Has horn length in an Eastern black rhino population (*Diceros bicornis michaeli*) decreased over time?

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Introduction

To provide information on long-term changes in rhino morphology, an evaluation of the extensive Rhino Resource Center online repository of rhino images was made using image-based analyses (Wilson et al. 2022).

That study looked at, to what extent data on rhino morphology can be quantified from image repositories, with emphasis on horn sizes, and whether this has changed over time. All measurements were performed using Fiji for ImageJ (Schindelin et al. 2012). Horn length was defined as the distance from the tip to the base of the horn parallel to the long axis of the horn. Given the absence of a scale bar, all measurements were made in arbitrary units.

The authors' measurements reported a small but significant decline in relative horn lengths over time in all (rhino) species. However, the validity of this and other conclusions made by the authors was challenged (Ferreira et al. 2024). One criticism was that the images were from multiple sites and did not consider potential differences within species (subspecies) differences.

However, the questions raised 'has the length of the horns of black rhinos decreased with time?' and if so, 'why?' are pertinent. This paper, with data from a single fully enclosed reserve populated with Eastern black rhino (*Diceros bicornis michaeli*) over a 33-year period, contributes to the discussion.

Methodology

A rudimentary system for measuring rhino horns from photographs (Patton 2021) was used to provide horn length data from profile photographs of Eastern black rhinos from a wild but fenced population, taken at intervals over 33 years.

The photographs available for measurement were right-side profiles of six mature adult females with the longest horns in the years 1989, 2006, 2017 and the 2020s. This sampling of the six largest did not account for whether none or one or more of the same females appeared in more than one sampling year. The ages of the females in each sample year were also not considered. All photos were standardized so that the distance between the center of the base of the rear horn and the lowest point of the jaw was the same.

Results

The results in Table 1 show a small reduction between the measurements of both the front and rear horn photographs of 1989 and each of the other three years. There was a significant reduction in front horn lengths between the 2006 and 2020 calculations, but not in rear horn lengths. In all but one of the 24 photographs, the front horn was longer than the rear, as would usually be expected in Eastern black rhinos. (Twelve are shown in Fig. 1 below).

An analysis of variance (ANOVA) did not show significant differences between the rear horns over the years. Figure 2 shows an ANOVA for the front horns only, across the 24 data points, with a significant year effect ($p = 0.00743$). When one outlier front horn was excluded, there was still a significant year effect ($p = 0.0214$).

Discussion

The results, although from a small sample, suggest that horn length may be declining in this population. This ‘suggestion’ would need to be validated from a much larger sample. However, it raises the question ‘what may be the cause of the decline’? This, in turn,

Table 1 Mean of the six measurements of the length of the longest-horned female Eastern black rhino horns in each sampling year. The measurements are in cm from head size-standardized side profile rhino photographs printed on paper.

Year	Front	Rear
1989	4.27	2.73
2006	3.74	2.53
2017	3.24	2.39
2020s	3.33	2.56

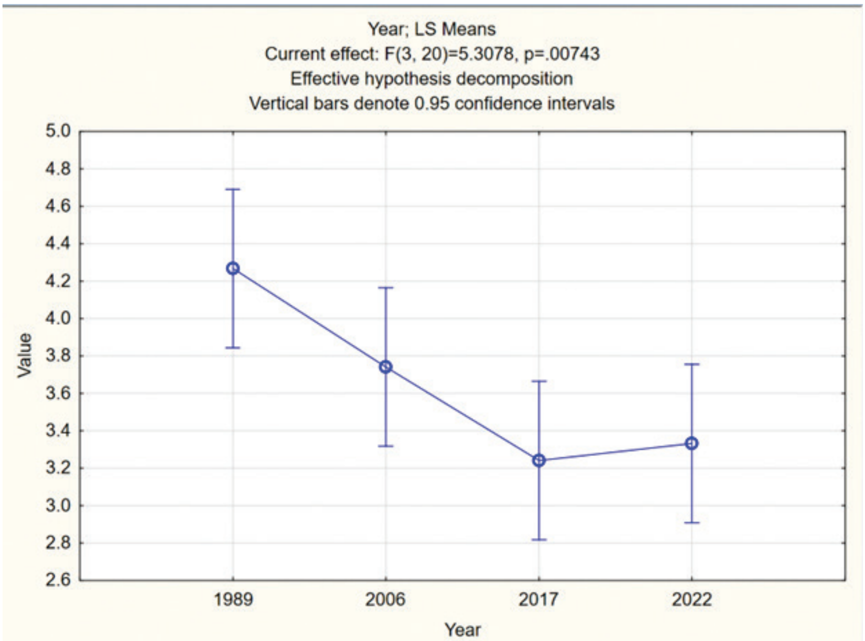

Figure 2. The ANOVA for the front horns of six female Eastern black rhinos

raises the question of 'what affects horn growth and length attained in black rhino'?

One possibility is that it is a heritable trait. It could be postulated that long-horned female rhinos will produce females that will have long horns. There is a paucity of research on this. However, there are some limited data for comparison that can be obtained from available photographs, as mentioned above.

Figure 1 shows the right profile photographs of six adult females with long horns alongside right profile photos of their offspring, all of which are also long-horned when mature. Although only a small sample was analyzed for this study, it suggests that horn length could be a heritable trait; this can only be confirmed by genetic testing. Should this be the case, then the decline in horn length could be due, in whole or part, to the unnatural death of selected long-horned females, reducing the potential for passing on the trait.

However, another possibility of reduction in horn length could be due to a change in nutrition. There were a few black rhinos in the population that suffered from split or broken horns (6% of adults and subadults out of the total population). The author considered this to possibly be a sign of poor nutrition. An unpublished vegetation study carried out in 2006 showed a lack of grade-one food sources for black rhinos, particularly a lack of *Acacia drepanolobium*. This was not unexpected, as a programme to remove up to a third of the population was planned in 2006 due to acknowledged overpopulation. Despite the

(a)

(b)

(c)

(d)

(e)

(f)

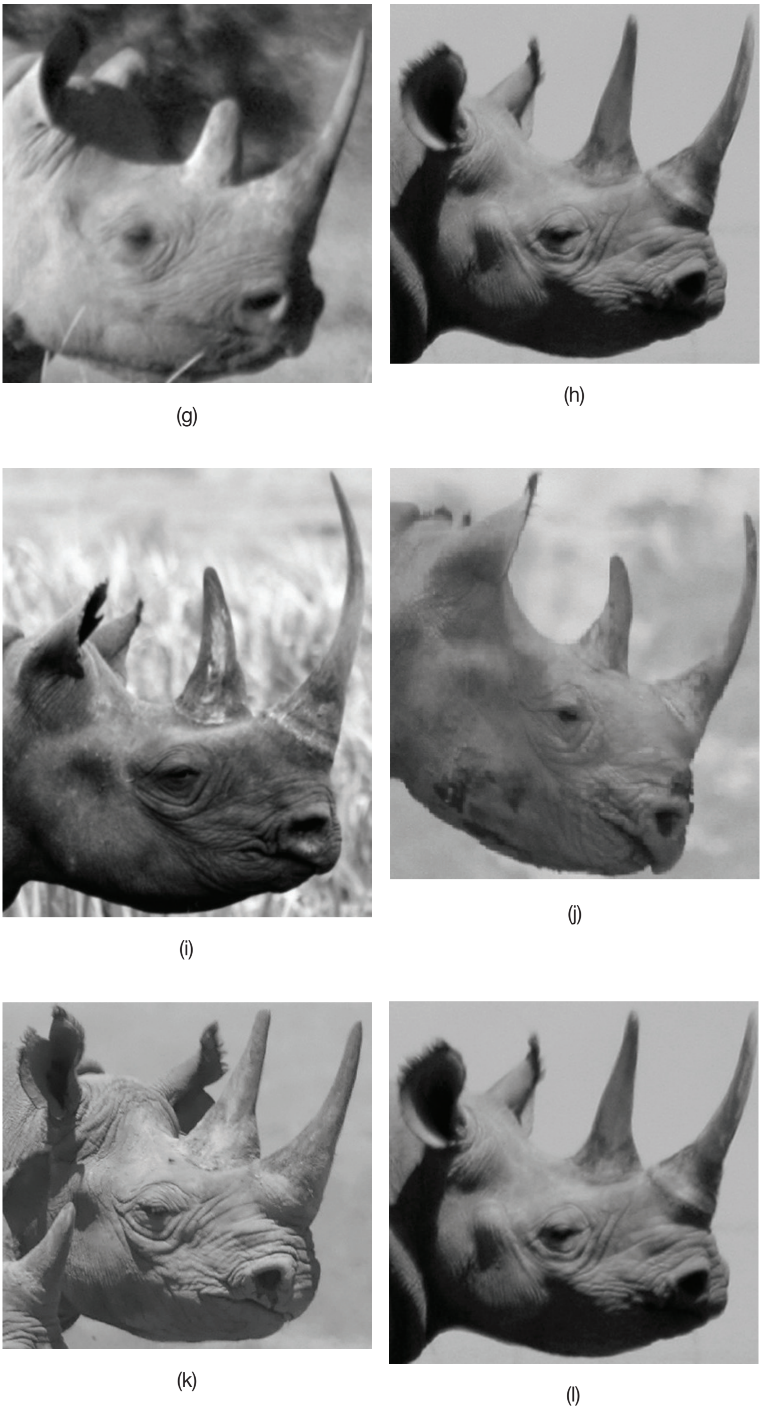

Figure 1. Six long-horned adult females (left: a, c, e, g, i, k) and their female, now adult, calves (right: b, d, f, h, j, l)

translocation (in February 2007) and a second smaller translocation (12 individuals in early 2012), and some losses due to poaching, the acacia did not recover significantly.

Other causes for a rhino horn not meeting its true potential length include the extent of horn rubbing and abrasiveness of the available substrate and the length of time that the horn may have had to develop (depending on the age of the rhino).

To date, there has been no published research on factors that affect rhino horn size. A limiting factor of this study is the small sample size; however, as most black rhino protected areas have collected photographs for individual rhino identification over many years for monitoring purposes, an analysis of factors affecting rhino horn characteristics can easily be extended.

Conclusions

It is clear that there are gaps in published research into the reasons for the variation in rhino horn length. With significant advances in rhino genetic techniques and analysis and the potential availability of source material from translocations, ear notching, dehorning and other interventions, opportunities exist for research studies. Furthermore, research on the ecological carrying capacity and whether or not the nutritional needs of black rhinos are being met in intensive protection zones and sanctuaries in Kenya is recommended for future study.

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