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Research

Effects of 2 forms of environmental enrichment on a group of captive blackbucks (*Antilope cervicapra*): A pilot study

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ABSTRACT

The aim of this preliminary study was to assess the effects of 2 forms of environmental enrichment (i.e., branched tree trunk and brushes) on the behavior of a group of 8 captive blackbucks. Animals were directly observed for 4 hours a day (09:30-11:30 and 12:30-14:30), on days 1, 3, 6 (pre-enrichment phase, before the new individual was born), 8, 10, 15, 17 (pre-enrichment phase, after the birth of the new individual), 22, 24, 29, 31, 43, 64 (enrichment phase), using instantaneous scan sampling every minute. Video recordings were also performed in days 24, 43, 64, from 09:30 to 11:00 and from 12:30 to 14:00 and analyzed using a continuous behavioral sampling method, for activities directed to the tree trunk. Friedman and Wilcoxon tests were performed both on the total number of scans and on the percentage of scans in which the animals were not out-of-sight. The blackbucks interacted significantly more with the tree trunk than with the brushes ($P = 0.012$). The duration of the interactions with the tree trunk declined over time ($P < 0.001$). The animals increased their feeding activity and decreased their rumination while in the standing position in the enrichment phase in comparison with the 2 preceding phases. The results of this preliminary study suggest a slightly beneficial effect of the provision of a tree trunk for blackbucks as a form of environmental enrichment and highlight some problems when observing this prey species.

Introduction

In captive animals, environmental enrichment (defined as "an improvement in the biological functioning of captive animals resulting from modifications to their environment"; Newberry, 1995) has been used to promote animal welfare and to increase the educational and the conservation value of the animals (Mason et al., 2007). Frequently described enrichment benefits include an increase in the expression of species-specific behavioral patterns (Reinhardt and Reinhardt, 2011) and a reduction/elimination of abnormal repetitive behaviors (for a review, see Mason et al., 2007), which can occupy a significant percentage of the animal time (e.g., 23% of tigers' daytime in Mohapatra et al., 2014). Several reports of increased active and social behaviors and reduction in stereotypies after the introduction of various forms of enrichment can be found in the scientific literature [e.g., white-lipped peccaries (Nogueira et al., 2011); African wild dogs (Rafacz and Santymire, 2014); grizzly bears (Andrews and Ha, 2014)]. There are many other similar examples in the scientific literature, but a detailed review is outside the scope of this article.

The scientific interest in environmental enrichment has increased over the last decades. A search for "zoo" and "environmental enrichment" on the Web of Science (http://wokinfo.com/) retrieves 22 entries from 1991 to 2000, 72 from 2001 to 2010, and 93 between 2011 and 2015. However, although Arctiodactyla species are present in most of western-world zoo exhibitions, only a few studies specifically mention them (Parker et al., 2006; Kelling et al., 2012; Majchrzak et al., 2015), if one excludes generic articles on environmental enrichment (citing Artiodactyla species among others, e.g., Reading et al., 2013).

Artiodactyla species react to suboptimal housing and management conditions, as can be seen in the literature concerning farm animal welfare (e.g., Johannesson and Sorensen, 2000; von Keyserlingk et al., 2009), and they can gain benefits by the

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provision of forms of environmental enrichment (see, for example, Ishiwata et al., 2006; Kohari et al., 2007; Wilson et al., 2002). A few examples can be found for species in captivity. Parker et al. (2006) found a decrease in the stereotypic behavior of 2 captive vicugnas when their feed was divided into 2 portions, one fed inside and the other outside, thus increasing forage patch choice. Fecal cortisol levels of Chinese gorals (*Naemorhedus griseus*) rise when housed in higher densities [27 m^2 vs. 400 m^2 per anima (Khonmee et al., 2014)].

The aim of this pilot study was to investigate the effects of the provision of a tree trunk and of brushes as forms of environmental enrichment in captive blackbucks (*Antilope cervicapra*, a species belonging to Artiodactyla).

Studies on captive animals are often conducted in less than optimal experimental conditions, mostly related to inherent characteristics of the structures where animals are kept. Concerns include limited availability of space and animals, the impracticability of separating animals in groups, and the function of the zoo as an exhibit space. This study suffers the same limitations: animals could not be split into an experimental and a control group, so any effect of environmental enrichment could be evaluated only through changes in behavior after introduction of the enrichment items into a single group of animals. Accordingly, this study should be considered as a pilot. However, in view of the lack of published research on captive blackbucks and more generally on Arctyodactila, pilot studies may also provide valuable information about the welfare and behavior of these species.

Methods

Study site and animals

This research was carried out at the Parco Faunistico Cappeller in Northeastern Italy (45°42′50″04 N, 11°41′47″76 E), between October 2011 and December 2011. The study involved eight blackbucks (*Antilope cervicapra*) maintained in a 483-m^2 (21 m × 23 m) sized earth enclosure at the park. In the enclosure, there were a 13.5-m^2 (4.5 m × 3 m) building acting as shelter, a sheltered outdoor feeding area/manger (1.5 m × 2.5 m), a dripping water source, and some tall trees. The trunk of the trees was protected by a wire mesh net to avoid damaging by blackbucks (Figure 1). The blackbucks could see the surroundings of their enclosure, including visitors, through the wire mesh fence.

The blackbucks were fed concentrate food around 08:00 hours once daily and hay *ad libitum*. The enclosure was cleaned once daily between 08:00 hours and 11:00 hours. There were no particular forms of environmental enrichment in the enclosure at the beginning of the study.

The 8 blackbucks studied were 4 males and 4 females aged between 7 months and 11 years (Table 1). From the second week onward, another individual was present in the enclosure because 1 blackbuck was born on day 7 after the beginning of the study. The birth was an unexpected event, as pregnancy was not evident. Particular effort and training was needed during the preliminary observations (1 week before the beginning of the study) to learn to even differentiate the 3 adult females.

Environmental enrichment

Two enrichment forms were used in the present study. They consisted of

1. Two brushes of 90 cm × 10 cm, fixed to the wooden fence of the enclosure in vertical position. The lower part of the brush was approximately 20 cm from the ground.
2. A tree trunk of approximately 60 cm in diameter and 1 m in length, lying on its side. A 4-m long branch rested orthogonally on the middle point of the tree trunk (Figure 1). It had several bifurcations, and its diameter was about 15 cm at its maximum. This item was placed approximately in the middle of the enclosure.

The enrichment items were introduced on day 21 and left in place until the end.

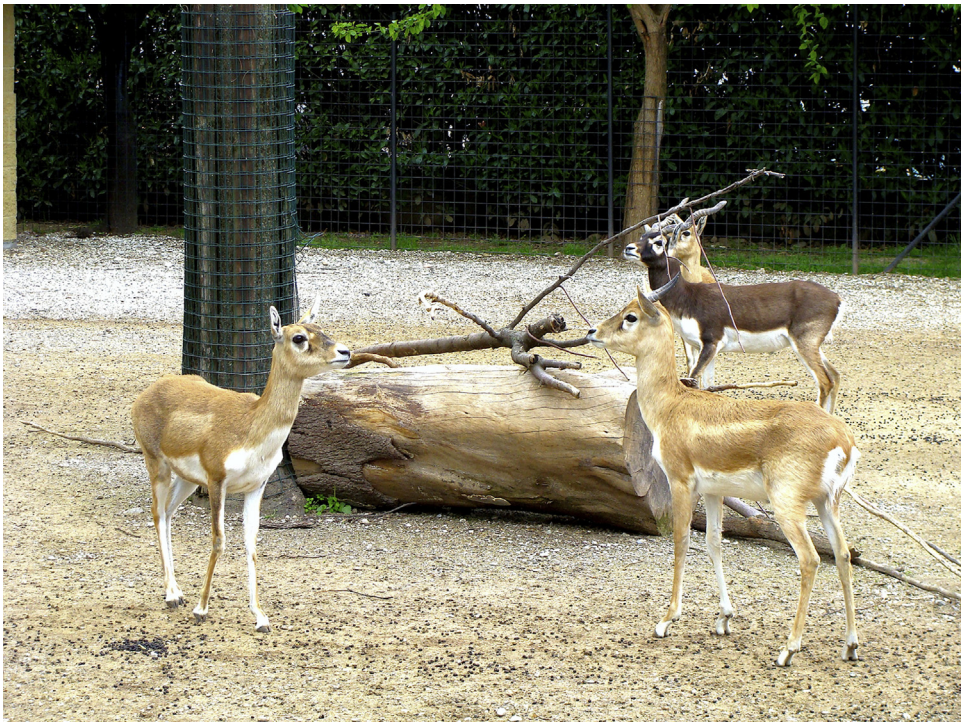

Figure 1. The tree-trunk stimulus.