Sul, also occurring in Argentina and Paraguay	Sazima & Haddad (1992), Martins et al. (2001), Campbell & Lamar (2004), Condez et al. (2009), Forlani et al. (2010)
<i>Bothrops newwiedi</i> (Wagler, 1824)	Typical species of the Cerrado and also occurs in areas of transition between Cerrado and Atlantic Forest	In occurs in Brazil only in the states of Bahia, Goiás, Minas Gerais, Rio de Janeiro, São Paulo, Santa Catarina and possibly in northern Rio Grande do Sul	Silva & Rodrigues (2008), São Pedro & Pires (2009), Sousa et al. (2010)
<i>Crotalus durissus</i> (Linnaeus, 1758)	Occurs naturally in open formations, and adapts well to deforested areas	Widespread distribution throughout South America except Ecuador and Chile	Sazima & Haddad (1992), Marques et al. (2001), Bastos et al. (2005), Campbell & Lamar (2004), Wüster et al. (2005)

(South America and Central America). These facts demonstrate the importance of regional collections, and highlight how the reptilian fauna of the CHUFJF-Reptiles can be representative of local, regional and even national levels.

The area whose species composition is most similar to that of Juiz de Fora is the municipality of Viçosa and its surrounding area.

This result is expected given the similarity between the vegetation cover and geographical proximity between the two municipalities (approximately 120 km). Nevertheless, there is a high rate of species substitution between these two cities, emphasizing the heterogeneity of species composition of “Zona da Mata” region and highlighting Minas Gerais biodiversity. However, other areas such as the transition

**Table 2.** Papers used to compare the list of reptile species in the municipality of Juiz de Fora, Minas Gerais, Brazil, with other locations in Minas Gerais.**Tabela 2.** Trabalhos de outras localidades do estado de Minas Gerais utilizados para comparação com a lista de espécies de répteis do município de Juiz de Fora, Minas Gerais, Brasil.

Place/city	Biome	Number of species recorded	References
Various forest fragments in the Jequitinhonha river basin, in northeastern part of the state	Atlantic Forest	11	Feio & Caramaschi (2002)
RPPN Feliciano Miguel Abdala/Caratinga	Atlantic Forest	20 (only snakes)	Palmuti et al. (2009)
Viçosa and surrounding region	Atlantic Forest	53	Costa et al. (2009, 2010)
RPPN Alto da Boa Vista/Descoberto	Atlantic Forest	16	Gomides & Sousa (in press)
Peti Environmental Station/São Gonçalo do Rio Abaixo e Santa Bárbara	Atlantic Forest and Cerrado	18	Bertoluci et al. (2009)
Ouro Branco and surrounding region	Atlantic Forest, Cerrado and Campo Rupestre	28 (only snakes)	São Pedro & Pires (2009)
Ritópolis and surrounding region	Atlantic Forest and Cerrado	31	Sousa et al. (2010)
Parque Nacional Grande Sertão Veredas, border area between the states of Minas Gerais and Bahia	Cerrado	50	Recoder & Nogueira (2007)
Juiz de Fora	Atlantic Forest	41	This study

between the Cerrado and Atlantic Forest also have some similarity because of the occurrence of widespread species shared between the two regions. The information about the geographical distribution and biology of the reptile species recorded for Juiz de Fora in the Herpetological Collection of Juiz de Fora Federal University (CHUFJF-Reptiles) is listed in Tables 1 and 2. Relevant information of the local fauna is summarized and presented below.

#### TESTUDINES

*Hydromedusa maximiliani* (Figure 3a) is classified as Near Threatened by the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) (Rodrigues 2005) and as vulnerable by the IUCN (International... 2011). In Juiz de Fora it is found in streams and backwaters of some protected and well-preserved forested areas, and so far has not been found in open or disturbed areas, highlighting the importance of conservation of remnant vegetation in the municipality. *Phrynops geoffroanus* (Figure 3b) is found in Juiz de Fora in natural and disturbed environments, such as reservoirs, and also in the Paraibuna River, which crosses the city and is highly polluted.

#### SQUAMATA – AMPHISBAENIA

*Amphisbaena cf. alba* has been recorded for the city, but has no representative in CHUFJ-Reptiles, with records for the municipality of Viçosa (Costa et al. 2009). Amphisbaenids, being fossorial species, are usually recorded opportunistically. In this case, we have only one specimen photographed. *Leposternon microcephalum* is the most common amphisbaenid found in the municipality of Juiz de Fora. In Minas Gerais, it was also reported by Costa et al. (2009) for the Atlantic Forest area of Viçosa.

#### SQUAMATA – LIZARDS

The species *Enyalius bilineatus* was recorded in preserved areas of the Peti Environmental Station in Minas Gerais state (Bertoluci et al. 2009). There are additional records for areas of disturbed and regenerating forest in Viçosa (Costa et al. 2009). In Juiz de Fora, *E. bilineatus* is found mainly in forest borders and urban forest fragments (Gomides et al. 2010). *Enyalius brasiliensis* (Figure 3c) is a rare species in Juiz de Fora, found only in a particular property of forest fragment well preserved of 370 hectares (Gomides et al. 2010). *Enyalius perditus* (Figure 3d) is the most abundant lizard species in urban forest fragments in Juiz de Fora (Sousa, personal observation), occurring only in small forest fragments (80 to 400 ha) which have suffered human impacts (portions of grazing areas in regeneration).

In São Paulo, the species is sensitive to forest fragmentation but seems to tolerate disturbed environments (Dixo & Metzger 2009). *Urostrophus vaultieri* (Figure 3e) is a lizard that in Juiz de Fora can be found on the university campus (Ribeiro & Sousa 2006) and in other fragments of Atlantic Forest.

*Tropidurus torquatus* (Figure 3f) is the most abundant lizard species in open areas, often found in rocky outcrops in rural areas and *Hemidactylus mabouia*, is also a species very common in Juiz de Fora. However, there are no records of this species in natural areas, only in the urban area.

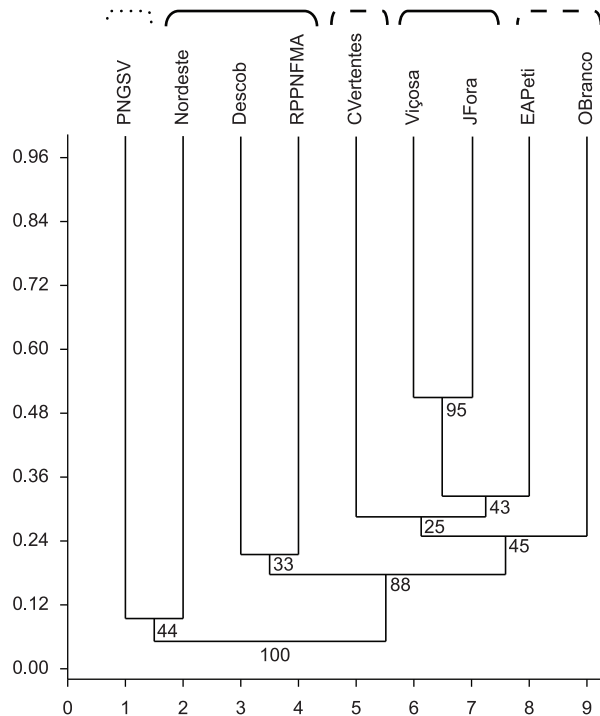
*Ophiodes striatus* (Figure 3g) is a limbless lizard very common that occurs in Juiz de Fora, both in disturbed areas and preserved ones, such as the campus of Juiz de Fora Federal University. As indicated by Martins (1998), a taxonomic revision was necessary for the genus, but despite this statement, the corresponding data for revision were not published.

*Tupinambis merianae* (Figure 3h) is a large sized species of lizard very common in Juiz de Fora, that is listed as vulnerable in Appendix II of CITES because it is targeted by hunters because mainly of their skin value (Mieres & Fitzgerald 2006). This happens in the Atlantic Forest zone of the state of Minas Gerais, where it is used also as food in rural areas (Sousa, personal observation).

*Eubleopis gaudichaudii* (Figure 3i) is a small gymnophthalmid lizard that has a wide distribution in the Atlantic Forest. It is relatively common species although not easily seen because of its cryptozoic habits and small size (Condez et al. 2009). Several specimens were captured in pitfall and funnel traps installed in forest fragments in Juiz de Fora. *Heterodactylus imbricatus* is also gymnophthalmid lizard with cryptozoic habits, living in forest litter. It can be considered rare in the forest habitats sampled in Juiz de Fora, as only one specimen from Juiz de Fora has been housed in CHUFJF. *Placosoma glabellum* (Figure 3j) is a small gymnophthalmid lizard that is very common in Juiz de Fora and is frequently captured in funnel traps installed in forest fragments. However, a specimen was found in a bush a few centimeters from the ground. Contrary to the sympatric microteiid, this species is more scansorial and commonly found on vegetation (Marques & Sazima 2004).

*Mabuya dorsivittata* (Figure 3k) and *Mabuya frenata* are scincid lizards that have wide distribution in open areas, both species are uncommon in the samples and the collection.

#### SQUAMATA – SNAKES



**Figure 2.** Similarity dendrogram of the composition of reptile species in the municipality of Juiz de Fora and other regions of the Atlantic Forest and Atlantic Forest/Cerrado transitional areas in Minas Gerais state. Jaccard index and UPGMA clustering method (cophenetic correlation coefficient = 0.9088). The dotted line refers to the Cerrado area, the solid line refers to Atlantic Forest area and the dashed line refers to areas of transition between biomes. PNGSV = Parque Nacional Grande Sertões Veredas, Nordeste = northeastern region of Minas Gerais; Descob = RPPN Alto da Boa Vista, Descoberto; RPPNFMA = RPPN Feliciano Miguel Abdala, Caratinga; CVertentes = Ritópolis region, Campo das Vertentes region; Viçosa = Viçosa region; JFora = Juiz de Fora; EAPeti = Peti Environmental Station, between the municipalities of São Gonçalo do Rio Abaixo and Santa Bárbara; OBranco = Ouro Branco region.

**Figura 2.** Dendrograma de similaridade das listas de composição das espécies de répteis entre a cidade de Juiz de Fora e outras regiões de Mata Atlântica e áreas de transição Mata Atlântica/Cerrado no estado de Minas Gerais. Índice de Jaccard e método de agrupamento “UPGMA” (Coeficiente de Correlação Cofenética = 0,9088). A linha pontilhada se refere à área de Cerrado, a linha inteira a área de Mata Atlântica, e a linha tracejada se refere a áreas de transição entre os biomas. PNGSV = Parque Nacional Grande Sertões Veredas; Nordeste = região nordeste do estado de Minas Gerais; Descob = RPPN Alto da Boa Vista, Descoberto; RPPNFMA = RPPN Feliciano Miguel Abdala, Caratinga; CVertentes = Ritópolis e região, região do Campo das Vertentes; Viçosa = Viçosa e região; JFora = Juiz de Fora; EAPeti = Estação Ambiental de Peti, entre as cidades de São Gonçalo do Rio Abaixo e Santa Bárbara; OBranco = Ouro Branco e região.

The collection has only one specimen of *Chironius bicarinatus* and the occurrence of *Chironius exoletus* was recorded by CETAS/JF (public agency for the purpose to receive, triage and manage the wild animals rescued or apprehended).

*Elapomorphus quinquelineatus* (Figure 4a) is a fossorial species that is commonly found in forested and altered environments of Juiz de Fora, with several specimens having been found on the campus of Juiz de Fora Federal University.

*Erythrolamprus aesculapii* (Figure 4b) is a false coral that has wide distribution in the Neotropical region and it is a rare species in Juiz de Fora, found only one specimen in a forest fragment. *Oxyrhopus clathratus* (Figure 4f) is an endemic species of the Atlantic

Forest (Sazima 2001). It inhabits forests and anthropic environments (Morato 2005, Marques et al. 2009), and its occurrence in forested or developed areas in Juiz de Fora is very common. *Oxyrhopus guibei* (Figure 4g) is very common in open areas and forest borders (Andrade & Silvano 1996) and it often occurs in urban areas. Because of their coloring, these snakes are readily killed by people, who confuse them with the true coral snakes of the genus *Micrurus*.

*Liophis miliaris* (Figure 4c), *Liophis poecilogyrus* (Figure 4d) and *Liophis typhlus* (Figure 4e) are species widely distributed. *Liophis miliaris* can even be found near the seashore, foraging in mangroves and along rocky shores (Marques & Souza 1993). It has a complex taxonomic history, with populations from different regions that may represent distinct species, requiring taxonomic revision (Costa et al. 2010). *Liophis poecilogyrus* has wide distribution, inhabiting forests and anthropogenic areas (Pontes & Rocha 2008). This species needs taxonomic revision to clarify the relationship of the four subspecies (Forlani et al. 2010). *Liophis typhlus* is a species widely distributed in Brazil in the Atlantic Forest (Marques et al. 2009) and Cerrado (Sousa et al. 2010), even in anthropic environments. In Juiz de Fora, the three *Liophis* species are commonly found along the banks of water bodies, being *L. miliaris* the most common and *L. typhus* the rarest.

*Philodryas olfersii* (Figure 4h) has widespread distribution throughout South America and possibly represents a complex with more than one cryptic species (Thomas 1976, Forlani et al. 2010). It is considered as potentially causing bites, but since it has opisthoglyphous dentition, poisoning from this species are uncommon (Puerto & França 2003). *Philodryas patagoniensis* (Figure 4i) in Minas Gerais, has been reported by São Pedro & Pires (2009) in the city of Ouro Branco and by Costa et al. (2010) in a transition area between the Cerrado and Atlantic Forest in Viçosa (Atlantic Forest area).

*Sibynomorphus mikanii* (Figure 4j) is common even in urban environments, occurring in places like vacant lots (Brites & Bauab 1988, Barbo 2008, Marques et al. 2009.). *Sibynomorphus newwiedi* (Figure 4k) is quite common in southeastern Atlantic Forest areas (Marques et al. 2001). *Sibynomorphus newwiedi* is common on the campus of Juiz de Fora Federal University and surrounding neighborhoods and we have only one record of the *Sibynomorphus mikanii* in the collection.

*Spilotes pullatus* (Figure 3l) has wide distribution, occurring in forested environments and in open and secondary open areas, to which it appears to be very tolerant (Cunha & Nascimento 1978, Argôlo 2004, Forlani et al. 2010). The various specimens reported in Juiz de Fora were found in forest fragments.

*Taeniophallus affinis* (Figure 4l), being a cryptozoic snake (Sazima & Haddad 1992, Marques et al. 2001, Pontes & Rocha 2008), is difficultly sighted in field samples, although its occurrence in the forests of Juiz de Fora is common, but not very common in the collection.

*Thamnodynastes cf. nattereri* (treated as *Thamnodynastes* sp. in Franco & Ferreira 2002) (Figure 5a) in Minas Gerais is found in transition areas between Cerrado and Atlantic Forest (Bertoluci et al. 2009, Costa et al. 2010), but with only one record in a forest fragment of Juiz de Fora. *Tropidodryas striaticeps* (Figure 5b) is a semiarboreal species, apparently diurnal snake, in Atlantic coastal regions, ecotonal regions of Atlantic Forest. It is a rare species in Juiz de Fora, with a single record from a well preserved 370 hectares privately owned forest fragment.

*Xenodon merremii* (Figure 5c) is widely distributed, being commonly found in open areas in Juiz de Fora and *Xenodon newwiedi* is a species with wide geographical distribution, which mainly



## Reptiles of Juiz de Fora, MG



**Figure 3.** Some species of reptiles recorded in the municipality of Juiz de Fora, Minas Gerais, southeastern Brazil. a) *Hydromedusa maximiliani*; b) *Phrynops geoffroanus* (Fonte:Marcelo Ribeiro); c) *Enyalius brasiliensis*; d) *Enyalius perditus*; e) *Urostrophus vaultieri*; f) *Tropidurus torquatus*; g) *Ophiodes striatus*; h) *Tupinambis merianae*; i) *Ecleopopus gaudichaudii*; j) *Placosoma glabellum*; k) *Mabuya dorsivittata*; and l) *Spilotes pullatus*.

**Figura 3.** Algumas espécies de répteis registradas no município de Juiz de Fora, Minas Gerais, sudeste do Brasil. a) *Hydromedusa maximiliani*; b) *Phrynops geoffroanus* (Fonte:Marcelo Ribeiro); c) *Enyalius brasiliensis*; d) *Enyalius perditus*; e) *Urostrophus vaultieri*; f) *Tropidurus torquatus*; g) *Ophiodes striatus*; h) *Tupinambis merianae*; i) *Ecleopopus gaudichaudii*; j) *Placosoma glabellum*; k) *Mabuya dorsivittata*; e l) *Spilotes pullatus*.

inhabits forested. In Juiz de Fora both species are not very common in the collection.

*Micrurus corallinus* (Figure 5d) is a coral snake that occurs throughout the Atlantic Forest domain (Campbell & Lamar 2004). The only specimen in the CHUFJF-Reptiles Collection was captured in the Lajinha Municipal Park, an urban forest fragment of Juiz de Fora.

Several specimens of *Bothrops jararaca* (Figure 5e) were captured in the research developed in the municipality of Juiz de Fora on urban forest fragment. It can cause serious accidents due to its

abundance and aggressive behavior (Campbell & Lamar 2004). Only one specimen photographed of *Bothrops alternatus* (Figure 5h) and only one specimen of the *Bothrops neuwiedi* (Figure 5f) is deposited in the collection.

*Crotalus durissus* (Figure 5g) is present in cleared rainforest areas due to deforestation (Marques et al. 2001). In Juiz de Fora, in recent years there has been a large increase in reports of *C. durissus*, causing a reversal in relation to reports of *B. jararaca*, according to data obtained from CETAS/JF.



**Figure 4.** Some species of reptiles recorded in the municipality of Juiz de Fora, Minas Gerais, southeastern Brazil. a) *Elapomorphus quinquelineatus*; b) *Erythrolamprus aesculapii*; c) *Liophis miliaris*; d) *Liophis poecilogyrus*; e) *Liophis typhlus*; f) *Oxyrhopus clathratus*; g) *Oxyrhopus guibeii*; h) *Philodryas olfersii*; i) *Philodryas patagoniensis*; j) *Sibynomorphus mikanii*; k) *Sibynomorphus neuwiedi*; and l) *Taeniophallus affinis*.

**Figura 4.** Algumas espécies de répteis registradas no município de Juiz de Fora, Minas Gerais, sudeste do Brasil. a) *Elapomorphus quinquelineatus*; b) *Erythrolamprus aesculapii*; c) *Liophis miliaris*; d) *Liophis poecilogyrus*; e) *Liophis typhlus*; f) *Oxyrhopus clathratus*; g) *Oxyrhopus guibeii*; h) *Philodryas olfersii*; i) *Philodryas patagoniensis*; j) *Sibynomorphus mikanii*; k) *Sibynomorphus neuwiedi*; e l) *Taeniophallus affinis*.

The composition of the reptile fauna of the municipality of Juiz de Fora, Minas Gerais, showed that many species recorded are typical of open areas (e.g., *Tropidurus torquatus*, *Mabuya dorsivittata*, *Crotalus durissus* and *Oxyrhopus guibeii*). Nevertheless, species that depend on well-preserved forest areas are still present (e.g., *Hydromedusa maximiliani*, *Ecpleopus gaudichaudii*, *Enyalius brasiliensis*, *Heterodactylus imbricatus*, *Placosoma glabellum*, *Taeniophallus affinis* and *Micrurus corallinus*).

*Thamnodynastes* cf. *nattereri*, *Tropidodryas striaticeps* and *Enyalius brasiliensis* were the species considered very rare and *Elapomorphus quinquelineatus*, *Sibynomorphus neuwiedi*, *Bothrops jararaca* and *Enyalius perditus* were the species very common for the municipality of Juiz de Fora. Finally, in addition to providing data for biogeographic studies of Brazilian herpetofauna, the results documented here can be a source of information for policy makers to make decisions on environmental preservation measures and to help monitor the status of the diversity of reptile fauna in the region.

## Reptiles of Juiz de Fora, MG



**Figure 5.** Some species of snakes recorded in the municipality of Juiz de Fora, Minas Gerais, southeastern Brazil. a) *Thamnodynastes* cf. *nattereri*; b) *Tropidodryas striaticeps*; c) *Xenodon merremii*; d) *Micrurus corallinus*; e) *Bothrops jararaca*; f) *Bothrops neuwiedi*; g) *Crotalus durissus*; and h) *Bothrops alternatus*.

**Figura 5.** Algumas espécies de répteis registradas no município de Juiz de Fora, Minas Gerais, sudeste do Brasil. a) *Thamnodynastes* cf. *nattereri*; b) *Tropidodryas striaticeps*; c) *Xenodon merremii*; d) *Micrurus corallinus*; e) *Bothrops jararaca*; f) *Bothrops neuwiedi*; g) *Crotalus durissus*; e h) *Bothrops alternatus*.

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