

Abstract

African elephants (*Loxodonta africana*) are highly popular and attract tourists from all around the world. However, these animals face a lot of welfare issues, such as stress or anxiety, typically assessed through fecal cortisol concentrations or by observing stereotypical behaviors. Nevertheless, cortisol testing protocols are costly, time-consuming, and do not allow us to identify the underlying causes of stress, nor do the observation of stereotypical behaviors. Thus, using a new and non-invasive method could be an alternative for assessing their well-being and improving their management in captivity.

This study aims to confirm the existence of a correlation between increased fecal cortisol concentrations and increased frequency of self-directed behaviors (SDB). During this study, SDBs were considered as a potential marker of distress, anxiety, and frustration in African elephants. This method has already been validated in primates to evaluate their well-being. Currently, there is not a lot of available information regarding these behaviors in African elephants.

During this study, we observed SDBs related to the trunk, the tail, and the body in two populations of African elephants: a group of 5 semi-captive individuals kept at Knysna Elephant Park (KEP), which is a tourist destination where tourists can have close interactions with the elephants; and a group of 9 semi-captive elephants at Plettenberg Bay Game Reserve (PGR), another tourist destination where tourists do not come into contact with animals. Observations were continuous, and SDBs were recorded each time they occurred, every minute for 30 minutes, along with the number of tourists nearby (< 5 meters) and the nature of tourist interaction (3 levels: None, Feeding, Tour), the presence or absence of the tractor bringing tourists (4 levels: Absent, Approaching, Stopped, Leaving), and the person (3 levels: Guide, Volunteer, Tourist) and the nearest elephant, as well as the distance separating them from the focal animal, measured in meters.

Then, SDB frequencies were compared with fecal cortisol concentrations, which were determined from samples collected on the day of behavioral observation (T0), the following day (T24), and the day after (T48).

By the end of this study, 14 African elephants were observed during the day, and 108 fecal samples were analyzed by using the generalized linear mixed-effects model (GLMM). The results showed that elephants exhibited more SDBs when at least one tourist was within a 5-meter radius ($p < 0.05$) and less SDBs when they were grazing ($p < 0.05$). Distance also appeared to be significant: SDB rates were significantly increased when any person (not only a tourist) was within a 5-meter radius ($p < 0.05$). The type of tourist interaction had no significant effect on SDB rates ($p > 0.05$). Furthermore, the comparison of the two populations revealed that SDBs were more frequently displayed at KEP, while fecal cortisol concentrations were higher at PGR. Cortisol seemed to be associated with chronic stress, whereas SDBs appeared to represent acute stress. The negative correlation found between fecal cortisol concentrations and SDB rates supports this hypothesis ($r = -0.2663$; $p = 0.0103$).

This study could be considered as additional evidence that self-directed behaviors are a reliable tool for measuring the well-being of African elephants and preventing them from chronic stress states. However, it would be useful to work with larger populations and establish a baseline for SDBs for each individual for future studies.

Keywords: *Loxodonta africana*, self-directed behaviors, animal welfare, tourism, cortisol.