
The Bahian Sand Dunes Whiptail Lizard *Cnemidophorus abaetensis* Dias, Rocha & Vrcibradic 2002 (Reptilia, Scleroglossa, Teiidae), geographic distribution and habitat use in Bahia, Brazil

MOACIR SANTOS TINÔCO^{1,2,3,4}, HENRIQUE COLOMBINI BROWNE RIBEIRO^{1,3}
and MARCELO ALVES DIAS^{1,3}

¹ *Centro de Ecologia e Conservação Animal (Centro ECOA – UCSAL), Avenida Prof. Pinto de Aguiar, 2589 - Pituvaçu - CEP: 41.740-090, Salvador, Bahia, Brazil.*

² *Departamento de Zoologia, Instituto de Ciências Biológicas, Universidade Católica do Salvador, Avenida Prof. Pinto de Aguiar, 2589 - Pituvaçu - CEP: 41.740-090, Salvador, Bahia, Brazil.*

³ *Lacerta Ambiental, Avenida Prof. Pinto de Aguiar, 2589 - Pituvaçu - CEP: 41.740-090, Salvador, Bahia, Brazil.*

⁴ Corresponding author: moacirst@ucsal.br or moacirtinoco@lacertaambiental.com.br

ABSTRACT - The Bahian Sand Dunes Whiptail Lizard is probably the most endangered reptile in Bahia, Brazil. It is an endemic lizard with a restricted distribution. Most of its populations are confined to a coastal sand dune vegetation ecosystem in the Atlantic Forest domain. Most of the literature records are disjunct and present occasional reports of the species in its natural habitat. Here we present a discussion of 11 new localities for the species, covering all the eight municipalities where it is originally distributed, and offer two new extensions of its geographic limits to the north and south. Our results indicate that the species has a confirmed contiguous distribution and its main populations are restricted to a single vegetation type. The species is suffering from severe habitat loss and efforts should be taken to address this and prevent the loss of genetic viability within its natural range.

THE genus *Cnemidophorus* comprises ten species of Whiptail Lizard (Bérnils, 2009), most of which occur in a variety of habitats in the Atlantic forest ecosystems in Brazil. Despite study of the ecology of the genus, knowledge on geographic distribution of *Cnemidophorus* in Bahia state, especially in Restinga habitats, is still very scarce. Among the ten known species, four of them, *Cnemidophorus abaetensis* (Fig. 1), *Cnemidophorus littoralis*, *Cnemidophorus nativo*, and *Cnemidophorus vacariensis*, are listed by the National Environmental Agency – IBAMA (Brazilian Institute for Natural Resources) as Vulnerable (Brasil, 2008). Major threats to the species include habitat loss, road and highway construction, environmental pollution and wildlife trafficking.

In Bahia two of the above species exist, *C. abaetensis* and *C. ocellifer*. *Cnemidophorus abaetensis*, the Bahian Sand Dunes Whiptail

Lizard, also known as the Abaeté Whiptail, was first described as endemic to the Restinga formation (Fig. 2) on the northern coast of Bahia at Abaeté Dunes (Dias et al., 2002). The region covers eight municipalities; Salvador, Lauro de Freitas, Camaçari, Mata de São João, Entre Rios, Esplanada, Conde, and Jandaíra (Fig. 3). Since its discovery at Abaeté, the species' geographic distribution has progressively extended to several areas surrounding the type locality. These areas include; APA (Environmental Protection Area) Lagoas e Dunas do Abaeté, Salvador, Bahia, Brazil and the northern and coastal areas of the region; Costa Azul, Baixios, and in the Guarajuba districts (Dias & Rocha, 2006), which include three further municipalities, Camaçari, Entre Rios and Jandaíra. Despite such information, there is still a lack of data describing the species geographic distribution and natural history. This creates a requirement for distribution records to fill gaps in territories that



Figure 1. An adult male *Cnemidophorus abaetensis* from the district of Praia do Forte, Mata de São João, Bahia, Brazil. This species has a distinct colour pattern when compared to most other *Cnemidophorus* spp. Although it has colour similarities to *C. littoralis* its supraocular scales differ (Dias et al., 2002). *C. abaetensis* and *C. littoralis* are geographically separated by two major river basins (Photograph © M.Tinôco).

Figure 2. Open sand shrub vegetation, the main habitat of *Cnemidophorus abaetensis*, Entre Rios municipality, Bahia, Brazil. Individuals can be found foraging within scrub on bare sand and soil, next to a nearby leaf-litter cover. When disturbed they retreat into refuges and dug holes. Note in the background, the typical sandy herbaceous beach vegetation with coconut palms, where most of the *C. ocellifer* specimens were recorded (Photograph © M.Tinôco).



are suffering habitat loss (Dias & Rocha, 2006; Machado et al., 2008). It is therefore necessary to increase research on this genera in Atlantic forests to reinforce action for species conservation in the country whilst maintaining and enhancing the creation of protected areas where vulnerable herpetofauna exists (Tinoco et al., 2008a).

Cnemidophorus abaetensis is one of the few active foragers of the genus found in the Restinga habitats that are distributed in the northern coastal region of the Atlantic forest of Brazil. In the north coast of Bahia (37°21'08.57" W on northern limit, and 38°30'03.57" W on southern limit of the species distribution), it is one of the most abundant and

widely distributed species. Other highly abundant species include *Tropidrus hygomi* Reinhardt & Luetken 1861 and *Cnemidophorus ocellifer* Spix 1825. *C. abaetensis*, is endemic to the north coast Bahian area and is categorized as 'under threat' by the National Red List (Machado et al., 2008). Its known distribution does not exceed 2,000 m from the high tide line. Hence its populations are at risk from tourist development (Dias et al., 2002; Dias & Rocha 2004; Dias & Rocha, 2006).

This paper presents new range findings for *C. abaetensis* across its geographic distribution in the state of Bahia and describes the major habitat types where it was found.

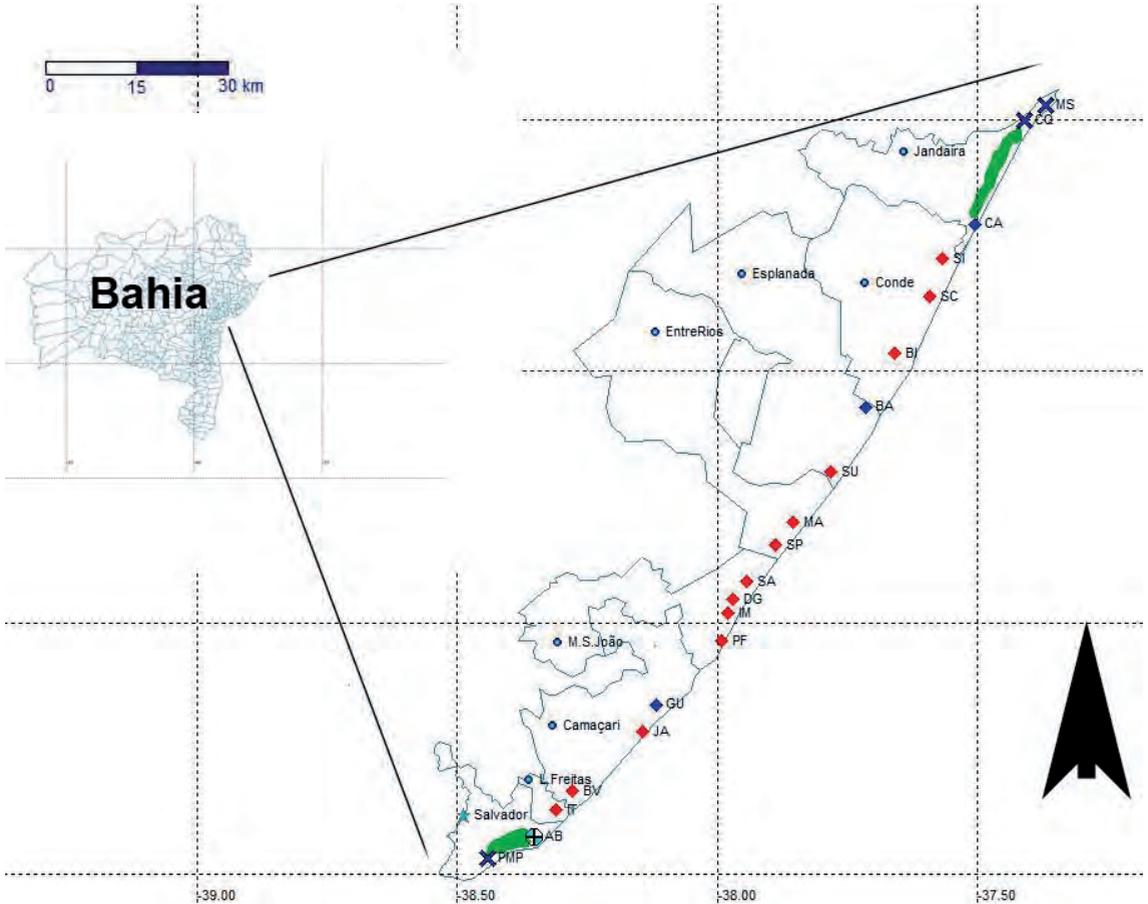


Figure 3. Geographic distribution of *Cnemidophorus abaetensis* in northern Bahia, Brazil. Red Diamonds = localities of sympatry between *C. abaetensis* and *C. ocellifer*; Black encircled cross = type locality; Green filled area = approximately extended distribution north and southbound; Blue Diamonds = literature records and confirmed localities; Red Diamonds = new localities (voucher specimens in Centro ECOA collection); Gray Lines = municipality limits; Blue X = new localities to the north and south; Capital city (Blue Star) and sites for main coastal cities are included with Blue dots.

METHODS AND MATERIALS

The region in which this study was conducted comprises approximately 220 km of coast line across eight municipalities and 25 metropolitan major districts (Fig. 3). The study's design covered all eight municipalities and 16 districts. Several field trips were carried out between 2005 and 2009 to the north coast municipalities to sample *C. abaetensis* by trapping and visual encounter survey. Lizards were sampled with ten pitfall traps (20 litres each) distributed on four transects covering major Restinga habitats, herbaceous sand dune vegetation, scrubby sand dune vegetation, and open scrubby vegetation in 16 localities.

Lizards were captured, marked and released at the site of capture. Survey and sample campaigns lasted for five days. Latitude, longitude and elevation were recorded using a Garmin™ GPS 12 Global Position Device and were later transferred to GPS Trackmaker™ software for complete distribution mapping and analysis (Fig. 3).

Voucher specimens from one locality were collected and deposited in the reference collection of the Animal Ecology and Conservation Center (ECOA), housed in the Biological Sciences Institute, of the University Catholic of Salvador, UCSAL, Salvador, Bahia, Brazil. Vouchers were

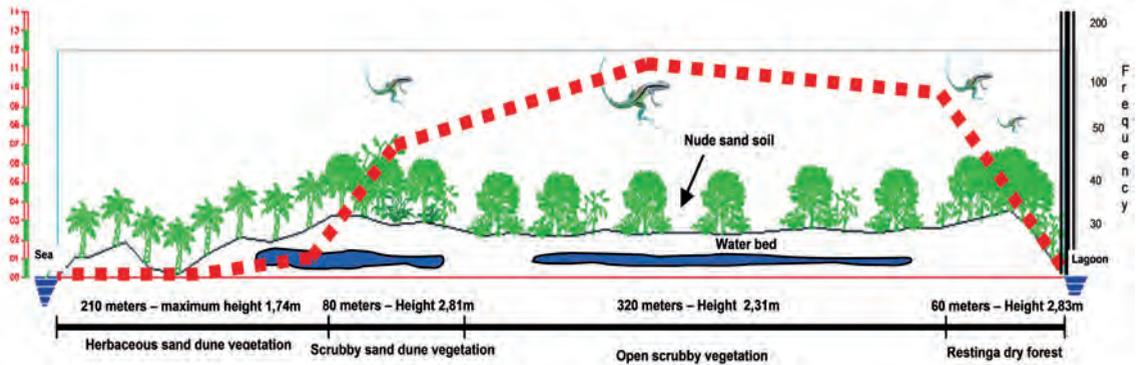


Figure 4. Broad habitat use of *Cnemidophorus abaetensis* in northern coast of Bahia based on the Praia do Forte locality’s data. Diagram shows species abundance in different vegetal formation (red dots). Note the species exhibits higher frequency on open shrub vegetation. The species frequency falls to zero on the herbaceous sand dune vegetation where *C. ocellifer* is abundant. On sand dune shrub vegetation the species frequency also falls where it meets the dense vegetated dry Restinga Forest habitat. *C. abaetensis* also becomes more frequent where the water bed is shallower (Diagram by C.M. Menezes, 2007).

collected under national environmental license number: 03/2009-NUFAU-IBAMA-BA.

RESULTS

The study captured and sampled (via pitfall traps and visual search) 618 lizards from 500 traps and 640 hours of field effort. Lizards were mainly found on open dune scrub habitats (> 70%) (Fig. 4) and some were also recorded in dry restinga forest habitat.

No lizards were found in the humid zones and herbaceous beach vegetation. The samples collected provide new distributional records and habitat types. One site, where the type locality exists showed specimens had extended into new territory, south of where they had previously been found.

New site locations are shown in Fig. 3, where we point out the previously known geographic distribution of the species based on literature and further localities surveyed as part of a biogeographical study of Bahian lizards, conducted by the ECOA, UCSAL (ECOA, 2009).

In thirteen localities, *Cnemidophorus abaetensis* was found in sympatry with *C. ocellifer* (Blue Spotted Whiptail Lizard) and other Teiids, including *Tupinambis merianae* Duméril & Bibron 1839 (Tegu Lizards), *Ameiva ameiva* Linnaeus 1758 (Greater Whiptail Lizard) and *Kentropix*

calcarata Spix 1825 (Water Whiptail Lizard). Over 40 amphibian species, some of them endemic to the restinga habitats, were also found in the same habitats (Tinoco et al., 2008b). Six localities between Guarajuba and Baixios, and from Baixios to Costa Azul represent major new localities for *Cnemidophorus abaetensis*. Ipitanga, Busca Vida, Barra do Jacuípe, Praia do Forte, Imbassaí, Diogo, Santo Antônio, Sauipe, Massarandupió, Subaúma, Barra do Itariri, Sítio do Conde, Siribinha, Coqueiros and Mangue Seco are also all new localities, not previously recognised in literature or other official records (Dias & Rocha, 2004; Dias & Rocha, 2006; Machado et al., 2008). One locality, Parque Metropolitano de Pituacu, south of the APA (Environmental Protection Area) Lagoas e Dunas do Abaete (type locality), represents a southerly extension of approximately 8.30 km relative to the previously known locality of *C. abaetensis*.

This means that all eight municipalities along the northern coast of Bahia now have records of *C. abaetensis*, filling a number of gaps on the map for this species in the region and State. All these localities are included in the political geographic distribution of Litoral Norte (North Coast), the second economic region of the State. The 16 localities studied are distant, occurring approximately 10 km from one another. With this in mind, we believe that the species shows a contiguous

distribution along the coastal line. However, we consider that because of habitat loss and other impacts on the species' natural environment it is possible that populations are becoming disjunct in some localities, especially those to south of its now known distribution.

Our results report not only new records which fill gaps between previously published localities, but also a significant extension in geographical range for *C. abaetensis*, which is verified by voucher specimens and consideration of previous literature. One specimen of *C. abaetensis* was found at the Pituauçu Metropolitan Park (12°57'55.78" S 38°24'38.51" W), on an open slope alongside a road. This locality is about 10 km south of APA Lagoas e Dunas do Abaeté, the southern-most locality cited by Dias & Rocha (2006).

DISCUSSION

Although *Cnemidophorus abaetensis* was found on the three major habitats of the Restinga ecosystems at Praia do Forte (12°32'39.66" S 37°59'22.59" W from 2005 to 2007) and Imbassai (12°28'45.00" S 37°57'23.21" W from 2005 to 2008) with some 247 and 184 individuals sampled respectively (Fig. 4), we found that our frequency of capture information showed the highest abundance of the species was in open scrub habitats. Dias & Rocha (2004) also verified that both species used open scrub vegetation on the APA Lagoas e Dunas do Abaeté.

The open scrub habitat lies between Restinga forest and herbaceous sand dune habitat to the east, and Atlantic Rainforest to the west. This type of habitat is more frequently used by *Cnemidophorus ocellifer* (Blue Spotted Whiptail Lizard) which is scarcely found in most open bush habitats (Dias & Rocha, 2004). Despite this, we noticed that in the sand dunes beach herbaceous vegetation *C. ocellifer* seemed to have low or no niche overlap with *C. abaetensis*.

The samples in our survey of the north coast of Bahia are intended to aid the future conservation of *Cnemidophorus abaetensis* and complete its geographic mapping. Although we recognize that the ecology of the taxon requires further study, our results provide a baseline of data. Pressures on the land from tourism that may alter populations

of *C. abaetensis*, and *C. ocellifer* by changing their distributional patterns is discussed by Browne-Ribeiro et al. (2008). Our study provides quantitative data toward showing that both species are affected by altered human habitat compared with data for natural habitats. Natural habitats seem to be the most suitable for the species (Dias & Rocha, 2004, 2006; Browne Ribeiro, et al., 2008) and because of the major threat of habitat loss imposed over these landscapes, we recommend the creation of regulations, through public policies to protect these habitats. As shown in our results, most of the species distribution is restricted to the Restinga habitats on the coast line of Bahia, which also agrees with Dias & Rocha (2006). However we suggest that *Cnemidophorus abaetensis* must be considered as more broadly distributed in the coastal Bahia State, as well as being an inhabitant of specialist open shrubby vegetation habitat. Given its status we recommend that the species should be considered for inclusion on a State Red List to assist in its protection.

In conclusion, we suggest, in support of Machado et al. (2008), that further new protected areas be created for *C. abaetensis* that improve measures to safeguard habitat. We acknowledge that such effort is already carried out by IBAMA (National Environmental Agency) in partnership with the ECOA Center. These institutions are proposing the creation of major conservation units, which will hopefully include over 30,000 ha of natural Restinga vegetation in three of the species' geographic municipalities, mostly at the northern end of its distribution. However, we advocate that the same measures should be allotted for the southerly distribution of the species range.

ACKNOWLEDGEMENTS

We thank the Centro de Ecologia e Conservação Animal, at the Universidade Católica do Salvador. The national environmental agency, Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis – IBAMA/MMA partnership on the Áreas Prioritárias para Conservação do Litoral Norte da Bahia Project. Thanks to Christiano Menezes for the use of the habitat profile diagram and the Lacerta Ambiental for field trip sponsorship. We also thank the entire land owner community

that allowed the research team to develop studies in their private properties. We sincerely thank Todd Lewis of the Herpetological Bulletin for editorial assistance.

REFERENCES

- Bérnils, R.S. (2009). Brazilian reptiles – List of species. <www.sbherpetologia.org.br/. Sociedade Brasileira de Herpetologia>. [Accessed: 27th April 2009].
- Brasil (2008). Lista Nacional das Espécies da Fauna Brasileira Ameaçadas de Extinção. Ministério do Meio Ambiente. Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis. <www.mma.gov.br/port/sbf/fauna/index.cfm>. [Accessed: April 2009].
- Browne Ribeiro, H.C., Tinoco, M.S., Dias, M.A., Santos, R.C. & Oliveira, M.L.T. (2008). Reptiles long term translocations and monitoring in Bahia, Brazil. 6th WCH. Manaus. Brazil. <<http://worldcongressofherpetology.org/index>>. [Accessed: April 2009].
- Dias, E.J.R., Rocha, C.F.D. & Vrcibradic, D. (2002). A new *Cnemidophorus* (Squamata: Teiidae) from Bahia State, northeastern Brazil. *Copeia* **2002**, 1070-1077.
- Dias, E.J.R. & Rocha, C.F.D. (2004). Thermal ecology, activity patterns and microhabitat use by two sympatric Whiptail Lizards (*Cnemidophorus abaetensis* and *Cnemidophorus ocellifer*) from northeastern Brazil. *J. Herpetol.* **38** (4), 586-588.
- Dias, E.J.R. & Rocha, C.F.D. (2006). Os répteis nas restingas do estado da Bahia: Pesquisa e ações para sua conservação. Rio de Janeiro: Instituto Biomas. 33 pp.
- ECO.A. (2009). Animais e Plantas do Parque Metropolitano de Pituáçu - Lista de Espécies. <www.ucsal.br/esquisa/ecoa/pesqapresentacao.asp>. Centro de Ecologia e Conservação Animal. [Accessed: April 2009].
- Machado, A.B.M., Drummond, G.M. & Paglia, A.P. (2008). Livro vermelho da fauna Brasileira ameaçada de extinção. Ministério do Meio Ambiente. IBAMA. Brasília. 46 pp.
- Tinoco, M.S., Browne Ribeiro, H.C., Dias, M.A. & Nascimento, I.A. (2008a). How much herpetofaunal diversity fits into the current protected areas network in Bahia, Brazil? 6th WCH. Manaus. Brazil. <<http://worldcongressofherpetology.org/index>>. [Accessed: April 2009].
- Tinoco, M.S., Browne Ribeiro, H.C., Dias, M.A., Santos, R.C. & Nascimento, I.A. (2008b). Habitat change and amphibian conservation in the Atlantic forest of Bahia - Brazil. *Froglog* **89**, 1-3.
-