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Pond use by captive African Penguins (*Spheniscus demersus*) in an immersive exhibit adjacent to human bathers

Running head

Visitor effect on African Penguins

Abstract

Animals in zoos are exposed to a continuous human presence, which affects their behavior and welfare. However, little is known about what role the "visitor effect" has on captive penguins. The African Penguin (*Spheniscus demersus*) is an endangered species commonly housed in zoos worldwide. The aim of this study was to evaluate whether the abundance of human bathers could reduce the average time spent in the water of a colony of African Penguins housed in an exhibit where their pond habitat was adjacent to a swimming pool. Observations were carried out on seven penguins in summer 2009. Data were collected over three time periods (T1=opening of the swimming season, T2=core of the season, T3=late season) of 14 days each. The human disturbance caused by bathers strongly reduced the pond use by penguins at T1 and T2, especially when there were large numbers of visitors. However, at T3, we observed that the overall use of the pond by penguins increased, and the average duration of their diving was no longer dependent on number of visitors.

Introduction

The animals in zoos and aquaria are subject to a variety of physical, social, dietary, and ecological limitations. In addition, they are exposed to a continuous human presence, which influences their behavior and welfare. Such influence has been defined as the "visitor effect" (Hosey, 2000; Margulis, Hoyos, & Anderson, 2003; Bortolini & Bicca-Marques, 2011). A review by Hosey (2000) led to identification of three different classes in which zoo visitors can influence exhibited animals, namely (1) being a source of stress; (2) being a source of enrichment; (3) being relatively neutral. In a more recent review, Davey (2007) suggested that behavioral responses to visitors are species-specific and related to body size. In particular, while small animals, such as arboreal primates, are usually aware of people, and are likely to respond with a behavior that tends to avoid massive audiences (Chamove, Hosey, & Schaetzel, 1988; Fernandez, Tamborski, Pickens, & Timberlake, 2009), larger animals are generally less responsive (Margulis et al., 2003), or react by displaying aggressive behavior (Anderson, Benne, Bloomsmith, & Maple, 2002; Lukas et al., 2002). The impact of the viewing public on a captive animal is also known to be affected by the habitat provided in the exhibit (Blaney & Wells, 2004). In particular, the visitor effect is more evident in impoverished environments (Broom & Johnson, 1993) whereas it is markedly reduced in naturalistic exhibits that offer shelter for animals to hide from visitors (Mononen, Kasanen, Harri, Sepponem, & Rekila, 2001; Simpson, 2004; Blaney & Wells, 2004).

One of the biggest challenges of modern zoos is to meet the expectations of visitors, which often include recreation and entertainment, whilst at the same time, providing education on the biology and conservation of endangered species. This goal can be achieved through creating immersive exhibits, which are fascinating to the public and attract visitors, involving them in an interactive environment (Ross & Gillespie, 2009). However, little is known about the influence of these modern facilities on the behavior of exhibited animals.

Regarding penguins, very few studies have investigated the effect of zoo visitors on these birds (Hosey, 2008). Warren, Parry, Cuthill, & Barham (2003) provided evidence that human presence can affect the behavior of Gentoo (*Pygoscelis papua*) and African (*Spheniscus demersus*) Penguins, and they observed, in both species, increased vigilance and activity associated with a persistently high number of people. In this study, the authors also carried out a "disturbance experiment", consisting of a human stranger walking through the enclosure. During this experimental condition, the birds dramatically increased their walking behavior and, after the person had left the exhibit, vigilance became the dominant activity in the subsequent

few minutes. However, a study by Brooking & Price (2004), that investigated the behavior of the same two species when exposed to visitors, only found a decrease in resting behavior in the African Penguins, without any reduction of the enclosure space utilization, dependent on increasing visitor density. Finally, Condon, Wehnelt, & Turner (2003) showed that, for the Humboldt's Penguin (*Spheniscus humboldti*), the presence of the viewing public both reduced the inactivity of these animals and increased their physical fitness, suggesting a positive response of the birds to the audience.

The African Penguin is an endangered marine bird (BirdLife International, 2012), endemic in South Africa and Namibia. Small groups of *S. demersus* are also exhibited in zoos and aquaria all over the world and, therefore, it is important that welfare specialists understand the impact of the audience on this species. To this end, we investigated the visitor effect on a colony housed in a zoological park in Italy, in order to assess if the presence of visitors results in reduced pool use by penguins.

Methods

The study was carried out on seven adult penguins (two males and five females) of the species *Spheniscus demersus* at the "Bolder Beach" enclosure of the biopark ZOOM Torino (44° 56' N, 7° 25' E), Italy. This exhibit covers an area of 1500 m^2, including a pond of 120 m^2 (water depth-maximum 3 m; temperature constantly maintained at 15 °C). The enclosure reproduces the habitat of "Boulders Beach", a natural nesting site in South Africa. The penguins' pond is physically, but not visually, separated from a swimming pool by two glass panels, which allow complete underwater vision of the animals (Figure 1). The swimming pool receives approximately 35,000 visitors per year, from late May to early September.

Data collection took place in 2009 over three time periods of 14 consecutive days each (T1, T2, T3), described in Table 1. The penguins were naïve to human bathers, and the study was conducted when the novel immersive exhibit had opened to the public for the first time. Moreover, at that time, the penguins had just been transferred from another zoo, which did not have this structural condition. Observations were carried out following the focal animal sampling method (Altmann, 1974) and lasted 14 hours per sampling period (one hour per day). Overall, each penguin was observed for two hours per period. During observation sessions, the number of bathers facing the glass panels (i.e. those that could be viewed by penguins) was constantly monitored and categorized into classes according to abundance: 0 (no visitors), 1 (1 to 15), 2 (16 to 30), 3 (more than 30), and the time spent by penguins in the water was recorded

using a stopwatch Konustart-3 (Konus®). The stopwatch was started when the focal bird spontaneously dived into the pond, and was stopped when the same animal left the water. However, the birds usually entered in and left the pool as a group.

Statistical analyses were carried out using the R software v. 3.0.1 (R Development Core Team 2007, available at http://cran.r-project.org) for Macintosh. Since the data did not follow a normal distribution, inferences were made using non-parametric statistical techniques.

Results

Overall, the time spent by penguins in the pond significantly increased at T3 compared to T1 and T2 (Kruskal-Wallis $\chi^2 = 35.47$, df = 2, $P < 0.001$; Figure 2). Moreover, at T1 and T2, the average time spent by penguins in the pond was strongly dependent on the abundance classes of the viewing public (T1: Kruskal-Wallis $\chi^2 = 17.28$, df = 3, $P < 0.001$; T2: Kruskal-Wallis $\chi^2 = 14.89$, df = 3, $P < 0.01$; Figure 3). In particular, the NDWD (Nemenyi Damico Wolfe Dunn) *post-hoc* comparison showed that, in these periods, the birds remained significantly less in the water when there was an abundance of bathers facing the glass panels; comparison between classes 0 and 3 (T1: $P < 0.001$; T2: $P < 0.01$) and between 1 and 3 (T1: $P < 0.001$; T2: $P < 0.01$). Conversely, at T3, the time spent by penguins in the pool was not conditioned by the number of bathers facing the glass panels (T3: Kruskal-Wallis $\chi^2 = 7.44$, df = 3, $P > 0.05$; Figure 3).

Discussion

We investigated whether the occurrence and abundance of human bathers have an influence on the pond use, in a colony of African Penguins (*Spheniscus demersus*) housed in an exhibit adjoining a swimming pool. To this end, we monitored the average time spent in the water by seven adult birds over three separate time periods corresponding, respectively, to the seasonal opening of the swimming pool (T1), the core of the season (T2), and the late season (T3).

We observed that the human disturbance due to bathers strongly reduced the pond use by penguins during the T1 and T2 observation periods, especially when large numbers of visitors were present. However, at period T3, we observed that the overall use of the pond by the penguins increased, and the average duration of their diving was no longer dependent on the number of people present. This is in line with the study by van Heezik & Seddon (1990), which showed that wild African Penguins exposed to a regular disturbance exhibit a high level of tolerance to visitors. More recently, Seddon & Ellenberg (2008) also confirmed that tolerance to

125 human proximity, by penguins, varies according to many different factors, including their own
126 previous experience. Finally, a study by Condon et al. (2003), performed on ten captive
127 Humboldt penguins (*Spheniscus humboldti*) housed at Chester Zoo (United Kingdom), showed
128 that the viewing public has a positive effect on the diving behavior of these birds. Specifically,
129 they observed an increase of submerged swimming relative to the presence of visitors, as a
130 result of human interaction through glass windows. Conversely, in our scenario, we did not
131 observe any positive influence exerted by human bathers in relation to pond use by the African
132 Penguins. In wild Yellow-eyed Penguins (*Megadyptes antipodes*), behavioral responses to
133 human disturbance can vary according to both individuality and gender (Ellenberg, Mattern, &
134 Seddon, 2009). However, these differences were not evident in other species (e.g. Ellenberg,
135 Mattern, Houston, Davis, & Seddon, 2012), and have never been reported for the African
136 Penguin. Further studies, carried out on a larger number of penguins of both sexes would be
137 useful to investigate whether these differences exist in this species.
138
139 Immersive exhibits represent a modern and attractive alternative to traditional zoo enclosures
140 (Ross & Gillespie, 2009). However, even if these exhibits provide a unique, interactive
141 environment for the viewing public, thus contributing an added value for education and
142 awareness purposes, the disadvantage is they could affect the behavior of animals due to the
143 close proximity to humans. Beale & Monaghan (2004) suggested that sea birds perceive the
144 human disturbance as a potential predation risk. Since predators of the wild adult African
145 Penguin are mostly aquatic animals such as the great white shark (*Carcharodon carcharias*)
146 (Randall B.M., Randall R.M., & Compagno, 1988; Johnson, Venter, Bester, & Oosthuizen,
147 2006) and the Cape fur seal (*Arctocephalus pusillus pusillus*) (du Toit, Barlett, Bester, & Roux,
148 2004; Johnson et al., 2006), we hypothesize that, at periods T1 and T2, the bathers facing the
149 glass panels that separated the pond from the swimming pool were perceived by the members of
150 colony as a potential threat. Consequently, penguins avoided using the pond, particularly when
151 there were large groups of visitors. We also suggest that the increased use of the pond, observed
152 at T3, was a result of a gradual habituation to human visitors that were no longer perceived by
153 the birds as potential predators.
154
155 Further research, taking into account a larger number of penguins, and comparing similar
156 scenarios, would be especially valuable, in order to gain a more complete understanding of this
157 behavior. We also recommend that zoos and aquaria, which do not exhibit penguins for
158 extended periods of time throughout the year, pay particular attention to the needs of these birds

at the beginning of the opening season, in order to re-habituate them to a massive audience exposure.

Conclusions

1. The presence of human bathers facing the glass panels reduced the average time spent by the penguins in the pond at T1 (opening of the swimming season) and T2 (core of the season).
2. In these periods of observation, the time spent by the birds in the pond was also strongly dependent on the abundance classes of the viewing public.
3. At time T3 (late season), the penguins habituated to presence of humans, and their use of the pond was no longer influenced by the presence or abundance of the public.

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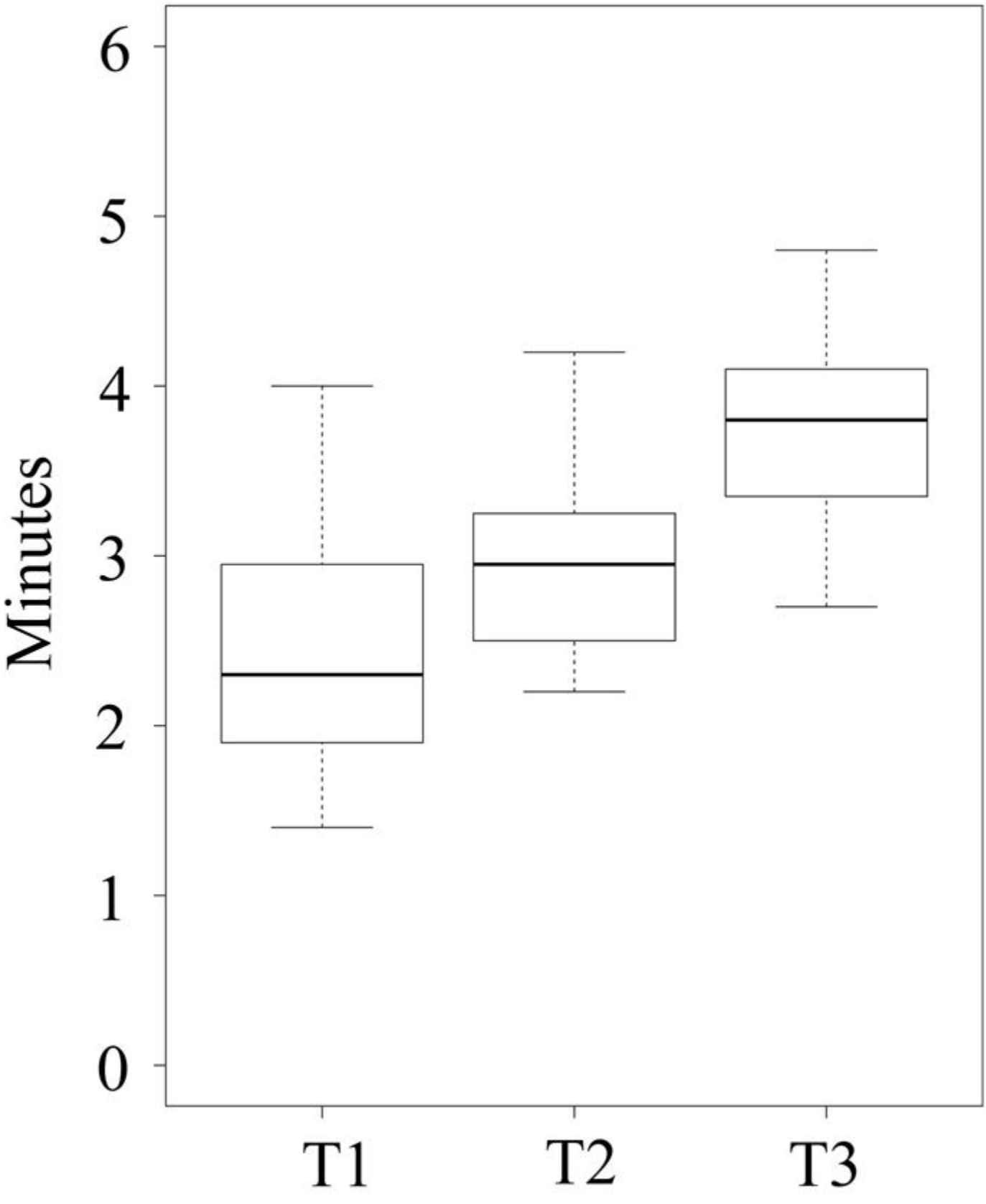
242

Table 1. Brief descriptions of the three periods of observation.

	Days	**Description**
T1	May 30th – June 14th	Opening of the swimming season
T2	June 30th – July 14th	Core of the season
T3	July 31th – August 14th	Late season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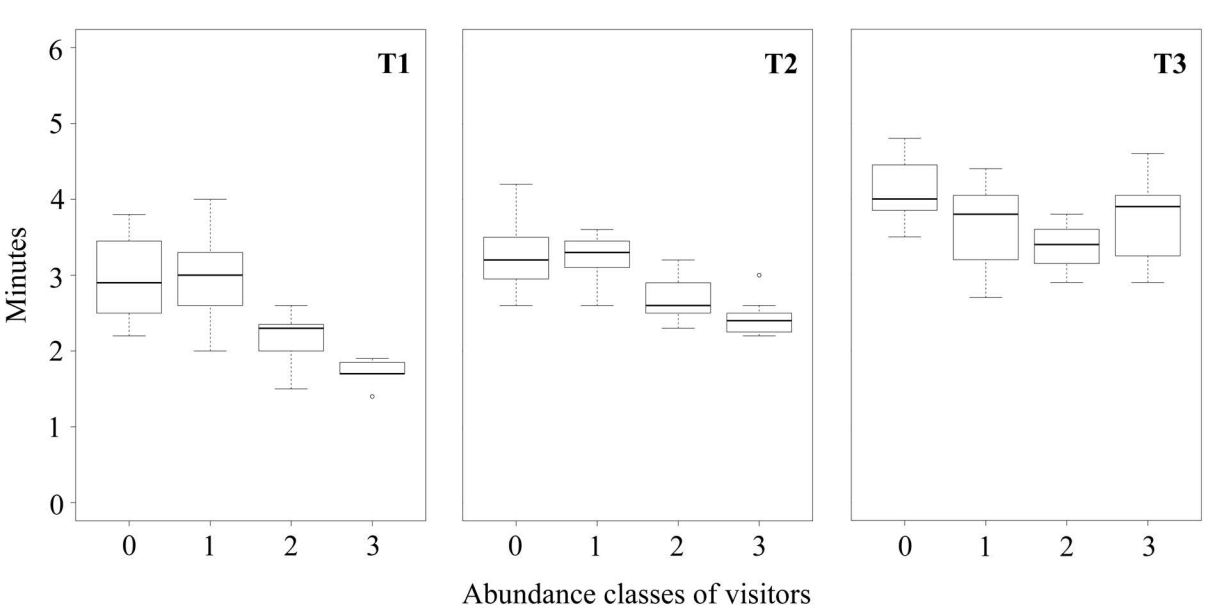
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Abundance classes of visitors