Amphibians and reptiles from a highly diverse area of the Caatinga domain: composition and conservation implications

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Abstract: We surveyed the herpetofauna from the Complex of Planalto da Ibiapaba (CPI), CE, Brazil, during two years, using five sampling methods and information available in the literature. The amphibians are represented by 38 species distributed into nine families. The reptiles found summed 84 species, distributed into 25 families. Most amphibians collected exhibited wide occurrence along CPI, where we recorded 24 species (63.2%), which occurred at least in 60% of the sampled environments. Reptiles showed a different pattern, since 52 species (62.6%) had a restricted distribution (up to two environments). Sixteen species out of 25 considered as rare in CPI are restricted to relict moist forests. We also applied a rarity-vulnerability index to determine the most susceptible species. *Pristimantis* sp., *Adelophryne baturitensis* Hoogmoed, Borges, and Cascon, 1994, *Pseudopaludicola* sp. (aff. *saltica*), *Scinax fuscomarginatus* (A. Lutz, 1925), and *Odontophrynus carvalhoi* Savage & Cei, 1965 were the most vulnerable amphibians in CPI. Reptiles showed a more diverse range in the scale of rarity with 40 species considered vulnerable. Among the vulnerable reptiles *Leposoma baturitensis* Rodrigues & Borges, 1997, *Bothrops* sp. (gr. *atrox*), *Atractus ronnie* Passos, Fernandes & Borges-Nojosa, 2007, *Apostolepis* sp. (gr. *pimy*), and *Mesoclemmys perplexa* Bour & Zaher, 2005 were the rarest species found in the whole complex of Ibiapaba mountain range. Results indicate that about 70% of the species found in Ceará are present in this complex. Also, CPI is the area of the Caatinga biome with the highest species richness, including rare and threatened species.
Keywords: *Amphibia, conservation, Herpetofauna, rarity index, Reptilia, Ubajara National Park.*

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Resumo: A herpetofauna do Complexo do Planalto da Ibiapaba (CPI), CE, Brasil, foi estudada durante dois anos, usando cinco métodos de amostragem e informação disponível na literatura. Os anfíbios estavam representados por 38 espécies distribuídos em nove famílias. Os répteis encontrados somaram 84 espécies, distribuídos em 25 famílias. A maioria dos anfíbios coletados apresentou ampla ocorrência ao longo do CPI, sendo 24 espécies (63,2%) ocorrendo em pelo menos 60% dos ambientes amostrados. Répteis tiveram um padrão diferente uma vez que 52 espécies (62.6%) tiveram uma distribuição restrita (até dois ambientes). Dezesseis das 25 espécies consideradas como rara no CPI são restritas as áreas de floresta úmida relictuais. Foi aplicado um índice de raridade/vulnerabilidade para determinar as espécies mais susceptíveis. *Pristimantis* sp., *Adelophryne baturitensis* Hoogmoed, Borges, and Cascon, 1994, *Pseudopaludicola* sp. (aff. *saltica*), *Scinax fuscomarginatus* (A. Lutz, 1925) e *Odontophrynus carvalhoi* Savage & Cei, 1965 foram os anfibios mais vulneráveis no CPI. Répteis mostraram uma variação mais diversa na escala de raridade com 40 espécies consideradas vulneráveis. Entre os répteis vulneráveis *Leposoma baturitensis* Rodrigues & Borges, 1997, *Bothrops* sp. (gr. *atrox*), *Atractus ronnie* Passos, Fernandes & Borges-Nojosa, 2007, *Apostolepis* sp. (gr. *pimy*) e *Mesoclemmys perplexa* Bour & Zaher, 2005 foram as espécies mais raras na encontradas ao longo do Complexo do Planalto da Ibiapaba. Os resultados indicam que aproximadamente 70% dos répteis encontrados no Ceará estão presentes nesse complexo. O CPI é também a área do Bioma Caatinga com a maior riqueza de espécies, incluindo espécies raras e ameaçadas.
Palavras-chave: *Amphibia, conservação, Herpetofauna, índice de raridade, Reptilia, Parque Nacional de Ubajara.*

Introduction

The Brazilian territory comprises extensive areas named landscape domains such as the Atlantic Forest and the Caatinga (Ab'Saber 1977). Each domain is usually formed by collections of fairly similar ecossystems in terms of their ecological features. However, it is possible to observe in each domain some areas that contrast with their surroundings. Ab'Saber (2003) referred to these areas as 'exception landscapes'. The most conspicuos example of 'exception landscapes' in the Caatinga domain are fragments of moist forests located at 600 m or higher elevations. These fragments harbor several species from tropical forests which that are incapable of inhabiting the semiarid/arid conditions in the adjacent Caatinga.

High altitude sites in Ceará are considered as priority areas for the conservation of Caatinga (Tabarelli & Silva 2003). However, several facts contribute to habitat loss and, therefore, to the decrease of biodiversity in these areas, in particular slash-and-burn agriculture, logging for firewood, hunting and cattle grazing (Leal et al. 2005).

The State of Ceará still needs systematic species inventories in almost all its territory to advance the knowledge on its herpetofauna. The complex of Ibiapaba mountain range (CPI), located in the northwest of the state, lacks a complete survey of amphibians and reptiles; there is only one inventory for amphisbaenians and lizards (Borges-Nojosa & Caramaschi 2003) and some geographic distribution notes (e.g. Loebmann et al. 2007, Loebmann 2008a, b, c, Loebmann 2009a, b, c, d, Loebmann & Roberto 2009, Roberto & Loebmann 2010). Therefore, the present study provides a list of amphibians and reptiles of the complex of Ibiapaba mountain range. Additionally, we demonstrated that this region is one of the most diverse of the Caatinga biome, presenting a mixed composition of fauna, with species from four Brazilian biomes.

Materials and Methods

1. Study area

The complex of the Planalto da Ibiapaba (Figure 1) represents the northwesternmost fragments of moist forest in the State of Ceará (3° 20'-5° 00' S and 40° 42'-41° 10' W). This complex is located at the boundary with the State of Piauí and comprises the municipalities of Viçosa do Ceará, Tianguá, Ubajara, Ibiapina, São Benedito, Carnaubal, Guaraciaba do Norte, Croatá and Ipu. The stratigraphic formation is part of the sedimentary basin Maranhão-Piauí, with the lithology of the formation Serra Grande and soil with predominance of dystrophic marine quartzic sands, red-yellow latosols and dark-red latosols. The area is relatively close to the coast (73 km), and has the lowest average annual temperatures (22-26 °C) and the highest average annual rainfall of the state (e.g. São Benedito with 2,062.8 mm, Ibiapina with 1,744.6 mm and Ubajara with 1,441.1 mm) (Bezerra et al. 1997).

Five main phytophysiognomies occur along the complex (Figure 2). Sub-evergreen Tropical Nebular Rainforest; a Relictual moist Forest (RF) with a canopy higher than 20 m that extends along about 150 km, is between 400 and 950 m wide, and covers the Eastern and Northern regions of CPI. From the hilltop to the west the relict forest is gradually substituted for the Thorny Deciduous Forest or High Altitude Caatinga (HC). This is a short (canopy up to 4 m high) and dense forest, with intense leaf loss (over 70%) during the dry season (June-December). At the lower portion of the hill (120-450 m) is the Sub-deciduous Tropical Rainforest or Arboreal Caatinga (AC) (Figueiredo 1997). This forest exhibits high trees (up to 20 m) with straight trunks and an understory composed of small trees and short-lived bushes. In its superior part the AC touches the

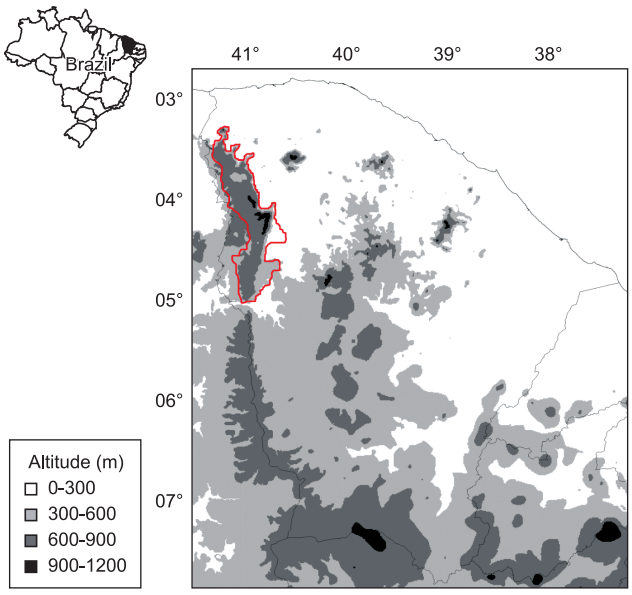

Figure 1. Altitudinal map of the State of Ceará. The redline delimits the Complex of Planalto da Ibiapaba.

RF and below it touches the Steppe Savanna or Low Altitude Caatinga (LC). In this environment there are wax palm forests or vegetation similar to the HC. However, LC areas have lower shrub densities than HC areas, with wide areas of bare soils. Eventually, areas of high altitude (among 450 to 700 m altitude), are occupied by patches of Cerrado (CE), similar to the rock fields (*Campos rupestres*) found in highland areas in Central and Southeastern Brazil.

Parts of the CPI are protected areas, incorporated by Parque Nacional de Ubajara (National Park of Ubajara) with 563 ha, Reserva Particular do Patrimônio Natural Serra Grande ('RPPN'– Serra Grande Private Reserve of National Heritage) and Área de Proteção Ambiental Serra da Ibiapaba ('APA'- Environmental Protection Area of Ibiapaba Mountain Range) with 1,592,550 ha; the latter is considered the second largest 'APA' of Brazil.

We carried out collections from January 2007 to April 2009. The area sampled in this study has about 5,360 km^2 and a perimeter of about 520 km, and covered all phytophysiognomies previously described. We captured amphibians and reptiles using the following methods: 1) A total of 8,640 pitfall traps (number of traps × days × months) (Corn 1994). For each pitfall we used a plastic bucket of 60 L. Six transects were set up for the whole duration of the samplings, each one comprising of six buckets 10 m apart from each other. 2) A total of 288 hours/person of time-limited search (Campbel & Christman 1982), covering a distance of about 672 km. 3) Approximately 15,000 km of road sampling (Fitch 1987). 4) Opportunistic encounters: specimens found by chance, not during searching or sampling activities, including specimens collected by local people. 5) Amphibians were also obtained during monthly monitoring of five reproduction sites (Scott Jr. & Woodward 1994). To complete the species list we included records available in the literature.

To classify the species according to their abundance we used a rarity model (Rabinowitz 1981) (Table 1). Rabinowitz's model focuses on three basic characteristics to categorize each species: 1) local abundance, 2) geographic distribution known for the species and 3) flexibility to use different kinds of habitats. Whenever one of these attributes is dichotomized, eight detailed categories are used to classify the species into different types of rarity or

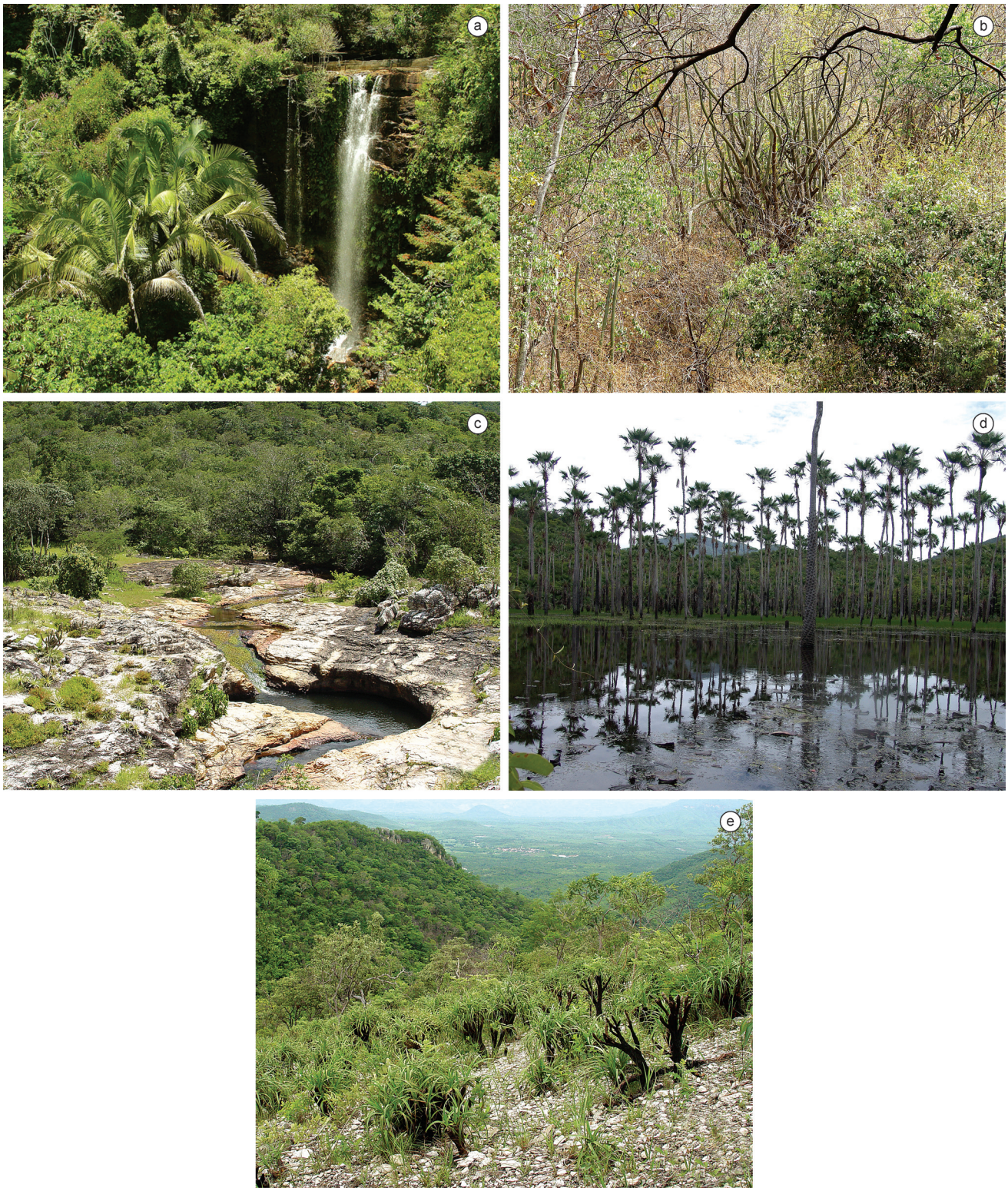

Figure 2. Environments composing the CPI. a) Relictual Moist Forest; b) High Altitude Caatinga; c) Arboreal Caatinga; d) Low Altitude Caatinga; and e) Cerrado.

commonness (letters A-H). Seven out of eight categories contain rare species in some sense of the word. Only the species with a wide distribution range that occur in several habitats in high abundance are not considered as rare (Rabinowitz 1981). In the same diagram (see Table 1), it is possible to create a Vulnerability index (VU), considering the species rarity for each parameter analyzed, as follow: Non-rare species in any parameters (letter A; VU = 4), rare species in only one parameter (letters B, C, and E; VU = 3), rare species in two parameters (letters D, F, and G; VU = 2), and rare species in all parameters (letter H; VU = 1).

Table 1. Representation of the rarity model proposed by Rabinowitz (1981) with the scores of vulnerability (in parentheses) used in this article. Geographical range is based on total species distribution known; habitat specificity is considered large for generalist species and narrow when the species has specialized habitat (e.g. bromeliads, bamboo, altitude); local population size is divided in rare and abundant based on our samples. Species with historical records only were considered rare. Scores of vulnerability values: Non-rare species in any parameters (letter A; VU = 4), rare species in only one parameter (letters B, C, and E; VU = 3), rare species in two parameters (letters D, F, and G; VU = 2), and rare species in all parameters (letter H; VU = 1).

Geographic range		**Large**		**Small**	
Habitat specificity		**Wide**	**Narrow**	**Wide**	**Narrow**
Size population (local)	Abundant	A (4)	B (3)	C (3)	D (2)
	Rare	E (3)	F (2)	G (2)	H (1)

Collecting permits were issued by Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA) (Processes 12545-1, 12545-2, 13571-1, 14130-1, 16381-1, and 17400-2). Voucher specimens were deposited in Coleção de anfíbios Célio F. B. Haddad (CFBH), Universidade Estadual Paulista "Julio de Mesquita Filho", campus de Rio Claro, São Paulo, Brasil; coleção de serpentes do Instituto Butantan (IBSP) and coleção de referência do Instituto Butantan (CRIB), São Paulo, São Paulo, Brasil; coleção herpetológica da Universidade Federal do Rio Grande do Sul (UFRGS), Porto Alegre, Rio Grande do Sul, Brasil; Coleção Herpetológica da Universidade de Brasília (CHUNB), Brasília, Distrito Federal, Brasil; Museu de História Natural da Universidade de Campinas (ZUEC), Campinas, São Paulo, Brasil; and coleção herpetológica do Museu Nacional (MNRJ), Rio de Janeiro, Rio de Janeiro, Brasil. Species were taxonomically classified mainly based in Faivovich et al. (2005), Frost et al. (2006), Grant et al. (2006), Gamble et al. (2008), Hedges et al. (2008), Adalsteinsson et al. (2009), Curcio et al. (2009), Fenwick et al. (2009), Hoser (2009), Mott & Vieites (2009), and Zaher et al. (2009).

Results

The amphibians found at the CPI are represented by 38 species distributed into two orders (37 Anura and 1 Gymnophiona), nine families (Brachycephalidae, Bufonidae, Cyclorhamphidae, Eleutherodactylidae, Hylidae, Leiuperidae, Leptodactylidae, Microhylidae, and Caeciliidae), and 18 genera (Table 2; Figures 3-7). The most representative families were Hylidae with 36.84% of the species (N = 14), followed by Leptodactylidae (21.05%, N = 8), and Leiuperidae (18.42%, N = 7). The species *Dendropsophus rubicundulus* and *Pseudopaludicola* sp. (gr. *saltica*) were recorded for the first time in the state.

We collected 80 reptile species during the present study. Other four species were not collected in this study, but were reported in the literature (Borges-Nojosa & Caramaschi 2003). Therefore, reptiles were represented by 84 species, three orders (4 Testudines, 1 Crocodylia and 78 Squamata), 25 families and 62 genera (Table 3; Figures 8-18). The families exhibiting highest species richness were Dipsadidae with 22 species (27.5%) and Colubridae with 10 species (12.5%). *Chelonoides carbonaria*, *Caiman crocodilus* and *Hemidactylus mabouia* are not native reptiles to the CPI.

Most amphibians occurred in a wide range of environments at the CPI: we recorded 24 species (63.2%) in at least three (60%) of the sampled environments. The reptiles, on the contrary, showed a different pattern, since 52 species (62.6%) had a restricted distribution (up to two environments); 38 species (45.8%) were restricted to only one environment. Only 29 species (34.9%) had a wide distribution within the complex.

Some amphibians were restricted to only one environment: *Leptodactylus* sp. (aff. *hylaedactylus*) in the arboreal caatinga; *Pseudopaludicola* sp. (aff. *saltica*) in the cerrado; *Dendropsophus rubicundulus*, *Scinax fuscomarginatus*, *Physalaemus cicada*, *Pseudopaludicola* sp. (gr. *mystacalis*), *Elachistocleis piauiensis* in the low altitude caatinga; and *Adelophryne baturitensis* and *Odontophrynus carvalhoi* were restricted to the relict forest.

The reptiles collected in only one environment were mainly associated with relict forests: *Chelonoides carbonaria*, *Mesoclemmys perplexa*, *Amphisbaena pretrei*, *Amphisbaena polystegum*, *Anolis fuscoauratus*, *Polychrus marmoratus*, *Enyalius bibronii*, *Strobilurus torquatus*, *Cercosaura ocellata*, *Leposoma baturitensis*, *Mabuya nigropunctata*, *Ophiodes* sp. (aff. *striatus*), *Typhlops brongersmianus*, *Corallus hortulanus*, *Bothrops* sp. (gr. *atrox*), *Micrurus* cf. *lemniscatus ditius*, *Chironius bicarinatus*, *Drymoluber dichrous*, *Mastigodryas boddaerti boddaerti*, *Pseustes sulphureus*, *Xenopholis undulatus*, *Atractus ronnie*, *Imantodes cenchoa cenchoa*, *Apostolepis* sp. (gr. *pimy*), *Liophis taeniogaster*, *Oxyrhopus melanogenys*, and *Taeniophalus affinis*. Other reptiles were found only in the low altitude caatinga: *Kinosternon scorpioides*, *Caiman crocodilus*, *Vanzosaura rubricauda*, *Lygophis dilepis*, and *Psomophis joberti*; high altitude caatinga: *Diploglossus lessonae*, *Thamnodynastes* sp. and *Bothropoides lutzi*; and arboreal caatinga: *Mabuya arajara*, *Liotyphlops* cf. *ternetzi*, and *Micrurus lemniscatus lemniscatus*.

Thirty-three (86.8%) species of amphibians were considered non-threatened. The other species *Pristimantis* sp., *Adelophryne baturitensis*, *Pseudopaludicola* sp. (aff. *saltica*), *Scinax fuscomarginatus*, and *Odontophrynus carvalhoi* showed only one parameter considered as rare (classified in the categories B, C, and E - see Tables 2 and 4).

Reptiles showed a broader range in the scale of rarity (Tables 3 and 4). As the amphibians, most reptiles (43 species, 51.8%) were classified as not rare and not threatened. A total of 33 species (39.8%) were classified as E: locally rare species that have a wide distribution and are habitat-generalists. *Imantodes cenchoa cenchoa* was classified as F. *Leposoma baturitensis*, *Bothrops* sp. (gr. *atrox*), *Atractus ronnie*, *Apostolepis* sp. (gr. *pimy*) were classified as G and showed two parameters of rarity. *Mesoclemmys perplexa* was the only species included in the category H and, therefore, considered the rarest species in the whole complex of Ibiapaba mountain range.

Discussion

In the first species list for the State of Ceará there were 34 amphibians and 68 reptiles (Lima-Verde & Cascon 1990). Since then, regional studies have been adding species and improving knowledge on the herpetofauna of Ceará. However, efforts were still not enough for a more complete knowledge of the herpetofauna, and those studies usually have added only the most common species. For example, Borges-Nojosa & Caramaschi (2003), who inventoried five areas of relict forests in Ceará, including CPI, concluded that the herpetofauna of all areas would sum up 115 species. In the present study we sampled 121 species of amphibians and reptiles only in CPI,

Table 2. List of amphibians from the CPI, State of Ceará, Brazil, with their respective rarity level (sensu Rabinowitz 1981) and environments where they are found (AC = Arboreal Caatinga; CE = Cerrado; LC = Low Altitude Caatinga; RF = relictual moist forests and; HC = High Altitude Caatinga).

Taxon	Rarity level	Environment observed				
		AC	CE	LC	RF	HC
Class Amphibia Gray, 1825 (38 species)						
Order Anura Fischer von Waldheim, 1813 (37 species)						
Family Eleutherodactylidae Lutz, 1954 (1 species)						
Subfamily Phyzelaphryninae Hedges, Duellman, and Heinicke, 2008						
Genus *Adelophryne* Hoogmoed and Lescure, 1984						
1 *Adelophryne baturitensis* Hoogmoed, Borges, and Cascon, 1994	C	-	-	-	X	-
Family Brachycephalidae Günther, 1858 (1 species)						
Genus *Pristimantis* Jiménez de la Espada, 1870						
2 *Pristimantis* sp.	B	X	-	-	X	X
Family Hylidae Rafinesque, 1815 (14 species)						
Subfamily Phyllomedusinae Günther, 1858						
Genus *Phyllomedusa* Wagler, 1830						
3 *Phyllomedusa nordestina* Caramaschi, 2006	A	X	-	X	X	X
Subfamily Hylinae Rafinesque, 1815						
Genus *Corythomantis* Boulenger, 1896						
4 *Corythomantis greeningi* Boulenger, 1896	A	X	-	X	X	X
Genus *Dendropsophus* Fitzinger, 1843						
5 *Dendropsophus* sp. (gr. *microcephalus*)	A	-	-	X	X	X
6 *Dendropsophus minutus* (Peters, 1872)	A	-	-	X	X	X
7 *Dendropsophus nanus* (Boulenger, 1889)	A	-	-	X	X	X
8 *Dendropsophus rubicundulus* (Reinhardt and Lütken, 1862)	A	-	-	X	-	-
9 *Dendropsophus soaresi* (Caramaschi and Jim, 1983)	A	-	-	X	X	X
Genus *Hypsiboas* Wagler, 1830						
10 *Hypsiboas multifasciatus* (Günther, 1859)	A	X	-	-	X	-
11 *Hypsiboas raniceps* Cope, 1862	A	X	-	X	X	X
Genus *Scinax* Wagler, 1830						
12 *Scinax fuscomarginatus* (A. Lutz, 1925)	E	-	-	X	-	-
13 *Scinax nebulosus* (Spix, 1824)	A	-	-	-	X	X
14 *Scinax* sp. (gr. *ruber*)	A	X	X	X	X	X
15 *Scinax* cf. *x-signatus* (Spix, 1824)	A	X	X	X	X	X
Genus *Trachycephalus* Tschudi, 1838						
16 *Trachycephalus venulosus* (Laurenti, 1768)	A	X	X	X	X	X
Family Leiuperidae Bonaparte, 1850 (7 species)						
Genus *Physalaemus* Fitzinger, 1826						
17 *Physalaemus albifrons* (Spix, 1824)	A	-	-	X	-	X
18 *Physalaemus cicada* Bokermann, 1966	A	-	-	X	-	-
19 *Physalaemus cuvieri* Fitzinger, 1826	A	X	X	X	X	X
Genus *Pleurodema* Tschudi, 1838						
20 *Pleurodema diplolister* (Peters, 1870)	A	X	X	X	-	X
Genus *Pseudopaludicola* Miranda-Ribeiro, 1926						
21 *Pseudopaludicola* sp. (gr. *falcipes*)	A	-	-	X	X	X
22 *Pseudopaludicola* sp. (gr. *mystacalis*)	A	-	-	X	-	-
23 *Pseudopaludicola* sp. (aff. *saltica*)	C	-	X	-	-	-
Family Leptodactylidae Werner, 1896 (8 species)						
Genus *Leptodactylus* Fitzinger, 1826						
24 *Leptodactylus* sp. (aff. *andreae*)	A	X	X	-	X	X
25 *Leptodactylus fuscus* (Schneider, 1799)	A	X	-	X	X	X
26 *Leptodactylus* sp. (aff. *hylaedactylus*)	A	X	-	-	-	-
27 *Leptodactylus macrosternum* Miranda-Ribeiro, 1926	A	X	X	X	X	X
28 *Leptodactylus mystaceus* (Spix, 1824)	A	X	-	X	X	X

Table 2. Continued...

Taxon	Rarity level	Environment observed				
		AC	CE	LC	RF	HC
29 *Leptodactylus* sp. (aff. *syphax*)	A	X	X	-	-	-
30 *Leptodactylus troglodytes* Lutz, 1926	A	X	X	X	X	X
31 *Leptodactylus vastus* (Lutz, 1930)	A	X	X	X	X	X
Family Cyclorhamphidae Bonaparte, 1850 (2 species)						
Subfamily Alsodinae Mivart, 1869						
Genus *Odontophrynus* Reinhardt and Lütken, 1862						
32 *Odontophrynus carvalhoi* Savage & Cei, 1965	E	-	-	-	X	-
Genus *Proceratophrys* Miranda-Ribeiro, 1920						
33 *Proceratophrys cristiceps* (Müller, 1883)	A	X	X	X	X	X
Family Bufonidae Gray, 1825 (2 species)						
Genus *Rhinella* Fitzinger, 1826						
34 *Rhinella granulosa* (Spix, 1824)	A	X	X	X	X	X
35 *Rhinella jimi* (Stevaux, 2002)	A	X	X	X	X	X
Family Microhylidae (2 species)						
Subfamily Gastrophryninae Fitzinger, 1843						
Genus *Dermatonotus* Méhely, 1904						
36 *Dermatonotus muelleri* (Boettger, 1885)	A	-	-	X	X	X
Genus *Elachistocleis* Parker, 1927						
37 *Elachistocleis piauiensis* Caramaschi & Jim, 1983	A	-	-	X	-	-
Order Gymnophiona Müller, 1832 (1 species)						
Family Caeciliidae Rafinesque, 1814 (1 species)						
Genus *Siphonops* Wagler, 1828						
38 *Siphonops* sp. (aff. *paulensis*)	A	X	-	-	X	-

evincing that those previous results were underestimates. Another evidence of the previous poor knowledge of the herpetofauna of Ceará is the high number of new occurrences and distribution extensions that have been recently published (e.g. Loebmann et al. 2007, Leite Jr. et al. 2008, Loebmann 2008a, b, c, Loebmann & Mai, 2008a, Loebmann 2009a, b, c, d, Loebmann et al. 2009, Roberto & Loebmann 2009).

Data for each relict forest available in the literature (see below) do not consider all groups of the herpetofauna, though it is already possible to find some comparable datasets and confirm the relevance of CPI. Borges-Nojosa (2007) found 88 species (30 amphibians and 58 reptiles) in Baturité mountain range: only 73% of the species richness found in CPI. For 'Chapada do Araripe', a relict forest located in the far Southern Ceará, there are data only on Squamate reptiles (Borges-Nojosa & Caramaschi 2003, Vanzolini et al. 1980, Vanzolini 1981, Ribeiro et al. 2008): 55 species were recorded, 20 less than in CPI.

For the relict forests of Maranguape and Aratanha, only data on amphisbaenas and lizards are available in the literature (Borges-Nojosa & Caramaschi 2003). Maranguape with 20 species: 16 lizards and 4 amphisbaenas; and Aratanha with 16 species: 14 lizards and 2 amphisbaenas; they represent only 52.6 and 42.1%, respectively, of the number of species found in CPI.

The fauna of xeric environments in the Caatinga biome comprises 49 amphibians and 107 reptiles (Rodrigues 2003). Considering only the species found in xeric environments of CPI, i.e., all environments except for the relict forest, 28 out of 49 amphibian species and 51 out of 107 reptile species occur in CPI, which corresponds to 57.1 and 49.6%, respectively, of the known herpetofauna for the whole Caatinga. Besides, more six amphibian species were recorded in this domain: *Dendropsophus rubicundulus*, *Leptodactylus* sp. (aff. *hylaedactylus*), *Pristimantis* sp., *Pseudopaludicola* sp. (aff. *saltica*), *Scinax fuscomarginatus* and *Scinax nebulosus*.

Comparing our results with the ones found for a fragment of Atlantic Forest in the State of Paraíba (Santana et al. 2008), and putting aside the different sizes of these localities, we could again observe a remarkably higher species richness in CPI, since only 51 species were found in that region in Paraíba, corresponding to 42.15% of the total number of species found in the present study.

There are not enough data in the literature on coastal areas. Loebmann & Mai (2008b) reported the occurrence of 22 amphibian species in the coastal zone of Piauí, a neighbor State of Ceará and 70 km apart in a straight line from CPI, from which 21 species also occur in CPI.

Inventories of herpetofauna in the Caatinga areas showed lower species richness when compared with our results. In Serra das Almas, an area located in Western Ceará, a total of 45 species were recorded (18 amphibians and 27 reptiles) (Borges-Nojosa & Cascon 2005). In Parque Estadual da Pedra da Boca and Capivara farm, State of Paraíba, 52 species were recorded: 21 amphibians and 31 reptiles (Arzabe et al. 2005). In Reservas Particulares do Patrimônio Natural de Maurício Dantas and Cantidiano Valgueiro, State of Pernambuco, 41 species were recorded: 19 amphibians and 22 reptiles (Borges-Nojosa & Santos 2005).

Borges-Nojosa & Caramaschi (2003) characterized the fauna of relict forests of Ceará as rainforest species, which are highly influenced by tree species typical of large Neotropical forests, occasionally including components from drier surrounding areas. Our results diverge from that characterization, as 94.7% of amphibians

Figure 3. Amphibian species found in the region of CPI. a) *Adelophryne baturitensis*; b) *Pristimantis* sp.; c) *Phyllomedusa nordestina*; d) *Corythomantis greeningi*; e) *Dendropsophus* sp. (gr. *microcephalus*); f) *Dendropsophus minutus*; g) *Dendropsophus nanus*; and h) *Dendropsophus rubicundulus*.

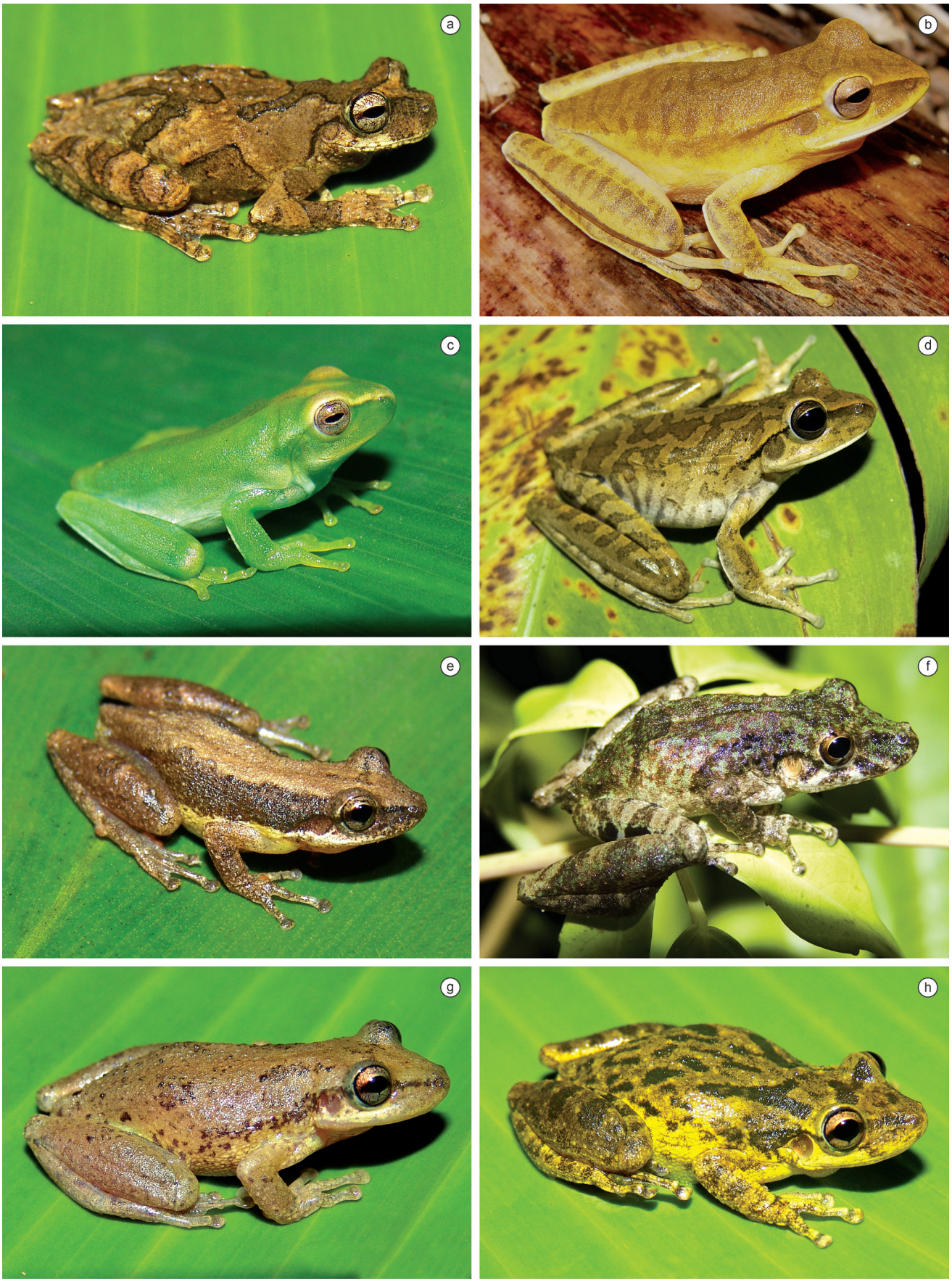

Figure 4. Amphibian species found in the region of CPI. a) *Dendropsophus soaresi*; b) *Hypsiboas multifasciatus*; c) *Hypsiboas raniceps* (juvenile); d) *Hypsiboas raniceps* (adult); e) *Scinax fuscomarginatus*; f) *Scinax nebulosus*; g) *Scinax* sp. (gr. *ruber*); and h) *Scinax* cf. *x-signatus*.

Figure 5. Amphibian species found in the region of CPI. a) *Trachycephalus venulosus*; b) *Physalaemus albifrons*; c) *Physalaemus cicada*; d) *Physalaemus cuvieri*; e) *Pleurodema diplolister*; f) *Pseudopaludicola* sp. (gr. *falcipes*); g) *Pseudopaludicola* sp. (gr. *mystacalis*); and h) *Pseudopaludicola* sp. (aff. *saltica*).

Figure 6. Amphibian species found in the region of CPI. a) *Leptodactylus* sp. (aff. *andreae*); b) *Leptodactylus fuscus*; c) *Leptodactylus* sp. (aff. *hylaedactylus*); d) *Leptodactylus macrosternum*; e) *Leptodactylus mystaceus*; f) *Leptodactylus* sp. (aff. *syphax*); g) *Leptodactylus troglodytes*; and h) *Leptodactylus vastus*.

Figure 7. Amphibian species found in the region of CPI. a) *Odontophrynus carvalhoi*; b) and c) *Proceratophrys cristiceps*; d) *Rhinella granulosa*; e) *Rhinella jimi*; f) *Dermatonotus muelleri*; g) *Elachistocleis piauiensis*; and h) *Siphonops* sp. (aff. *paulensis*).

Table 3. List of reptiles from the CPI, State of Ceará, Brazil, with their respective rarity level (sensu Rabinowitz 1981) and environments where they were found (AC = Arboreal Caatinga; CE = Cerrado; LC = Low Altitude Caatinga; RF = relictual moist forests and; HC = High Altitude Caatinga).

Taxon	Rarity level	Environment observed				
		AC	CR	LC	RF	HC
Class Reptilia Laurenti, 1768 (83 species)	-	-	-	-	-	-
Order Testudines Linnaeus, 1758 (4 species)	-	-	-	-	-	-
Suborder Cryptodira Cope, 1869 (2 species)	-	-	-	-	-	-
Family Testudinidae Batsch, 1788 (1 species)	-	-	-	-	-	-
Genus *Chelonoides* Fitzinger, 1835	-	-	-	-	-	-
1 *Chelonoides carbonaria* (Spix, 1824) (Introduced)	E	-	-	-	X	-
Family Kinosternidae Baur, 1893 (1 species)	-	-	-	-	-	-
Genus *Kinosternon* Spix, 1824	-	-	-	-	-	-
2 *Kinosternon scorpioides* (Linnaeus, 1766)	E	-	-	X	-	-
Suborder Pleurodira Cope, 1869	-	-	-	-	-	-
Family Chelidae Gray, 1825 (2 species)	-	-	-	-	-	-
Genus *Mesoclemmys* Gray, 1863	-	-	-	-	-	-
3 *Mesoclemmys perplexa* Bour & Zaher, 2005	H	-	-	-	X	-
4 *Mesoclemmys tuberculata* (Lüderwaldt, 1926)	A	X	-	X	X	X
Order Crocodylia Gmelin, 1789 (1 species)	-	-	-	-	-	-
Family Alligatoridae Cuvier, 1807 (1 species)	-	-	-	-	-	-
Genus *Caiman* Spix, 1825	-	-	-	-	-	-
5 *Caiman crocodilus* (Linnaeus, 1758) (Introduced)	E	-	-	X	-	-
Order Squamata Oppel, 1811 (75 species)	-	-	-	-	-	-
Suborder Amphisbaenia Gray, 1844	-	-	-	-	-	-
Family Amphisbaenidae Gray, 1865 (5 species)	-	-	-	-	-	-
Genus *Amphisbaena* Linnaeus, 1758	-	-	-	-	-	-
6 *Amphisbaena alba* Linnaeus, 1758	A	-	-	-	X	X
7 *Amphisbaena pretrei* Duméril & Bibron, 1839	E	-	-	-	X	-
8 *Amphisbaena vermicularis* Wagler, 1824	A	-	-	X	X	X
9 *Amphisbaena anomala* (Barbour, 1914)	A	-	-	-	X	X
10 *Amphisbaena polystegum* (Duméril, 1851)	A	-	-	-	X	-
Suborder Sauria McCartney, 1802	-	-	-	-	-	-
Infraorder Iguania Cope, 1864 (5 species)	-	-	-	-	-	-
Family Iguanidae Oppel, 1811 (1 species)	-	-	-	-	-	-
Genus *Iguana* Laurenti, 1768	-	-	-	-	-	-
11 *Iguana iguana* (Linnaeus, 1758)	A	X	-	X	X	X
Family Polychrotidae Fitzinger, 1843 (3 species)	-	-	-	-	-	-
Genus *Anolis* Daudin, 1802	-	-	-	-	-	-
12 *Anolis fuscoauratus* D'Orbigny, 1837	A	-	-	-	X	-
Genus *Polychrus* Cuvier, 1817	-	-	-	-	-	-
13 *Polychrus acutirostris* Spix, 1825	A	X	-	X	-	X
14 *Polychrus marmoratus* (Linnaeus, 1758)	A	-	-	-	X	-
Family Leiosauridae Frost, Etheridge, Janies, & Titus, 2001 (1 species)	-	-	-	-	-	-
Subfamily Enyaliinae Frost, Etheridge, Janies, & Titus, 2001	-	-	-	-	-	-
Genus *Enyalius* Wagler 1830	-	-	-	-	-	-
15 *Enyalius bibronii* Boulenger, 1885	A	-	-	-	X	-
Family Tropiduridae Bell, 1843 (3 species)	-	-	-	-	-	-
Genus *Strobilurus* Wiegmann, 1834	-	-	-	-	-	-
16 *Strobilurus torquatus* Wiegmann, 1834	E	Not observed*				
Genus *Tropidurus* Wied-Neuwied, 1824	-	-	-	-	-	-
17 *Tropidurus hispidus* (Spix, 1825)	A	X	X	X	X	X
18 *Tropidurus semitaeniatus* (Spix, 1825)	A	X	X	X	X	X
Infraorder Gekkota Cuvier, 1817	-	-	-	-	-	-

* Species previously collected by Borges-Nojosa & Caramaschi (2003).

Table 3. Continued...

Taxon	Rarity level	Environment observed				
		AC	CR	LC	RF	HC
Family Gekkonidae Gray, 1825 (3 species)	-	-	-	-	-	-
Genus *Hemidactylus* Gray, 1825	-	-	-	-	-	-
19 *Hemidactylus brasilianus* (Amaral, 1935)	E	Not observed*				
20 *Hemidactylus agrius* Vanzolini, 1978	A	X	X	X	X	X
21 *Hemidactylus mabouia* (Moreau de Jonnès, 1818) (Alien)	A	-	-	-	X	-
Family Phyllodactylidae Gamble, Bauer, Greenbaum & Jackman, 2008 (1 species)	-	-	-	-	-	-
Genus *Phyllopezus* Peters, 1877	-	-	-	-	-	-
22 *Phyllopezus pollicaris* (Spix, 1825)	A	X	-	X	-	X
Family Sphaerodactylidae Underwood, 1954 (1 species)	-	-	-	-	-	-
Genus *Coleodactylus* Parker, 1926	-	-	-	-	-	-
23 *Coleodactylus merionalis* (Boulenger, 1888)	A	-	-	-	X	-
Infraorder Scincomorpha Camp, 1923 (12 species)	-	-	-	-	-	-
Family Gymnophthalmidae Merrem, 1820 (7 species)	-	-	-	-	-	-
Subfamily Cercosaurinae Gray 1838	-	-	-	-	-	-
Genus *Cercosaura* Wagler, 1830	-	-	-	-	-	-
24 *Cercosaura ocellata* Wagler, 1830	E	-	-	-	X	-
Genus *Colobosaura* Boulenger, 1887	-	-	-	-	-	-
25 *Colobosaura modesta* (Reinhardt & Lütken, 1862)	E	Not observed*				
Genus *Stenolepis* Boulenger, 1888	-	-	-	-	-	-
26 *Stenolepis ridleyi* Boulenger, 1887	E	Not observed*				
Subfamily Ecpleopinae Fitzinger, 1843	-	-	-	-	-	-
Genus Colobosauroides Cunha & Lima-Vende, 1991	-	-	-	-	-	-
27 *Colobosauroides cearensis* Cunha, Lima-Verde & Lima, 1991	E	X	-	-	X	-
Genus *Leposoma* (Spix, 1825)	-	-	-	-	-	-
28 *Leposoma baturitensis* Rodrigues & Borges, 1997	G	-	-	-	X	-
Subfamily Gymnophthalminae Merrem, 1820	-	-	-	-	-	-
Genus *Micrablepharus* Dunn, 1932	-	-	-	-	-	-
29 *Micrablepharus maximiliani* (Reinhardt & Lutker, 1862)	E	X	X	X	X	X
Genus *Vanzosaura* Rodrigues, 1991	-	-	-	-	-	-
30 *Vanzosaura rubricauda* (Boulenger, 1902)	E	-	-	X	-	-
Family Scincidae Gray, 1825 (3 species)	-	-	-	-	-	-
Subfamily Lygosominae Greer, 1970	-	-	-	-	-	-
Genus *Mabuya* Fitzinger, 1826	-	-	-	-	-	-
31 *Mabuya arajara* Rebouças-Spieker, 1981	E	X	-	-	-	-
32 *Mabuya heathi* Schmidt & Inger, 1951	A	X	X	X	X	X
33 *Mabuya nigropunctata* (Spix, 1825)	A	-	-	-	X	-
Family Teiidae Gray, 1827 (3 species)	-	-	-	-	-	-
Subfamily Teiinae Merrem, 1820	-	-	-	-	-	-
Genus *Ameiva* Meyer, 1795	-	-	-	-	-	-
34 *Ameiva ameiva* (Linnaeus, 1758)	A	X	X	X	X	X
Genus *Cnemidophorus* Wagler, 1830	-	-	-	-	-	-
35 *Cnemidophorus ocellifer* (Spix, 1825)	A	X	X	X	X	X
Subfamily Tupinambinae Daudin, 1802	-	-	-	-	-	-
Genus *Tupinambis* Daudin, 1810	-	-	-	-	-	-
36 *Tupinambis merianae* (Duméril & Bibron, 1839)	A	X	-	-	X	X
Infraorder Diploglossa Cope, 1864	-	-	-	-	-	-
Family Anguidae Gray, 1825 (2 species)	-	-	-	-	-	-
Genus *Diploglossus* Wiegmann, 1834	-	-	-	-	-	-
37 *Diploglossus lessonae* Peracca, 1890	E	-	-	-	-	X
Genus *Ophiodes* Wagler, 1828	-	-	-	-	-	-

* Species previously collected by Borges-Nojosa & Caramaschi (2003).

Table 3. Continued...

Taxon	Rarity level	Environment observed				
		AC	CR	LC	RF	HC
38 *Ophiodes* sp. (aff. *striatus*)	C	-	-	-	X	-
Suborder Serpentes Linnaeus, 1758 (44 species)	-	-	-	-	-	-
Infraorder Scolecophidia Cope, 1864 (3 species)	-	-	-	-	-	-
Family Anomalepididae Taylor, 1939 (1 species)	-	-	-	-	-	-
Genus *Liotyphlops* Peters, 1881	-	-	-	-	-	-
39 *Liotyphlops* cf. *ternetzi* (Boulenger, 1896)	E	X	-	-	-	-
Family Leptotyphlopidae Stejneger, 1892 (1 species)	-	-	-	-	-	-
Genus *Siagonodon* Peters, 1881	-	-	-	-	-	-
40 *Siagonodon* sp. (aff. *brasiliensis*)	E	-	-	-	X	X
Family Typhlopidae Jan, 1863 (1 species)	-	-	-	-	-	-
Genus *Typhlops* Oppel, 1811	-	-	-	-	-	-
41 *Typhlops brongersmianus* Vanzolini, 1976	E	-	-	-	X	-
Infraorder Henophidia Nopcsa, 1923 (3 species)	-	-	-	-	-	-
Family Boidae Gray, 1842 (3 species)	-	-	-	-	-	-
Subfamily Boinae Gray, 1825	-	-	-	-	-	-
Genus *Boa* Linnaeus, 1758	-	-	-	-	-	-
42 *Boa constrictor constrictor* Linnaeus, 1758	A	X	-	X	X	X
Genus *Corallus* Daudin, 1803	-	-	-	-	-	-
43 *Corallus hortulanus* (Linnaeus, 1758)	A	-	-	-	X	-
Genus *Epicrates* Wagler, 1830	-	-	-	-	-	-
44 *Epicrates assisi* Machado, 1945	A	X	-	X	X	X
Infraorder Caenophidia Hoffstetter, 1939 (38 species)	-	-	-	-	-	-
Family Viperidae Oppel 1811 (3 species)	-	-	-	-	-	-
Genus *Bothrops* Wagler (in Spix), 1824	-	-	-	-	-	-
45 *Bothrops* sp. (gr. *atrox*)	G	-	-	-	X	-
Genus *Bothropoides* Fenwick, Gutberlet Jr, Evans, & Parkinson, 2009	-	-	-	-	-	-
46 *Bothropoides lutzi* (Miranda-Ribeiro, 1915)	E	-	-	-	-	X
Genus *Caudisona* Laurenti, 1768	-	-	-	-	-	-
47 *Caudisona durissa* (Linnaeus, 1758)	E	X	-	X	X	X
Family Elapidae Boie 1827 (3 species)	-	-	-	-	-	-
Genus *Micrurus* Wagler (in Spix), 1824	-	-	-	-	-	-
48 *Micrurus* sp. (aff. *ibiboboca*)	A	X	X	X	X	X
49 *Micrurus* cf. *lemniscatus ditius* Burger, 1955	A	-	-	-	X	-
50 *Micrurus lemniscatus lemniscatus* Burger, 1955	E	X	-	-	-	-
Superfamily Colubroidea Oppel, 1811 (32 species)	-	-	-	-	-	-
Family Colubridae Oppel, 1811 (10 species)	-	-	-	-	-	-
Genus *Chironius* Fitzinger, 1826	-	-	-	-	-	-
51 *Chironius bicarinatus* (Wied, 1820)	E	-	-	-	X	-
52 *Chironius flavolineatus* (Boettger, 1885)	A	X	-	X	X	X
Genus *Drymarchon* Fitzinger, 1843	-	-	-	-	-	-
53 *Drymarchon corais corais* (Boie, 1827)	A	X	-	X	X	X
Genus *Drymoluber* Amaral, 1930	-	-	-	-	-	-
54 *Drymoluber dichrous* (Peters, 1863)	E	-	-	-	X	-
Genus *Leptophis* Bell, 1825;	-	-	-	-	-	-
55 *Leptophis ahaetulla* (Linnaeus, 1758)	A	X	-	X	X	X
Genus *Mastigodryas* Amaral, 1934	-	-	-	-	-	-
56 *Mastigodryas boddaerti boddaerti* (Sentzen, 1796)	E	-	-	-	X	-
Genus *Oxybelis* Wagler, 1830	-	-	-	-	-	-
57 *Oxybelis aeneus* (Wagler, 1824)	A	X	-	X	X	X
Genus *Pseustes* Fitzinger, 1843;	-	-	-	-	-	-

* Species previously collected by Borges-Nojosa & Caramaschi (2003).

Table 3. Continued...

Taxon	Rarity level	Environment observed				
		AC	CR	LC	RF	HC
58 *Pseustes sulphureus sulphureus* (Wagler, 1824)	E	-	-	-	X	-
Genus *Spilotes* Wagler, 1830	-	-	-	-	-	-
59 *Spilotes pullatus* (Linnaeus, 1758)	E	X	-	X	X	X
Genus *Tantilla* Girard (in Baird & Girard), 1853	-	-	-	-	-	-
60 *Tantilla* sp. (aff. *melanocephala*)	A	X	-	X	X	X
Family Dipsadidae Bonaparte, 1838 (23 species)	-	-	-	-	-	-
Genus *Xenopholis* Peters, 1869 (*incertae sedis*)	-	-	-	-	-	-
61 *Xenopholis undulatus* (Jensen, 1900)	E	-	-	-	X	-
Subfamily Dipsadinae Bonaparte, 1838	-	-	-	-	-	-
Genus *Atractus* Wagler, 1828	-	-	-	-	-	-
62 *Atractus ronnie* Passos, Fernandes & Borges-Nojosa, 2007	G	-	-	-	X	-
Genus *Imantodes* Duméril, 1853	-	-	-	-	-	-
63 *Imantodes cenchoa cenchoa* (Linnaeus, 1758)	F	-	-	-	X	-
Genus *Leptodeira* Fitzinger, 1843	-	-	-	-	-	-
64 *Leptodeira annulata pulchriceps* (Duellman, 1958)	A	X	X	X	X	X
Genus *Sibon* Fitzinger, 1826	-	-	-	-	-	-
65 *Sibon nebulata nebulata* (Linnaeus, 1758)	A	-	-	-	X	X
Subfamily Xenodontinae Bonaparte, 1845	-	-	-	-	-	-
Genus *Apostolepis* Cope, 1861	-	-	-	-	-	-
66 *Apostolepis cearensis* Gomes, 1915	E	X	-	X	X	X
67 *Apostolepis* sp. (gr. *pimy*) Boulenger, 1903	G	-	-	-	X	-
Genus *Boiruna* Zaher, 1996	-	-	-	-	-	-
68 *Boiruna sertaneja* Zaher, 1996	E	-	-	X	-	X
Genus *Liophis* Wagler, 1830	-	-	-	-	-	-
69 *Liophis poecilogyrus schotti* (Schlegel,1837)	A	-	-	X	-	X
70 *Liophis reginae semilineata* (Wagler, 1824)	A	X	-	-	X	-
71 *Liophis taeniogaster* Jan, 1863	E	-	-	-	X	-
72 *Liophis viridis* Günther, 1862	A	-	-	X	-	X
73 *Liophis dilepis* Cope, 1862	E	-	-	X	-	-
Genus *Oxyrhopus* Wagler, 1830	-	-	-	-	-	-
74 *Oxyrhopus melanogenys orientalis* Cunha & Nascimento, 1983	A	-	-	-	X	-
75 *Oxyrhopus trigeminus* Duméril, Bibron & Duméril, 1854	A	X	-	X	X	X
Genus *Philodryas* Wagler, 1830	-	-	-	-	-	-
76 *Philodryas nattereri* Steindachner, 1870	A	X	-	X	X	X
77 *Philodryas olfersii herbeus* (Wied, 1825)	A	X	-	X	X	X
Genus *Pseudoboa* Schneider, 1801	-	-	-	-	-	-
78 *Pseudoboa nigra* (Duméril, Bibron & Duméril, 1854)	A	X	-	X	X	X
79 *Pseudoboa* sp.	A	X	-	X	X	X
Genus *Psomophis* Myers & Cadle, 1994	-	-	-	-	-	-
80 *Psomophis joberti* (Sauvage, 1884)	E	-	-	X	-	-
Genus *Taeniophallus* Cope, 1895	-	-	-	-	-	-
81 *Taeniophalus affinis* (Günther, 1858)	E	-	-	-	X	-
82 *Taeniophalus occipitalis* (Jan, 1863)	E	X	-	-	-	X
Genus *Thamnodynastes* Wagler, 1830	-	-	-	-	-	-
83 *Thamnodynastes* sp.	A	-	-	-	-	X
Genus *Xenodon* Boie, 1826	-	-	-	-	-	-
84 *Xenodon merremii* (Wagler, 1824)	A	X	-	X	X	X

* Species previously collected by Borges-Nojosa & Caramaschi (2003).

Figure 8. Reptile species found in the region of CPI. a) *Chelonoides carbonaria*; b) *Kinosternon scorpioides*; c) *Mesoclemmys perplexa*; d) *Mesoclemmys tuberculata*; e) *Caiman crocodilus*; f) *Amphisbaena alba*; g) *Amphisbaena pretrei*; and h) *Amphisbaena vermicularis*.

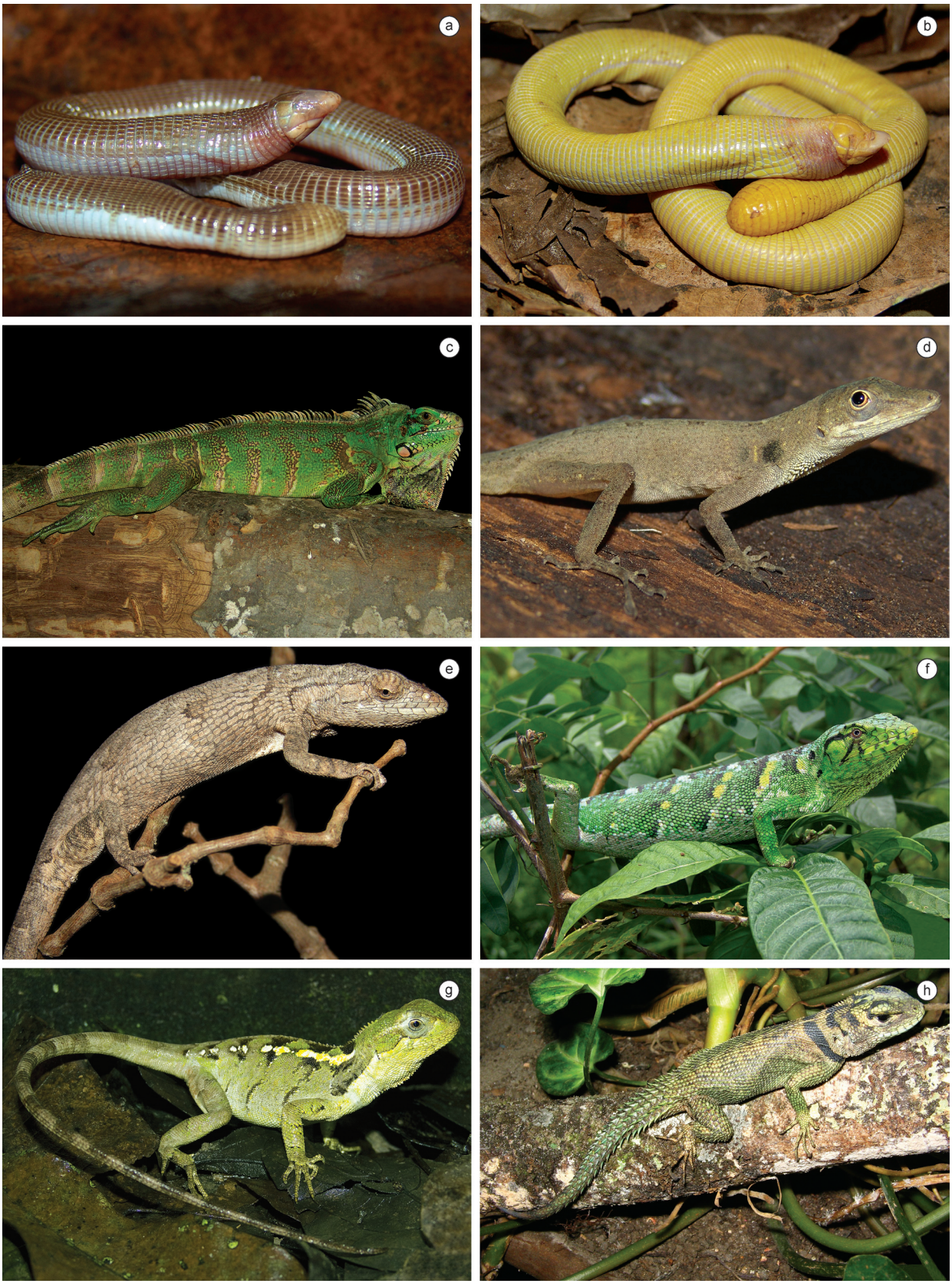

Figure 9. Reptile species found in the region of CPI. a) *Amphisbaena anomala*; b) *Amphisbaena polystegum*; c) *Iguana iguana*; d) *Anolis fuscoauratus*; e) *Polychrus acutirostris*; f) *Polychrus marmoratus*; g) *Enyalius bibronii*; and h) *Strobilurus torquatus*.

Figure 10. Reptile species found in the region of CPI. a) *Tropidurus hispidus*; b) *Tropidurus semitaeniatus*; c) *Hemidactylus agrius*; d) *Hemidactylus mabouia*; e) *Phyllopezus pollicaris*; f) *Coleodactylus merionalis*; g) *Cercosaura ocellata*; and h) *Colobosaura modesta*.

Figure 11. Reptile species found in the region of CPI. a) *Colobosauroides cearensis*; b) *Leposoma baturitensis*; c) *Micrablepharus maximiliani*; d) *Vanzosaura rubricauda*; e) *Mabuya arajara*; f) *Mabuya heathi*; g) *Mabuya nigropunctata*; and h) *Ameiva ameiva*.

Figure 12. Reptile species found in the region of CPI. a) *Cnemidophorus ocellifer*; b) *Tupinambis merianae*; c) *Diploglossus lessonae* (juvenile); d) *Diploglossus lessonae* (adult); e) *Ophiodes* sp. (aff. *striatus*); f) *Liotyphlops* cf. *ternetzi*; g) *Siagonodon* sp. (aff. *brasiliensis*); and h) *Typhlops brongersmianus*.

Figure 13. Reptile species found in the region of CPI. a) *Boa constrictor constrictor*; b) *Corallus hortulanus*; c) *Epicrates assisi*; d) *Bothrops* sp. (gr. *atrox*); e) *Bothropoides lutzi*; f) *Caudisona durissus*; g) *Micrurus* sp. (aff. *ibiboboca*); and h) *Micrurus* cf. *lemniscatus ditius*.

Figure 14. Reptile species found in the region of CPI. a) *Micrurus lemniscatus lemniscatus*; b) *Chironius bicarinatus*; c) *Chironius flavolineatus*; d) *Drymarchon corais corais*; e) *Drymoluber dichrous* (juvenile); f) *Drymoluber dichrous* (adult); g) *Leptophis ahaetulla*; and h) *Mastigodryas boddaerti boddaerti* (juvenile).

Figure 15. Reptile species found in the region of CPI. a) *Mastigodryas boddaerti boddaerti* (adult); b) *Oxybelis aeneus*; c) *Pseustes sulphureus* (juvenile); d) *Pseustes sulphureus* (adult); e) *Spilotes pullatus*; f) *Tantilla* sp. (aff. *melanocephala*); g) *Xenopholis undulatus*; and h) *Atractus ronnie*.

Figure 16. Reptile species found in the region of CPI. a) *Imantodes cenchoa cenchoa*; b) *Leptodeira annulata pulchriceps*; c) *Sibon nebulata nebulata*; d) *Apostolepis cearensis*; e) *Apostolepis* sp. (gr. *pimy*); f) *Boiruna sertaneja*; g) *Liophis poecilogyrus schotti* (juvenile); and h) *Liophis poecilogyrus schotti* (adult).

Figure 17. Reptile species found in the region of CPI. a) *Liophis reginae semilineata*; b) *Liophis taeniogaster*; c) *Liophis viridis* (juvenile); d) *Liophis viridis* (adult); e) *Lygophis dilepis*; f) *Oxyrhopus melanogenys orientalis*; g) *Oxyrhopus trigeminus*; and h) *Philodryas nattereri*.

Figure 18. Reptile species found in the region of CPI. a) *Philodryas olfersii herbeus*; b) *Pseudoboa nigra* (juvenile); c) *Pseudoboa* sp.; d) *Psomophis joberti*; e) *Taeniophalus affinis*; f) *Taeniophalus occipitalis*; g) *Thamnodynastes* sp.; and h) *Xenodon merremii*.

Table 4. Distribution of amphibians (A) and reptiles (R) species among different categories of vulnerability, according to a combination of geographic distribution, habitat specificity, and population size.

Populatoin size		Geographic distribution							
		Habitat specificity				Habitat specificity			
		Broad		Restricted		Broad		Restricted	
		A	R	A	R	A	R	A	R
Abundance	Total nº species	33	44	1	0	2	1	0	0
	Vulnerability index	4		3		3		2	
Rare	Total nº species	2	33	-	1	-	4	-	1
	Vulnerability index	3		2		2		1	

and 65.1% of reptiles are from open areas or have wide distribution, evidencing a strong influence of the open areas such Caatinga e Cerrado fauna on the relict forest.

The high species richness in CPI may be explained by a combination of factors: 1) the highest areas of the Planalto have the highest average annual rainfall and the lowest average annual temperature, which makes the climate of some areas milder and therefore favors the presence of species from higher latitudes, especially amphibians (e.g., *O. carvalhoi*); 2) the strong altitudinal gradient, undoubtedly represents an important factor on species composition of CPI; 3) the region has the most heterogeneous environment mosaic of the state, hence, harbors components of the fauna from four different biomes; e.g. *P. cicada* and *P. pollicaris* from Caatinga biome, *A. anomala* and *O. melanogenys* from Amazon Forest biome, *T. affinis* from Atlantic Forest biome, *B. lutzi* and *M. perplexa* from Cerrado biome; 4) apart from this mixture, the area shelters species apparently endemic of Ceará such as: *A. baturitensis*, *L. baturitensis* and *A. ronnie*; 5) and the area is partially protected by law, favouring some species, in particular those that are habitat-specific.

1.Conservation implications

The complex of Ibiapaba shelters a rich herpetofauna, which is highly representative of the State of Ceará. We estimate that about 70% of species found in Ceará occur in this complex. Colubrids are also very well-represented in the region, corresponding to almost 30% of the number of species recorded in Brazil (Bérnils 2010).

The Catinga biome has about 735,000 km^2 (Leal et al. 2005), and CPI comprises a little more than 0.7% of this area. However, over a half of the known herpetofauna of this biome (ca. 51%; see Rodrigues 2003) is present in CPI. These results, associated with the high species richness in CPI, when compared with studies on similar areas, indicate that this region may be considered as the area with the highest herpetofauna richness known for the whole Caatinga region, so far.

Agriculture and cattle grazing are historically the main causes of habitat loss in CPI (Borges-Nojosa & Caramaschi 2003). The complex has two priority areas for conservation of the Caatinga biological diversity: Planalto da Ibiapaba, classified as being of extreme biological importance, and Serra das Flores, classified as having very high biological importance (Tabarelli & Silva 2003). Although the complex includes protected areas, these may not be a guarantee of full preservation of forest remnants and their associated fauna. Therein, two out of the six studied environments within the CPI deserve more attention: the relict forests and the Cerrado. The relict forests in spite of constituting an almost continuous formation, representing a huge ecological corridor, are highly altered in the high areas of the plateau, without pristine forest fragments in the region. Therefore, it is likely that recent extinctions may have occurred as a result of human activities in these forests. For example, it is possible that *Rhinella hoogmoedi*, a species of forested areas that reproduces in lentic environments, was once present in CPI, since there is a population in the Baturité massif (Caramaschi & Pombal Jr. 2006), a similar area in the same latitude, but with better preserved fragments in its plateau. The Cerrado areas of CPI represent the far Northern distribution of this ecosystem in Brazil. The Cerrado areas (*campos rupestres*) in the CPI have low species richness when compared to the other sampled environments, but *Pseudopaludicola* sp. (aff. *saltica*) seems to be restricted to this environment.

Species from relict forests that show habitat specificity are the most susceptible to environment loss. Sixteen species out of 25 considered rare in CPI (two amphibians and 14 reptiles) are restricted to this environment. Remarkably, we found well-established populations of *Adelophryne baturitensis* in several areas of CPI. This species is considered vulnerable in the Red List of Threatened Species of Brazil, and until now was believed to be restricted to the Baturité massif (Haddad 2008).

Liotyphlops cf. *ternetzi*, *Bothrops* sp. (gr. *atrox*), *Typhlops brongersmianus*, *Ophiodes* sp. (aff. *striatus*), and *Mesoclemmys perplexa* deserve special attention, as they were not recorded in other areas in Ceará. Therefore, 5.8% of the herpetofauna in CPI is not apparently present in other areas of Ceará State.

Ultimately, we emphasize that high altitude caatingas are peculiar environments and have exclusive species, such as *Bothropoides lutzi* and *Diploglossus lessonae*. We also consider that these areas have the most severe lack of data within the complex; therefore, there is a real need for more sampling. Certainly, studies on this environment will increase the number of species present in this complex, as well as the possibility of finding new taxa.

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Appendix

Appendix 1. Voucher list of specimens collected at the CPI.

Amphibians. *Adelophryne baturitensis* (CFBH 20431-20440); *Corythomantis greeningi* (CFBH 16115, 16129-16130, 20450, 20450-20454); *Dendropsophus* sp. (gr. *microcephalus*) (CFBH 15883-15885); *Dendropsophus minutus* (CFBH 15852-15854); *Dendropsophus nanus* (CFBH 15857-15858); *Dendropsophus rubicundulus* (CFBH 23464); *Dendropsophus soaresi* (CFBH 15864-15865, 15869-15873, 16172, 19296-19311, 23472-23475); *Dermatonotus muelleri* (CFBH 16104-16105, 16107-16108, 16127-16128, 16172, 23435-23444); *Elachistocleis piauiensis* (CFBH 15880, 15902-15903, 23465-23471); *Hypsiboas multifasciatus* (CFBH 16142, 16147-16149, 16151-16156); *Hypsiboas raniceps* (CFBH 15998-16006, 16124, 23766); *Pristimantis* sp. (CFBH 16165, 20304-20318); *Leptodactylus* sp. (aff. *andreae*) (CFBH 15898); *Leptodactylus* sp. (aff. *hylaedactylus*) (CFBH 15887-15890, 20456-20458); *Leptodactylus fuscus* (CFBH 16122-16123, 16150); *Leptodactylus macrosternum* (CFBH 16121); *Leptodactylus mystaceus* (CFBH 16101, 16103, 16117, 16132); *Leptodactylus* sp. (aff. *syphax*) (CFBH 20398, 23747-23755); *Leptodactylus troglodytes* (CFBH 16133); *Leptodactylus vastus* (CFBH 23445-23446, 23765); *Odontophrynus carvalhoi* (CFBH 20301-20302, 20415, 23764); *Phyllomedusa nordestina* (CFBH 15868, 23447); *Physalaemus albifrons* (CFBH 16137-16140, 16157-16164); *Physalaemus cicada* (CFBH 19389-19392, 19395); *Physalaemus cuvieri* (CFBH 16136, 16170-16172); *Pleurodema diplolister* (CFBH 16143-16145, 16166-16169, 23769-23770, 23771-23776); *Proceratophrys cristiceps* (CFBH 16102, 16112-16114, 16119-16120, 16125-16126, 16131, 23756, 23455-23462, 23758-23762); *Pseudopaludicola* sp. (gr. *falcipes*) (CFBH 20298-20300); *Pseudopaludicola* sp. (gr. *mystacalis*) (CFBH 20285-20287); *Pseudopaludicola* sp. (gr. *saltica*) (CFBH 20288-20297); *Rhinella granulosa* (CFBH 16106, 16110-16111); *Rhinella jimi* (CFBH 16007-16009, 23395-23400); *Scinax* cf. *x-signatus* (CFBH 15874-15875); *Scinax fuscomarginatus* (CFBH 19386); *Scinax* sp. (gr. *ruber*) (CFBH 15876-15878); *Scinax nebulosus* (CFBH 15859-15861); *Siphonops* sp. (aff. *paulensis*) (CFBH 16135, 20399-20411); *Trachycephalus venulosus* (CFBH 16116, 16118, 23448-23449).

Reptiles. *Ameiva ameiva* (UFRGS 4958, ZUEC 3419); *Amphisbaena alba* (CRIB 484-485, 611); *Amphisbaena anomala* (CRIB 288, ZUEC 3412); *Amphisbaena polystegum* (CRIB 489); *Amphisbaena pretrei* (ZUEC 3379, 3411); *Amphisbaena vermicularis* (CRIB 487-488, UFRGS 4945, ZUEC 3431); *Anolis fuscoauratus* (UFRGS 4946, 4959, 4960); *Apostolepis cearensis* (IBSP 76855, 77101, 77109, 77509); *Apostolepis* sp. (gr *pimy*) (ZUEC 3384); *Atractus ronnie* (MNRJ 17326); *Boa constrictor constrictor* (IBSP 77053); *Boiruna sertaneja* (IBSP 77514, ZUEC 3402); *Bothrops* sp. (gr. *atrox*) (IBSP 77064, 77067, 77070-77071); *Bothropoides lutzi* (UFPB 4506, ZUEC 3373-3376); *Cercosaura ocellata* (MNRJ 9914-9915); *Chironius bicarinatus* (IBSP 77076); *Chironius flavolineatus* (IBSP 77058-77059, 77113-77114, 77529-77531); *Cnemidophorus ocellifer* (ZUEC 3381-3383); *Coleodactylus merionalis* (ZUEC 3485-3400); *Colobosaura modesta* (MNRJ 9916-9917); *Colobosauroides cearensis* (CHUNB 57380, ZUEC 3413, 3429-3430); *Corallus hortulanus* (IBSP 77056); *Caudisona durissus* (IBSP 77241-77243); *Drymarchon corais corais* (IBSP 77237, 77553); *Drymoluber dichrous* (IBSP 77074, 77506, ZUEC 3424); *Enyalius bibronii* (CHUNB 57375-57379; CRIB 615-617); *Epicrates assisi* (IBSP 77062, 77086, 77105, 77107, 77235, 77523); *Hemidactylus agrius* (UFRGS 4953-4956); *Hemidactylus mabouia* (CHUNB 57374, ZUEC 3415); *Iguana iguana* (CHUNB 57364); *Imantodes cenchoa cenchoa* (IBSP 77072); *Kinosternon scorpioides* (ZUEC 3377); *Leposoma baturitensis* (UFRGS 4957); *Leptodeira annulata pulchriceps* (IBSP 77054, 77060, 77525, 77526); *Leptophis ahaetulla* (IBSP 77075, 77240); *Siagonodon* sp. (aff. *brasiliensis*) (ZUEC 3380); *Liophis poecilogyrus schotti* (IBSP 77099, 77104, 77238); *Liophis reginae semilineata* (IBSP 77051, 77097, 77100, 77233, 77551-77552); *Liophis taeniogaster* (IBSP 76850, 77050, 77084, 77098, ZUEC 3428); *Liophis viridis* (IBSP 77108); *Liotyphlops* cf. *ternetzi* (IBSP 76856); *Lygophis dilepis* (IBSP 77115); *Mabuya arajara* (CHUNB 57367, 57370, ZUEC 3407); *Mabuya heathi* (UFRGS 4947); *Mabuya nigropunctata* (UFRGS 4948); *Mastigodryas boddaerti boddaerti* (IBSP 76844, 77234, 77510, 77554-77555, ZUEC 3416); *Mesoclemmys perplexa* (CRIB 289); *Mesoclemmys tuberculata* (CRIB 618); *Micrablepharus maximiliani* (UFRGS 4949-4950); *Micrurus* sp. (aff. *ibiboboca*) (IBSP 76849, 77073, 77081, 77093, 77112; 77512); *Micrurus* cf. *lemniscatus ditius* (IBSP 77096); *Micrurus lemniscatus lemniscatus* (IBSP 77079); *Ophiodes* sp. (aff. *striatus*) (UFRGS 4898-4915, ZUEC 3420, 3427); *Oxybelis aeneus* (IBSP 77088, 77237, 77532); *Oxyrhopus melanogenys orientalis* (IBSP 76842, 77061, 77069, 77082, 77089, 77232); *Oxyrhopus trigeminus* (IBSP 76853, 77057, 77085, 77090, 77092, 77094, 77111, 77539-77540); *Philodryas nattereri* (IBSP 76840, 76854, 77083); *Philodryas olfersii herbeus* (IBSP 77077, 77535-77538); *Phyllopezus pollicaris* (CHUNB 57388-57436; 57515); *Polychrus acutirostris* (CRIB 612-614); *Polychrus marmoratus* (CHUNB57381-57386); *Pseudoboa nigra* (IBSP 77052, 77102, 77547-77549); *Pseudoboa* sp. (IBSP 77550); *Pseustes sulphureus* (IBSP 77504; 77505); *Psomophis joberti* (IBSP 76843); *Sibon nebulata nebulata* (IBSP 76848, 77063, 77065, 77068, 77087, 77096, 77527, 77528); *Spilotes pullatus* (IBSP 77503, ZUEC 3401); *Taeniophalus affinis* (IBSP 76363, 76364); *Taeniophalus occipitalis* (IBSP 76852, 77508, ZUEC 3405); *Tantilla* sp. (aff. *melanocephala*) (IBSP 76841, MNRJ 17331-17336, ZUEC 3409); *Thamnodynastes* sp. (IBSP 77507); *Tropidurus hispidus* (UFRGS 4952); *Tropidurus semitaeniatus* (UFRGS 4951); *Tupinambis merianae* (ZUEC 3372); *Typhlops brongersmianus* (IBSP 76365, 76845-76847); *Vanzosaura rubricauda* (CHUNB 57373); *Xenodon merremii* (IBSP 77066, 77533, 77534); *Xenopholis undulatus* (IBSP 76832, 77110).