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Short communication

Density estimates of *Mazama gouazoubira* (Cervidae) using the pellet count technique in the arid Chaco (Argentina)

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Abstract. The fecal pellet group count technique was used to estimate gray brocket deer density in a protected area in the west of Córdoba province (Chancaní Reserve), Argentina. Seventy plots were surveyed for brocket pellets on two occasions: summer (February) and winter (August). The density of brockets recorded were 4.41 individuals/km^2 in summer and 5.12 individuals/km^2 in winter. It was the first count of the species density in the Reserve and constitutes an important management tool for monitoring the population of this species within this protected area, as well as in other similar habitats in the arid Chaco.

[Keywords: fecal pellet group (FPG) count, fecal standing crop (FSC) technique, gray brocket deer, Chancaní Reserve]

Resumen. Estimación de densidad de *Mazama gouazoubira* (Cervidae) usando la técnica de conteo de pellas en el Chaco árido (Argentina). La técnica de conteo de pellas fue usada para estimar la densidad de la corzuela parda (*Mazama gouazoubira*) en un área protegida en el oeste de la provincia de Córdoba (Reserva Chancaní), Argentina. Para el conteo de pellas fueron censadas setenta parcelas en dos ocasiones, verano (febrero) e invierno (agosto). Los resultados obtenidos, 4.41 individuos/km^2 en verano y 5.12 individuos/km^2 en invierno, son una primera estimación de la densidad de la especie en la Reserva Chancaní y constituyen una herramienta de manejo para el monitoreo de las poblaciones dentro de esta área protegida, así como para ambientes similares del Chaco árido.

[Palabras clave: conteo de grupo de pellas, técnica de cosecha fija, corzuela parda, Reserva Chancaní]

Introduction

The gray brocket deer (*Mazama gouazoubira*) is the brocket with the broadest distribution, extending from Central America to central Argentina, where it can be found as far west as the dry mountain region (Emmons & Feer 1997; Parera 2002). This species is easily distinguished from others of the same genus by its gray to light brown color, it is smaller and shorter than *M. americana* and bigger than *M. nana* (Redford & Eisenberg 1992). It is a typical inhabitant of forest and edge areas, showing preference for forests with high vegetation cover (Parera 2002). According to Kufner et al. (2008), in forests of the dry southern portion of the South American Chaco subjected to livestock grazing, more than 80% of the gray brocket deer diet are dicots, especially woody species (trees and shrubs), during both the dry and wet seasons.

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There are indirect evidences that in Argentina, the number of individuals of this species may be decreasing throughout its distribution area (Chebez & Johnson 1984; Parera 1993; Richard et al. 1995). The loss of forested areas, the indiscriminate hunting of cervids in different parts of the country (Juliá & Richard 1999) and its use by local rural communities (Richard et al. 1995; Giraudo & Abamson 1998; Bolkovic 1999; Barbarán 2000) have a negative effect on the existing numbers of brockets. Therefore, there is a need for population studies that can evaluate the actual status of these cervids. This need was already pointed out in 2000, when the IUCN changed the worldwide status of the gray brocket deer to "Data Deficient", calling for base studies of the species (Deer Specialist Group 2000). At present, there are no management strategies or appropriate measures to protect brockets, due to the lack of an effective hunting control (Richard & Juliá 2001).

Currently, in Argentina there is no information on the abundance of this species. Gray brocket deer estimates in Bolivia help shed some light on gray brocket numbers, although the data is extremely variable depending on the time of the year (Rivero et al. 2004). According to this study, dry-season dung estimates for grays (30.57 individuals/km^2) were improbably high and four times their line-transect estimates (7.7 individuals/km^2), whereas wet-season dung estimates (6.77 individuals/km^2) were closer to transect estimates (4.4 individuals/km^2). The latter was probably due to the reduced effect of dung decay.

The population under study inhabits in the Chancaní Reserve. This protected area is located in western Córdoba province and, similarly to other regions in Argentina, is experiencing environmental degradation. Forest loss is due mostly to a long history of deforestation for timber extraction and agricultural use, which has resulted in the almost complete loss of grasslands and herbaceous strata of the original forest. Chancaní Reserve preserves nearly 5000 ha of undisturbed Chaco forest which provides a unique opportunity to carry out biodiversity and species population biology studies in a natural habitat representative of the arid Chaco.

The main objective of this work was to estimate population numbers of gray brocket deer in a relict of well conserved arid Chaco forest. The validation of a low-cost, effective sampling technique will allow for future population counts to monitor the status of this species in South America.

Methods

Chancaní Natural Forest Reserve and Natural Provincial Park, located at 30°22′ S and 65°26′ W in Pocho Department, western Province of Córdoba (Argentina) and created in 1986, is the southernmost protected area in the arid Chaco region. With an area of 4960 ha, it includes the last relatively unaltered standing relict forest with no records of grazing or fire (except for a 1994 fire that affected a small portion of its area). It is within the phytogeographical Province of Western Chaco (Cabrera 1976) in the southwestern portion of the arid Chaco (Morello et al. 1977).

Density estimation techniques for vertebrates derived from animal dung are commonly accepted. There are two types of vertebrate density estimation methods using pellet counts: Fecal Accumulation Rate (FAR) and Fecal Standing Crop (FSC). FAR consists of estimates obtained from the accumulation of new pellets between two known time periods and implies an initial removal of all pellets present in each plot. FSC consists of density estimates considering all pellets found, daily defecation rates and pellet persistence. Both techniques have been evaluated in the field but neither has proven to be more accurate or precise than the other, and most authors agree that the chosen technique and its success will depend on the species and the environment under consideration (Edge & Marcum 1989; Campbell et al. 2004; Smart et al. 2004; Hemami et al. 2005).

In this study, density estimates were based on the fecal standing crop (FSC) technique as it has been successfully used in other geographical areas including the United States

(Edge & Marcum 1989), Mexico (Mandujano & Gallina 1995), Kenia and Namibia (Komers & Brotherton 1997), Scotland (Campbell et al. 2004), and England (Smart et al. 2004; Hemami et al. 2005). In South America, it has been applied specifically to gray brockets in dry Chaco forest areas of Bolivia (Rivero et al. 2004). It was also chosen because it minimizes cost and effort, requiring only one visit to the study area.

Density estimations were conducted during two field sampling trips: summer (February) and winter (August) 2006. In each sampling trip, seventy 600 m^2 plots (total area=0.042 km^2) were randomly distributed throughout 3810 ha of the Reserve and a 5 km buffer zone, excluding steep mountain slopes. Plot assignment was determined using a 150 m^2 cell grid on an aerial image of the region; the plots were marked and their satellite position recorded. The density estimate of the gray brockets was determined using the following equation:

$$\text{Population density} = \frac{\text{Pellet groups per unit area}}{\text{Defecation rate X pellet persistence time}}$$

Assuming that the abundance of feces is proportional to the number of animals present and the number of daily defecations, this equation is the quotient between the number of pellet groups/area and daily defecation frequency, resulting in a use estimator (days x animal)/area. Population density (animals/area) is obtained by dividing the use estimator by the maximum persistence (in days) of the pellets on the ground (Ojasti & Dallmeier 2000).

In order to calculate pellet persistence, 10 groups of fresh pellets from different gray brocket deer were collected and placed along a transect at 10 m intervals. In order to account for the different soil and vegetation conditions found throughout the Reserve, the transect was placed in an area with varied vegetation and soil cover. The groups were checked every 15 days in order to estimate the maximum number of days of persistence. Since the number of pellets in each group varied between 68 and 112, we fixed a cutoff point when less than 10% of the original pellets were recognizable. The general criteria for this survey followed those of Harestad & Bunnell (1987).

The daily defecation rate for this species in the wild is unknown and studies with animals in captivity, such as the study by Rivero et al. (2004) in Bolivia, have resulted in low rates because of food and daily activity factors. For the current estimation, we decided to use the rate recommended by Neff (1968) of 13 defecations/day for small forest deer.

RESULTS

The variables included in the density equation were: maximum persistence time of pellets, daily defecation rate of 13 (Neff 1968), and fecal counts obtained in the study area. Since the maximum persistence time of pellets on the ground was 100 days, the gray brocket deer population estimated was 4.41 individuals/km^2 in summer and 5.12 individuals/km^2 in winter. Extrapolating these numbers to the 3810 ha sampled, we obtained an actual population of 182 gray brockets in the Chancaní Reserve.

DISCUSSION

The gray brocket density estimated in this study for the Chancaní Reserve is comparable to the values obtained using the pellet count technique in areas of the Bolivian Chaco, during the wet season (6.77 animals/km^2), but considerably lower than the estimate obtained in the dry season (30.57 individuals/km^2). The results are also comparable to values estimated with other techniques in other parts of South America: 3.7 animals/km^2 in the Brazilian pantanal (Schaller 1983), 1.2-2.4 animals/km^2 in the Bolivian Chaco (Ayala & Noss 1999), and 0.18-0.39 animals/km^2 in the Peruvian lower Amazon forest (Hurtado-Gonzales & Bodmer 2004). The difference between summer and winter estimates in our study are likely due to a sampling error and not to real differences, and indicate that the deer use the

Reserve all year round, even during periods of water shortage.

The variables used in the density estimation equation (number of daily defecations and pellet persistence time) are particularly sensitive to geographic region, since they are highly influenced by environmental factors (Wallmo et al. 1962; Neff 1968). Similar studies conducted in the Bolivian Chaco with the same species (Rivero et al. 2004) determined that pellets persisted on average, for a maximum of 40 days. However, Wallmo et al. (1962) found that, in an environment with 520 mm annual rainfall, only 9% of the total pellets of North American desert deer (*Odocoileus hemionus*) persisted on the ground after 116-144 days. Since annual rainfall in the Chancaní Reserve is approximately 550 mm (Capitanelli 1979), the 100 days estimated decomposition value is probably associated to low precipitation, and therefore differs from that observed by Rivero et al. (2004). The value of the number of daily defecations used (13 daily defecations) was obtained from the literature (Neff 1968). It would be necessary to conduct experiments to determine the value of this variable, for example by monitoring individuals in their natural habitat, to allow for a more accurate estimation of gray brocket density.

The development of a density estimation method, which can be standardized for use in forest areas, is an important management tool that would serve to evaluate the conservation status of the gray brocket deer in other areas. Population density of this species can be used as a reference for decision making, especially as current population numbers are unknown and brockets are affected by hunting and habitat destruction. This was also observed and pointed out as a priority by a group of native Argentine deer specialists (Dellafiore & Maceira 1998). The Fecal Standing Crop pellet group count technique used in our work is an appropriate first estimation tool due to its rapid application and low cost.

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