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DISCOVERY OF THE FIRST WILD POPULATION OF THE SMALL RED BROCKET DEER *Mazama bororo* (ARTIODACTYLA: CERVIDAE)

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ABSTRACT: *Mazama bororo* was described from a few captive specimens in Brazil by cytogenetic and morphological characters. These specimens supposedly originated in the Southern Atlantic Forest; however, no wild population has been reported. This study was initiated in 1998 to investigate the presence of this species in forest remnants of the Paranapiacaba mountain range, south São Paulo State, Brazil. Five specimens were captured between 2000 and 2002. Cytogenetic analysis of blood samples confirmed its specific identification, documenting the first population of small red brocket deer at the Intervalles State Park.

RESUMEN: Descubrimiento de la primera población silvestre de la pequeña corzuela roja *Mazama bororo* (Artiodactyla: Cervidae). *Mazama bororo* fue descrita a partir de algunos ejemplares cautivos en Brasil, a través de caracteres citogenéticos y morfológicos. El origen estimado de estos animales indicaba la presencia de la especie al sur del Bosque Atlántico, pero no se había reportado hasta la actualidad ninguna población en estado silvestre. Este estudio se inició en 1998 con el objetivo de investigar la presencia de la especie en remanentes de bosque en la Sierra del Paranapiacaba, al sur del estado de São Paulo, Brasil. Fueron capturados cinco especímenes entre 2000 y 2002. Los análisis citogenéticos de muestras sanguíneas confirmaron la identidad específica, reportándose la primera población de corzuela roja pequeña en el Parque Estatal Intervalles.

Key words. Atlantic forest. Brazil. Cryptic deer species. Cytogenetics. Neotropical fauna.

Palabras clave. Bosque atlántico. Brasil. Citogenética. Especies de corzuelas crípticas. Fauna neotropical.

The first report of the small red brocket deer *Mazama bororo*, one of the most recently documented cervid species, was identified after conducting a karyotypic characterization of Brazilian animals from the *Mazama* genus (Duarte, 1992). In that study, a zoo captive male originally from Capão Bonito (**Fig. 1**)

presented a diploid number (2n) equal to 32 chromosomes with a fundamental number (FN) of 46 chromosomal arms (Duarte, 1992). These results differed significantly from those reported in the literature for other *Mazama* species, although intraspecific chromosomal polymorphism in some other Brazilian taxa has

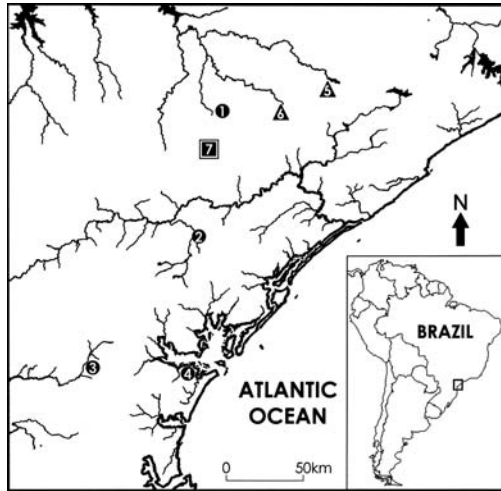


Fig. 1. Part of the Brazilian southern coast (see inset map) indicating the wild population of small red brocket deer (square 7-Intervales State Park), origin localities of the first captive specimens (circles 1-Capão Bonito, 2-Barra do Turvo, 3-São José dos Pinhais, 4-Paranaguá), and study sites with weak evidences of the species (triangles 5-Fazenda João XXIII, 6-Carlos Botelho State Park).

been found. For example, the Brazilian dwarf brocket deer *Mazama nana* ($2n = 36, 37$ or 38 and $FN = 56, 59$ or 60) and the red brocket deer *Mazama americana* ($2n = 50, 52$ or 53 and $FN = 54, 56$ or 57) (Duarte and Jorge, 1996). Three other animals karyotypically related to the Capão Bonito individual were found later in captivity by Duarte (1998) in different locations from São Paulo and Parana states (**Fig. 1**). The study with these specimens led to the official recognition of the small red brocket deer as a distinct species with $2n$ that varied between 32 to 34 chromosomes and $FN = 46$ (Duarte and Jorge, 2003). Although previous cytogenetic studies had already recognized this species (Duarte 1992), the morphological characterization made by Duarte (1996) was considered its formal description. Both the lectotype (MZUSP 33471) and the paracotype (MZUSP 33470) are deposited at Museu de Zoologia, Universidade de São Paulo, Brazil.

The external morphology of *Mazama bororo* is intermediate between *M. nana* and *M. americana* (Duarte and Jorge, 2003). Although similar in body shape and structure to *M. nana*, the small red brocket has a coloration that strongly resembles *M. americana*. Morphometric and morphological studies by Rossi (2000) based on skulls and skins from different Brazilian collections failed to differentiate *M. bororo* from *M. americana*, although the data indicated the presence of a partially differentiated population of *M. americana* distributed throughout the south coast of Brazil. Because of these, cytogenetic characters offer the most reliable tools to identify *M. bororo* (Duarte, 1996; Duarte and Merino, 1997; Duarte and Jorge, 2003).

The origin of the animals used by Duarte (1992, 1998) to describe *M. bororo* as well as Rossi's results suggested that this species is probably limited to the Atlantic Rain Forest. This biome is known to be one of the most important biodiversity hotspots on the planet (Myers et al., 2000), and has a history of intensive habitat loss and fragmentation due to human activity. These led the IUCN/SSC Deer Specialist Group to propose a set of conservation actions for this species, including a status survey in the wild (Wemmer, 1998). Thus, we considered that the localization of wild populations of small red brocket must be the first step, since this cervid was only known in captivity.

Consequently, in 1998 we started a study to confirm the presence of *M. bororo* in the wild and to obtain basic biological data for the species. Additionally, we sought to develop a methodology to study brocket deer in its natural habitat.

The studies were conducted in the Paranapiacaba mountain range (southern region of the São Paulo State, Brazil), the region where one of the evaluated captive specimens supposedly originated. This area was chosen due to its extensive and relatively well preserved natural forested area, as well as to the presence of several adjacent protected areas. This particular region has a humid subtropical climate (Köppen's type Cfa) with tran-

sition to humid subtropical of altitude (type Cfb) (Köppen, 1936) and shows a complex topography with altitudes between 30 and 1200 m above sea level.

The first stage of this study consisted of an ethnozoological approach in the respective region with the objective of directing our efforts to localize the animals. Local people (e.g. farmers, park rangers, wildlife and heart of palm poachers) from seven different places provided information on deer species present in the region, their common names and main morphological, behavioral and ecological characteristics (e.g. sizes, color patterns, habitats, diet, reproduction, space use, and activity patterns). This information allowed the identification of areas likely to support the species and helped to define the observation strategies used and ultimately the capture of the animals. The technical description of local hunting procedures was very important for conducting the study (Vogliotti, 2003).

Three sites were originally assessed for the presence of brocket deer species, a private forest located at the Fazenda João XXIII, and two officially protected areas: Carlos Botelho State Park and Intervales State Park, where hunting and exploitation of natural resources are forbidden to preserve the biota (Fig. 1). The specimens were sought through night watches (close to deer tracks or streams) and attraction sites (using several food items or feces, urine and epidermic gland secretions from captive individuals). The baited areas were monitored for tracks or with camera traps to determine the visitation patterns and to plan capture tactics. Some of the attraction and observation techniques used in these areas revealed no useful information for the capture of the deer (Vogliotti, 2003).

In Fazenda Joao XXIII a low visitation frequency by deer (0.09 photos/day) was recorded, and although inconclusive to identify the species, the photos taken appeared to represent *Mazama americana*. In Carlos Botelho State Park, although more deer were documented (0.19 photos/day), the photos obtained did not clearly indicate the presence of small red brocket deer.

The photos taken in Intervales Park agreed with the morphology of *M. bororo* (Fig. 2), then alternative capture methods were used. The main idea was to use a type of corral trap, which was inspired by the traditional hunting techniques sometimes used for some medium-sized mammal species (e.g. deer, peccaries, and agoutis). This type of trap, built over several days to avoid too much distress, was made of native bamboo. The traps did not have any type of attractant and the captures occurred after the activation of an animal-triggered mechanism to close the door when they walked through (Vogliotti, 2003). The monitoring of tracks detected a regular traffic of deer through the trap. This fact suggested that the trap structure did not alarm the animals, which led to the actual capture of the first animal in June of 2000.

This was an adult male deer, which was chemically restrained and processed according to a standard biometric protocol that included taking photographs and biological samples of blood, feces, ectoparasites, hair, and skin (Duarte and Jorge, 2003). The blood was immediately sent to the laboratory, where it was processed and analyzed according to Moorhead et al. (1960). The cytogenetic analysis revealed the typical chromosomal standard for *Mazama bororo* ($2n=32$ and $FN=46$) confirming the capture of the first small red brocket specimen from the wild. Moreover, remaining samples were stored for further analysis in molecular genetics and parasitology, and to establish a germplasm bank.

From 2000 to 2002, four other *M. bororo* were captured at the Intervales State Park by different techniques (e.g. disassembling version of the corral traps made with vinyl and unexpectedly capturing a specimen by hand). Except for a young female who died inside the trap, all animals were radio-collared and freed after recovery from anesthesia (Vogliotti, 2003). The dead specimen was collected and deposited at Museu de Zoologia, Universidade de São Paulo, Brazil (MZUSP 33469); and skin and muscular samples are deposited at NUPECCE (Núcleo de Pesquisa e Conservação de Cervídeos), Universidade



Fig. 2. Adult male of small red brocket deer photographed by camera trap at the Intervales State Park (Photo by Deer Research and Conservation Center of UNESP - NUPECCE).

Estadual Paulista. Some details about the animals and captures are presented in **Table 1**.

Both body form and chromosomal morphology from the captured animals agreed with those from the original specimens, documenting the first wild population of *M. bororo*. These results added a large mammal to the extensive list of Atlantic Rain Forest species. All study areas belong to a 1.7 million hectares continuous remnant of Atlantic Forest that was declared World Heritage by UNESCO in 1999. This location is made up of 30 governmental protected areas where the species may be spread out in a panmictic population. Although we have no demographic information, this scenario would provide a potentially safety status of conservation for the small red brocket. The interviews with local people suggested the occurrence of at least two other *Mazama* species (*M. americana* and *M. gouazoubira*). However, evidences of direct sympatry (im-

mediate habitat overlapping) or competition among them were not found in this survey.

The successful capture of these animals also identifies an improved methodology for studying other species in the genus *Mazama* overall. Despite this success, the low capture rate for this methodology constitutes an important obstacle for the assessment of these animals on a wide geographic scale. Although the objectives of this study were achieved, the results obtained led to two new and important questions: What is the geographic distribution of the small red brocket deer and how can this be assessed, considering the need to capture the animals for cytogenetic identification? The answers will depend on more efficient sampling and identification techniques.

For our next research step, molecular markers that are being developed from both wild and captive samples may constitute promising alternatives to assess the geographical distri-

Table 1

Summarized data of the *Mazama bororo* specimens from Intervales State Park with their respective sex (M: male, F: female), class of age, weight (kg), diploid number (2n) and fundamental number of chromosomic arms (FN), capture date, location (geographical coordinates), and technique employed.

Sex	Age	Weight	2n/FN	Date	Location	Technique
M	Adult	26	32/46	Jun 2000	24°18'29"S/48°24'26"W	Bamboo corral trap
F	Young	14.5	————*	Apr 2001	24°18'29"S/48°24'26"W	Bamboo corral trap
M	Adult	18.5	33/46	Jun 2001	24°18'29"S/48°24'26"W	Bamboo corral trap
F	Adult	28	32/46	Dec 2001	24°18'15"S/48°25'01"W	Manual capture
F	Young	14	32/46	Dec 2002	24°16'30"S/48°24'54"W	Vinyl corral trap

bution and some demographic parameters for this species, which will ultimately allow for a more precise evaluation of its conservation status. The hypothesis of a geographically restricted distribution needs to be tested through a systematic evaluation throughout the Atlantic Rain Forest and if confirmed, **it** would allow the small red brocket deer to be categorized as the largest endemic animal of Brazil.

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