SCIENTIFIC COMUNICATION

Records of the rattlesnakes *Crotalus durissus terrificus* (Laurenti) (Serpentes, Viperidae) in the State of Rio de Janeiro, Brazil: a possible case of invasion facilitated by deforestation

Eduardo G. de M. Bastos, Alexandre F. B. de Araújo & Hélio R. da Silva

Departamento de Biologia Animal, Universidade Federal Rural do Rio de Janeiro. Caixa Postal 74524, 23851-970 Seropédica, Rio de Janeiro, Brasil. E-mail: dudagmbastos@yahoo.com.br; araujo@ufrrj.br; helio@ufrrj.br

ABSTRACT. This paper documents the presence of rattlesnakes, as an invasive species, in several municipalities of the State of Rio de Janeiro. As previous registers indicate, these snakes probably invaded at least the municipality of Valença carried by floodwaters between the decades of 1950 and 1960. In the new environment, along the margins of the Rio Preto, these snakes were able to establish new populations in deforested areas turned into cattle grazing. The presence of rattlesnake in the municipality of Barra do Piraí, a municipality that has no border with Rio Preto, however, indicates that these snakes dispersal into new areas may be facilitated by open areas, represented by pastures, created after deforestations.
KEY WORDS. Atlantic Forest, habitat disturbance, range expansion, rattlesnake, snake.

RESUMO. **Registros da cascavel *Crotalus durissus terrificus* (Laurenti) (Serpentes, Viperidae) no Estado do Rio de Janeiro, Brasil: um possível caso de invasão facilitada por desmatamento.** Esse trabalho documenta a presença de cascavéis, como invasoras, em municípios do Estado do Rio de Janeiro. Conforme registros anteriores, essas cobras muito provavelmente invadiram pelo menos o município de Valença carreadas durante enchentes que ocorreram entre as décadas de 1950 e 1960. No novo ambiente, ao longo da margem do Rio Preto, essas cobras puderam se estabelecer principalmente em áreas desmatadas de pasto. Entretanto, a ocorrência de cascavéis no Município de Barra do Piraí, único município que não tem fronteira com o Rio Preto, indica a habilidade de dispersão desta espécie por áreas abertas de pastos, criadas após desmatamento.
PALAVRAS CHAVE. aumento de distribuição, cascavel, Floresta Atlântica, fragmentação, serpente.

Crotalus durissus Linnaeus, 1758 (Serpentes, Viperidae) is the most widely distributed rattlesnake, ranging from Mexico to Argentina. Nine sub-species are currently recognized in South America (Campbell & Lamar 1989). The species is highly common in dry and open vegetations of Cerrado (Colli *et al*. 2002), Caatinga and Chaco (Campbell & Lamar 1989). In Brazil, the subspecies *Crotalus durissus terrificus* (Laurenti, 1768) is found from the States of Rio Grande do Sul to Mato Grosso do Sul and Minas Gerais, Rondônia, Amazônia, and Pará (Melgarejo 2003). In the remaining South America, its distribution also includes Peru, Bolivia, Paraguay, Uruguay, and Argentina (Campbell & Lamar 1989, Peter & Oreja-Miranda 1986, Melgarejo 2003), always in dry-open areas. Until recently, the genus *Crotalus* Linnaeus, 1758 was considered absent from areas occupied by the Atlantic rain forests of Brazil (Campbell & Lamar 1989), especially from the State of Rio de Janeiro. However, specimens of *Crotalus durissus terrificus* were first reported for the Paraíba do Sul river valley by Barth (1957) in a compilation of the fauna of the Itatiaia National Park in an anecdotal manner (no specimen from museum collections is mentioned). Latter, several specimens have been collected from the Northwest of the State of Rio de Janeiro and reported by the first time by A. Melgarejo (1994) in an abstract presented at the XX Brazilian Meeting of Zoology. Herein, we present additional evidence relating the occurrence of *C. durissus terrificus* in the State of Rio de Janeiro and discuss the evidence that these records may represent recent invasion of the species into disturbed areas of the Atlantic Forest.

The Atlantic Forest was dominated by forested habitats along the oriental coast of South America (Marques *et al*. 2001). For 500 years, trees and other plant products of the Atlantic Forest have been explored and the areas originally covered by this biome have been slowly and steadily transformed into either sugarcane or other types of single crop plantations, or grass-

land for cattle grazing. In the State of Rio de Janeiro, at least 90% of the tropical rain forests were cut down for charcoal production. Additionally, the forests in the State were substituted by coffee plantations and, later, as a result of soil overuse and decline of the coffee plantations, pastures and cattle were implemented (Dean 1996). As a result, the landscape that was originally dominated by rainforest nowadays consists of several, small to medium size, forest fragments, the majority of which are smaller than 100 hectares (Fig.1) separated by pastures. Following a pattern similar to the one described for the forests in Rio de Janeiro, the neighbor States of Minas Gerais and São Paulo, were also deforested. However, while in Rio de Janeiro the Atlantic rainforest was predominant, in the western parts of Minas Gerais and São Paulo, the Cerrado (a savanna like vegetation) reaches the rainforest. Therefore, as results of the deforestation in these States, the limits between the two biomes (Atlantic Forest and Cerrado) were brought more to the east, making the transition zone that existed between them disappear (www.sosmatatlantica.org.br). The effects of such disturbance have never been explored scientifically, although some anecdotal cases of bird invasions of the newly created open areas do exist.

In order to access the extent of the occurrence of *Crotalus durissus terrificus* in the State of Rio de Janeiro, we used the Municipality of Valença as a starting point, because rattlesnakes were reported to be common there (Constantino, personal communication), and visited several other towns in search of new records. Two basic strategies were used to identify and guarantee the presence of these snakes. When specimens were collected by us or examined in the collections of the Museu Nacional and the Instituto Vital Brasil the records were considered formal, meaning these were the trustworthiest source of information. When we could only get information on the presence of the snake by interviewing farm-workers in the rural areas or by examining hospital records for the use of anti-venom for *Crotalus*, these records were considered informal. We considered the former records less trustworthy because mistakes in the identification of rattlesnakes are not uncommon by people not used to their presence in the wild. The data amalgamated herein is summarized the distribution map (Fig. 1).

Prior to our studies, all formal records of *Crotalus durissus terrificus* have come from the same area, the Municipality of Valença in the middle valley of the Paraíba do Sul River. New formal records of *C. durissus terrificus* came from Valença and two other nearby cities of Resende and Rio das Flores. Our survey got informal evidence that the snakes are present in Barra do Piraí, Comendador Levy Gasparian, Paraíba do Sul, Quatis, and Itatiaia. We did not find evidence of rattlesnakes in Miguel Pererira, Paty do Alferes, Pinheiral, Piraí, Penedo, Porto Real, Volta Redonda, and Vassouras. Nevertheless, despite of the fact that this snake is fairly well know by people in general, even in the City of Rio de Janeiro, no other reports of its occurrence in other areas along the border between Rio de Janeiro and Minas Gerais, along the Paraíba do Sul river valley exists. We also surveyed the municipalities of Sapucaia, in Rio de Janeiro, and parts of Chiador, in Minas Gerais and found no records of the snake. It appears that rattlesnakes, originally from the open habitats of Cerrado, recently invaded the areas of Valença, Rio das Flores, and Três Rios independently, but perhaps during similar floods.

Apparently, the location of the towns along the Rio Preto valley has favored the dispersion of this species into the areas previously covered by rain forest along the valley. It also seems possible that Paraíba do Sul river may have hampered dispersion into localities south of its valley. Its width, that reaches 400 m, may represent a natural barrier to the dispersion of this species. The relief east the river, dominated by the Serra do Mar mountain range, may also represent another barrier against further dispersion. Additionally, the topography around the valley of Rio Preto may have served as a corridor, linking the Cerrado to the Paraíba do Sul valley.

Intensive exploitation of wood, expansion of coffee plantations and, later, the introduction of pastures, from 1870 to 1920, may have helped to open dispersal corridors from areas in the Cerrado into areas in the Atlantic Forest. Additionally, some serpents may have dispersed down across the smaller Rio Preto, from Minas Gerais to Rio de Janeiro. Snakes may have been carried during unusual floods, which occurred between 1950 and 1967. Samples of this species in the collection housed by Instituto Vital Brazil have increased considerably in the last 15 years. Between April 1999 and September 2003 this Institute has received 82 specimens from Valença. These latest records suggest that a population of *Crotalus durissus terrificus* has successfully colonized these new areas and are now established in areas previously occupied by Atlantic Forest biome. Semideciduous forest fragments covering hills characterize this region landscape, remains of the Atlantic Forest scattered beyond the coastal high mountains. Rattlesnakes can use forested habitats, although not often (Reinert 1992). In the Cerrado domain, *Crotalus durissus terrificus* uses gallery forest as a secondary habitat and is able to cross forested areas. The fragmented forest along the Paraíba do Sul river valley is not an efficient barrier to the dispersion of the rattlesnake. The occurrence of *C. durissus terrificus* in the Municipality of Barra do Piraí, however, suggests these snakes have the ability to disperse actively into new areas, indicating the danger of becoming a plague in the State.

Crotalus durissus is responsible for 8% of snake-bite accident cases in Brazil (Araújo *et al*. 2003). The Atlantic Forest fragmentation may facilitate the increase rattlesnake distribution and density. As a consequence at least two outcomes may be expected from this invasive species in the state. The new arrival may cause disturbance in the resident population of snakes with similar ecology in the areas. For example, it may out compete *Bothrops jararaca* (Wied, 1824) in the open areas, as already suggested by Sazima (1992). Another consequence of

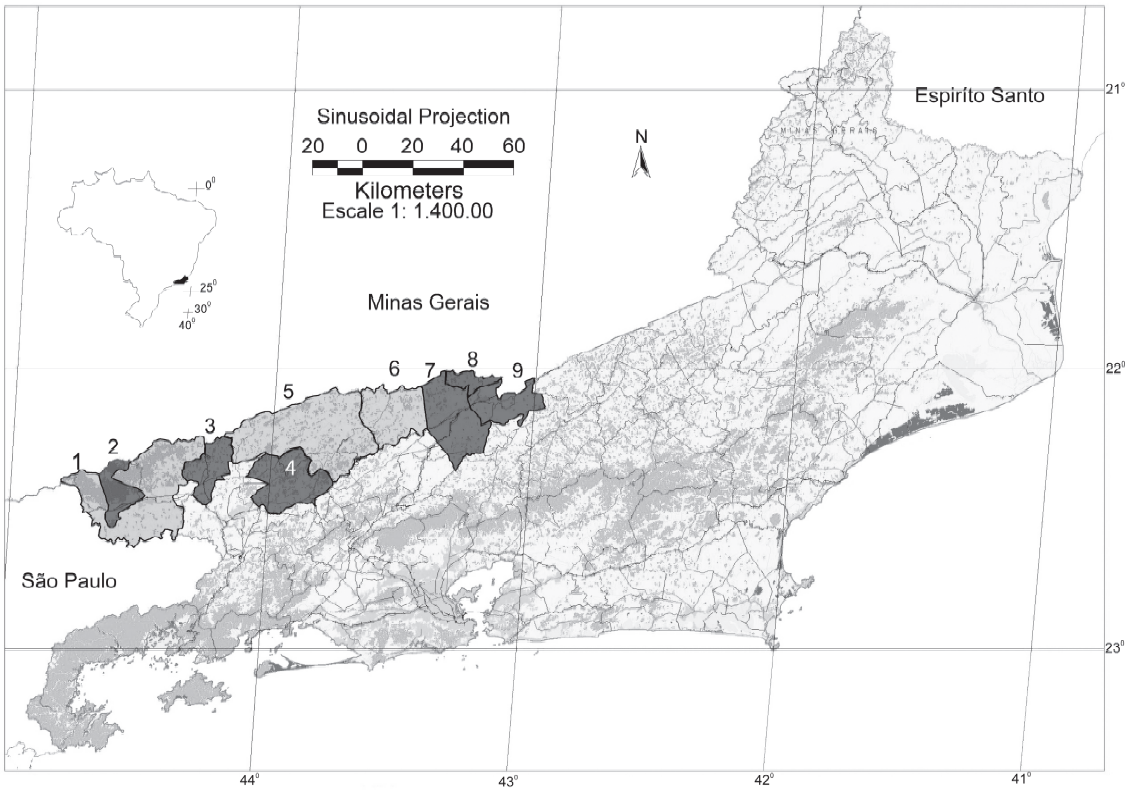

Figure 1. Map of the State of the Rio de Janeiro, showing details of forest fragmentation. Shaded lighter areas were rattlesnakes were collected and have been formally registered, representing the municipalities of (1) Resende, (5) Valença, and (6) Rio das Flores. Darker shade of gray represents areas were the records of the snakes are informal in the municipalities of (2) Itatiaia, (3) Quatis, (4) Northern part of Barra do Piraí, (7) Paraíba do sul, (8) Comendador Levy Gasparian, and (9) Três Rios. Modified from Atlas dos Remanescentes Florestais da Mata Atlântica 2000 (www.sosmatatlantica.org.br).

this invasion relates to this snake becoming a public and animal health concern in the State of Rio de Janeiro. In fact, health care officials in Valença (Consentino, personal communication) have already registered accidents with this snake.

A radiotelemetry monitoring research program for *Crotalus durissus terrificus* ecology is underway in the city of Valença, Rio de Janeiro, in order to acquire basic data on habitat use, home range, and other aspects of resource use, predation and parasite relationships. This research aims to provide ecological information for the management of this species in these new landscape conditions, including use of forested fragments.

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