Reptiles of the Complexo Energético Fundão-Santa Clara, central-south region of Paraná state, southern Brazil

Gilberto Alves de Souza Filho*, Luciano Leandro Plombon and Danilo José Vieira Capela

Hori Consultoria Ambiental, Rua Coronel Temístocles de Souza Brasil, 311, CEP 82.520-210, Curitiba, PR, Brazil

* Corresponding author. E-mail: gilbertoasfilho@yahoo.com.br

Abstract: Lists of reptiles of localities in Paraná are still scarce and restricted to three works, developed in the central-north and eastern regions of the state. Herein we present a list of reptiles of the Complexo Energético Fundão-Santa Clara, located in the central-south region of Paraná. The study was carried out from May 2010 to March 2012. We recorded 31 species: 20 snakes, seven lizards, two amphisbaenians and two testudines. We hope through this work contribute to a greater knowledge of the reptilian fauna of the central-south region of Paraná.

Key words: reptiles, Complexo Energético Fundão-Santa Clara, Paraná, Southern Brazil

INTRODUCTION

Brazil, with all its territorial extent and diversity of biomes, is among the countries with the richest fauna of reptiles, recording currently 760 species occurring in their territory (Costa and Bérnils 2014). In the state of Paraná 154 species are recorded, including nine chelonians, one crocodilian, eight amphisbaenians, 25 lizards and 111 snakes (Bérnils et al. 2007).

The knowledge of the reptilian fauna of Paraná is based on several works, mainly represented by lists of reptiles collected in the state by foreigners in past decades (Boettger 1906; Bérnils and Moura-Leite 1990, 2010), citations of new records for the state (Moura-Leite et al. 1996), studies of geographic distribution (D’Amato 1991; Ribas and Monteiro Filho 2002; Bérnils et al. 2007) and lists of endangered species (Morato et al. 1995; Bérnils et al. 2004). However, publications of lists of reptiles of localities in Paraná are still scarce and restricted to only three works (Bernarde and Machado 2002, 2006; Oliveira and Oliveira 2014).


In this work we present a list of species recorded during the execution of a monitoring program of the reptiles fauna in the area of the Complexo Energético Fundão-Santa Clara (CEFSC), in central-south Paraná. In addition to the field inventory, we also included museum records coming mainly from the faunal rescues previously carried out on the local.

MATERIALS AND METHODS

Study area

The CEFSC is constituted of two hydroelectric power plants located sequentially in the Jordão River, tributary of the Iguaçu River, in the central-south region of Paraná state (Figure 1). The Santa Clara Hydroelectric Power Plant (UHE Santa Clara) is situated between the municipalities of Candói and Pinhão (25°38′57″ S, 051°56′22″ W), and the Fundão Hydroelectric Power Plant (UHE Fundão) between Foz do Jordão and Pinhão (25°41′53″ S, 052°00′04″ W). These hydroelectric power plants went into operation between the years 2005 (Santa Clara) and 2006 (Fundão). The region is within the Terceiro Planalto Paranaense geomorphological unit (Maack 1981) and is located in the Atlantic Forest domain, comprising an ecotone between two phytosociognomies, Steppe and Araucaria Forest (Roderjan et al. 2002). The local climate is characterized according to the Cfb Köppen pattern, mesothermic humid subtropical, without a defined dry season, with mild summer and severe frosts (Cigolini et al. 2001).

Data Collection

The fieldwork was carried out every two months from May 2010 to March 2012, with duration of five days each phase. To the specimens record we used the following methods (Figure 1):
aquatic species, especially chelonians, areas of the reservoirs were covered daily and alternately with aluminum boat and outboard motor at low speed in the morning, between 09:30 h and 12:00 h, and in the afternoon, between 13:30 h and 16:00 h. The animals were visually searched on the banks of reservoirs, on rocks, logs and in the water. This method totaled 300 hours of sampling.

Funnel traps (adapted of Fitch 1951): Consisted of cylinders (1.2 m × 0.5 m) partially floating made of plastic mesh, with an inverted funnel in one openings, destined the capture of aquatic chelonians. These traps were scattered in the two reservoirs (12 in Santa Clara and seven in Fundão), baited with fresh fish and revised daily, staying active for a period of about five consecutive days during each phase. Total sampling effort of these traps was 1,140 funnels/day.

Occasional records: Corresponded to the record of specimens by other researchers during the fieldwork, generally in roads of the area during displacements with car.

To complete the list of species we also used museum records, available in the herpetological collection of the Museu de História Natural Capão da Imbuia (MHNCI) at Curitiba, Paraná, coming mainly from the faunal rescues previously carried out in the study area (Appendix 1).


Species not previously recorded to the region, when possible, were collected (collection permit IBAMA number 073/2010), killed by cooling, fixed in a solution of 10% formalin, preserved in a 70% ethanol solution, and deposited in the herpetological collection of the MHNCI (Appendix 1).

RESULTS
A total of 31 species of reptiles were recorded at CEFSC, including 20 snakes: Colubridae (n = 1), Dipsadidae (14), Elapidae (1), Viperidae (3) and Anomalepididae (1); seven lizards: Leiosauridae (1), Tropiduridae (1), Gymnophthalmidae (1), Teiidae (2), Scincidae (1) and Diploglossidae (1); two Amphibiaenidae; and two Chelidae (Figures 2 and 3; Table 1).

The majority of the recorded species during the fieldwork was found in open areas, represented locally by pastures and plantations, through the active search. The species recorded in the forest edge were found mainly in small dirt roads that border or cross forest fragments.

DISCUSSION
The 31 species found represent 20% of the 154 species registered to the state of Paraná (Bérnils et al. ...)
The majority of the observed species present wide distribution along the state. Contrary, some are restricted to a few localities in Paraná, in this group are included *Contomastix vacariensis* and *Philodryas agassizii*. *Contomastix vacariensis* was recorded only in the study area and in the municipality of Tibagi, central-eastern Paraná (Bérnils et al. 2004; Souza-Filho 2013). *Philodryas agassizii* occurs in the study area and in the municipalities of Palmeira, Ponta Grossa and Porto Amazonas, southeastern of the state (Souza-Filho and Plombon 2014). The record of *Philodryas agassizii* in this study represented the rediscovery of this species in Paraná, 40 years after the last record and it expanded its occurrence for the central-south region of the state (Souza-Filho and Plombon 2014).

The majority of the species preferentially occupy open areas, many of them are typical of these formations, such as *Boiruna maculata, Bothrops alternatus, Contomastix vacariensis, Crotalus durissus, Oxyrhopus rhomifer, Paraphimophis rusticus, Philodryas agassizii* and *P. patagoniensis* (Bérnils et al. 2007). Especially *C. vacariensis*, is endemic of the high elevation grasslands of the southern region of Brazil (Souza-Filho 2013). The occurrence of these species in the area corroborates with the environmental profile of the region, represented predominantly by Steppe phytophisiognomy.

Two species recorded are threatened of extinction in Paraná, *Phrynops williamsi* and *Contomastix vacariensis* are categorized as “Vulnerable” in the state (Bérnils et al. 2004). *Contomastix vacariensis* also has been categorized as “Vulnerable” at national level (MMA 2014). Among the main threats to *P. williamsi* in Paraná is the construction of hydroelectric power plants, which affect the availability of food resources to species and alter the lotic regime of rivers (Bérnils et al. 2004). The main threats to *C. vacariensis* are the agricultural expansion, cattle ranching, the use of fire in the preparation of pastures, and the planting of exotic species (Bérnils et al. 2004). During the fieldwork only *P. williamsi* was observed in the area, has been found only in the Jordão River rocky bed, and not in the reservoirs.

Within of the CEFSC is located the Parque Estadual...
Souza-Filho et al.  |  Reptiles of Complexo Energético Fundão-Santa Clara, Brazil

Figure 3. Some species of reptiles recorded at Complexo Energético Fundão-Santa Clara, state of Paraná, southern Brazil: A) *Paraphimophis rusticus*; B) *Philodryas agassizii*; C) *Philodryas patagoniensis*; D) *Thamnodynastes hypoconia*; E) *Thamnodynastes strigatus*; F) *Micrurus altirostris*; G) *Bothrops jararaca*; H) *Crotalus durissus*; I) *Liotyphlops beui*.

de Santa Clara, a conservation unit of integral protection created in 2006 and situated just below the dam of the UHE Santa Clara. The Park area was sampled during the fieldwork, being record nine species: *Atractus paraguayensis*, *Bothrops alternatus*, *B. jararaca*, *Cercosaura schreibersii*, *Crotalus durissus*, *Micrurus altirostris*, *Paraphimophis rusticus*, *Salvator merianae* and *Thamnodynastes strigatus*.

Comparing the number of species of reptiles with three other localities studied in Paraná, the region of Londrina presents the highest species richness (42 species; Bernarde and Machado 2002), then CEFSC (31 species; present study), Parque Estadual Mata dos Godoy (23 species; Bernarde and Machado 2006) and Colônia Castelhanos (21 species; Oliveira and Oliveira 2014). However, the majority of these areas present distinct phytosociomnies, the region of Londrina, including the Parque Estadual Mata dos Godoy, is represented by Semideciduous Forest, CEFSC by Steppe and Araucaria Forest, and Colônia Castelhanos by Ombrophilous Dense Forest.

Despite the significant species richness of reptiles found in Paraná, lists of species are still scarce in the state. We hope through this work contribute to a greater knowledge of the reptilian fauna of the central-south region of Paraná. We also emphasize the importance of more inventories in the state, as well as the effective publication of these studies.

ACKNOWLEDGEMENTS

We are grateful to A. Urben-Filho, A.C. de Azevedo, A.A. Gilliet, A.M. da Graça, A.H. Cruz, B.S.B. dos Santos, C.E. Conte, D.R. Zancanaro, F.R. Mendes, F.C. Straube, F.J. Venâncio, F. Teixeira, G.V. Bianconi, J. Dittrich, J.A. Rezini, L.R. Deconto, L.R. Mariotto, M.A.V. Vallejos, S. de Andrade, T. Molin and W.S. Teixeira for their assistance during fieldwork; to L.R. Deconto by the photo of *P. williamsi*; to Julio Cesar de Moura-Leite for the availability of the herpetological collection of MHNCI; to Instituto de Tecnologia para o Desenvolvimento (LACTEC) and Centrais Elétricas do Rio Jordão S/A (ELEJOR), especially to Luiz Eduardo Wolff, for logistic support in the field.
Table 1. Reptiles recorded at Complexo Energético Fundão-Santa Clara, central-south region of Paraná state, showing the habitat and the record type of the reptile species found in the area. Habitat: FE = forest edge; FO = forest (riparian forests); JR = Jordão River (rocky bed); OA = open areas (pastures and plantations); RE = reservoir. Record type: AS = active search; FT = funnel trap; MR = museum record; OR = occasional record; PT = pitfall trap.

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Habitat</th>
<th>Record type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Squamata</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chelidae</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydromedusa tectifera Cope, 1869</td>
<td>RE</td>
<td>FT; MR</td>
</tr>
<tr>
<td>Phrynops williamsi Rhodin &amp; Mittermeier, 1983</td>
<td>JR</td>
<td>AS</td>
</tr>
<tr>
<td><strong>Testudines</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anomalepididae</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crotalus durissus (Cope, 1891)</td>
<td>FO</td>
<td>PT; MR</td>
</tr>
<tr>
<td>Bothrops alternatus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bothrops jararaca</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crotalus durissus Linnaeus, 1758</td>
<td>OA</td>
<td>AS; MR; OR; PT</td>
</tr>
<tr>
<td>Lioyphlips beui (Amaral, 1924 )</td>
<td>FE</td>
<td>AS; MR</td>
</tr>
</tbody>
</table>

LITERATURE CITED


**Authors’ contribution statement:** GASF collected the data and wrote the text, and LLP and DJVC collected the data and revised the text.

**Received:** November 2014

**Accepted:** April 2015

**Academic editor:** Pedro M. S. Nunes

**Appendix 1.** Reptiles from Complexo Energético Fundão-Santa Clara housed in the herpetological collection of the Museum of História Natural Capão da Imbuia (MHCNI).

**Chelidae:** Hydromedusa tectifta (MHNCI 5154); Leiosauridae: Anisolepis grilli (MHNCI 12453-12459, 12468, 12569, 12594-12598);

**Tropiduridae:** Tropidurus catalanensis (MHNCI 12439, 12470);

**Teiidae:** Contomastix vacariensis (MHNCI 11536), Salvador merianae (MHNCI 12330, 12331, 12333, 12435, 12436, 12448-12451, 12585-12593);

**Diplodossidae:** Ophiodes infratetanus (MHNCI 12392, 12460-12462, 12599-12605); Amphibiana: Erythrolamprus microcephalus (MHNCI 12393-12396); Colubridae: Chironius bicarinatus (MHNCI 12369); Dipsadidae: Atractus paraguayensis (MHNCI 5156, 11714, 12344, 12345, 12362-12367, 12371, 12372, 12378-12385, 12397-12411, 12441-12443, 12463-12467), Boiruna maculata (MHNCI 12474, 12475), Erythrolamprus miliaris (MHNCI 12340, 12359-12361, 12386-12388, 12425, 12479), Erythrolamprus pocaclacrylus (MHNCI 5553), Helicops infratetanus (MHNCI 12423, 12442, 12443, 12430, Oxyrhopus clathratus (MHNCI 11706, 11711), Oxyrhopus rhombifer (MHNCI 11799), Paraphimophis rutilus (MHNCI 12335, 12336, 12357, 12358, 12370); Philodryas agassizii (MHNCI 12473), Philodryas olerissi (MHNCI 11797, 12337-12339, 12346-12352, 12376, 12389, 12421, 12422, 12444, 12445), Philodryas patagoniensis (MHNCI 12431), Thamnodynastes strigatus (MHNCI 5176, 11716, 11924, 12327-12329, 12342, 12343, 12377, 12428, 12479), Tomodon dorsatum (MHNCI 11498, 12368, 12446); Elapidae: Micrurus altirostris (MHNCI 5138, 12258, 12334, 12426, 12427, 12440, 12471); Viperidae: Bothrops alternatus (MHNCI 12432, 12434), Bothrops jararaca (MHNCI 5139, 11417, 11698-11704, 11707, 11709, 11710, 11712, 11713, 11715, 12292, 12332, 12341, 12353-12356, 12373-12375, 12472), Crotalus durissus (MHNCI 11416, 11700, 11705, 11708, 12437, 12438, 12476-12478); Anomalepididae: Liotyphylops beui (MHNCI 12390, 12391, 12412-12420, 12447, 12452).