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Little penguins, *Eudyptula minor*, show increased avoidance, aggression and vigilance in response to zoo visitors

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ABSTRACT

Multiple studies have shown that human disturbance can have negative impacts on wild penguin populations. Penguins in zoos may also be susceptible to negative impacts from humans, but this has not previously been investigated. We examined the visitor effect on a group of 25 little penguins, *Eudyptula minor*, by randomly imposing two treatments: (1) no visitor contact, which was achieved by closing the penguin exhibit on study days and (2) exposure to visitors, with the penguin exhibit open as usual. Treatments were imposed for 1-day periods, with five replicates of each treatment (total of 10 study days). Instantaneous point sampling and continuous sampling were used to record penguin behaviour including proximity to visitor viewing area, surface swimming, diving, vigilance, visibility, resting and intra-group aggression during a total of 3 h on each of the 10 study days. When exposed to visitors, penguins showed increased levels of aggression ($P = 0.02$), huddling ($P = 0.049$) and behaviours indicative of avoidance of visitors including increased time spent positioned behind enclosure features ($P = 0.024$) and increased distance from the visitor viewing area ($P = 0.002$). These behavioural results suggest that the presence of visitors or some aspect of visitor behaviour may have been fear-provoking for these penguins. To generalize beyond this group of animals and this enclosure requires further research.

1. Introduction

Penguins are a charismatic group of animals that draw large crowds of tourists both in zoos and in the wild (Seddon and Ellenberg, 2007; Stokes, 2007). This has led to the development of penguin-watching as a major eco-tourism attraction in various regions (Villanueva et al., 2012). Concern about the impact of tourism at wild penguin colonies motivated investigation into the effects of human exposure on penguin populations (McClung et al., 2004).

Indeed, many studies have provided evidence that human disturbance can have negative consequences for wild populations. For example, reproductive success in Humboldt penguins was found to decline at sites frequently visited by tourists (Ellenberg et al., 2006), travel from ice to sea was disrupted resulting in increased energetic cost of the commute in Emperor penguins when tourists were within 200 m of the birds (Burger and Gochfeld, 2007) and breeding success and fledging weights were reduced in yellow-eyed penguins at sites where tourism was unregulated (Ellenberg et al., 2007). On the other hand, some studies suggest that penguins can habituate to the presence of humans in the wild. For example, Walker et al. (2006) suggest that Magellanic penguins habituated rapidly to human visitation because they found that penguins with no previous exposure to tourists had a significant reduction in plasma corticosterone concentration after just 5 days of daily visits by humans.

Little penguins, *Eudyptula minor*, are the smallest of the penguin species (Klomp and Wooller, 1991; Warham, 1958) and similar to many of the above mentioned studies, there is some evidence that they can be affected adversely by human disturbance. For example, little penguins in Victoria and New South Wales, Australia, showed avoidance of nesting areas exposed to high levels of human visitation (Giling et al., 2008; Weerheim et al., 2003) while in Western Australia hatching success was lowest in nesting areas most visited by tourists (Klomp et al., 1991). This species of penguin is also commonly housed in Australian zoos, a setting where there is clear potential for intense human interaction.

Given the evidence for negative impacts from human exposure in some wild penguin populations, it is possible that this group

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of animals might be particularly fearful of humans and therefore potentially susceptible to negative effects from exposure to visitors in zoos. Previous studies on other species have demonstrated that visitors may compromise animal welfare in zoos (Davis et al., 2005; Hosey, 2013). For example, visitors have been associated with increased levels of aggression in Indian blackbuck (Rajagopal et al., 2011), decreased levels of affiliative behaviour in cotton-top tamarins (Chamove et al., 1988) and less time visible to the public in jaguars (Sellinger and Ha, 2005). However, we are unaware of any published studies that have investigated the impact of human presence on the welfare of penguins in zoos.

Using behavioural measures alone to assess zoo animal welfare in response to visitors can be challenging because interpretation of some behaviours can be ambiguous. Nevertheless, some behaviours are useful indicators of stress and thus compromised welfare (Dawkins, 2004). For example, avoidance of specific stimuli can reflect negative emotions such as fear (Broom and Johnson, 1993; Hemsworth and Coleman, 2011) and aggression has been associated with a physiological stress response (Honess and Marin, 2006). Authors have also suggested that behavioural deprivation, where an animal is highly motivated to perform a particular behaviour but the environment restricts it from doing so, compromises welfare (Dawkins, 1988; Fraser et al., 1997). For zoos that strive not only to meet the basic needs of their animals but to provide a stimulating environment, it is important to also consider behaviours that can indicate positive animal welfare, for example play and affiliative interactions (Boissy et al., 2007; Yeates and Main, 2008). Changes in the levels of any of these behaviours can provide insight into how well animals are coping in captivity.

The aim of this study was to investigate the impact of experimentally controlled visitor presence on little penguin behaviour in an Australian zoo. This study was initiated in response to concern from keepers who had noticed that these penguins spent most of their time near the back of their enclosure behind vegetation and very little time swimming during zoo open hours. Several interventions such as water feeds and the addition of enrichment items in the water were trialled to encourage swimming, but anecdotal observations indicated that these interventions had little effect. The enclosure design provides visitor access adjacent to the pool edge, and hence it was hypothesized that visitor presence would influence penguin behaviour.

2. Methods

2.1. Study animals and enclosure

This research received ethics approval from the Zoos Victoria Animal Ethics Committee. Melbourne Zoo, Australia houses a breeding group of 25 little penguins in a naturalistic, outdoor, 330 m^2 exhibit consisting of sand and vegetation areas, and a large swimming pool with current flow throughout the water (Fig. 1). The visitor pathway ran along two sides of the exhibit, with the predominant penguin viewing positions along the length of the pool. A 1.2 m high barrier separated visitors from the penguin enclosure. Diet (pilchard feeds twice per day) and husbandry (monitoring of animals, cleaning enclosure and feeding penguins) followed normal routines and remained consistent throughout the course of the experiment. The group consisted of 12 females and 13 males. All individuals were adults ranging from 1 to 14 years of age.

2.2. Experimental procedure

Two treatments were imposed for the experiment:

(1) *No visitor contact*; the penguin exhibit was closed to the public.

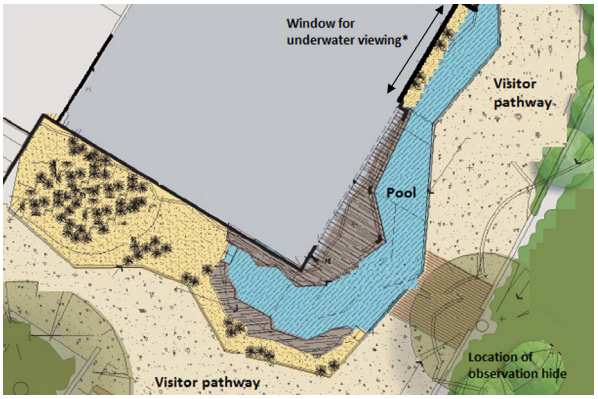

Fig. 1. Diagram of penguin exhibit at Melbourne Zoo. * The underwater viewing window was one-way glass so the penguins could not see the visitors but the visitors could see the penguins. The remainder of the building was viewing for seals.

(2) *Exposure to visitors*; the penguin exhibit was open as usual (standard zoo conditions).

Treatments were imposed for 1-day periods, with five replicates of each treatment (total of 10 study days). The study was only conducted on weekdays to reduce the normal variation in visitor numbers between weekdays and weekends. Moreover, to minimize potential effects from weather, the study was only conducted on days within a temperature range of 18 to 25 °C and study days were cancelled if rain was forecasted. Maximum daily temperature was recorded for each study day using the Bureau of Meteorology's data from the nearest weather station (roughly 4 km from the study site). All 10 study days fell within 3 consecutive weeks in March and April 2014 (Autumn). The treatments were randomly assigned to the 10 study days, making the experiment a five replicate, two treatment fully-randomised design.

On 'no visitor contact' days, barriers were put in place before zoo opening hours at 08:45 h to advise visitors that the penguin exhibit was closed. Barriers were then taken down at 15:30 h when the collection of behavioural data was complete for the day.

2.3. Behavioural observations

Behavioural observations were conducted by the same observer throughout the study (SS). Observations were performed from a purpose-built observation hide just behind the visitor viewing area in a position where the entire exhibit was within view (Fig. 1). The use of the hide ensured that observer presence did not influence penguin behaviour. Behavioural observations were conducted from 09:30 until 15:00 h in six, 30 min observation blocks (09:30–10:00, 10:15–10:45, 11:00–11:30, 11:45–12:15, 13:45–14:15, 14:30–15:00 h) using instantaneous point sampling at 5 min intervals. Penguin behaviours recorded were proximity to the viewing area, surface swimming, diving, vigilance, preening, visibility and resting (see descriptions in Table 1). Penguins had access to nest boxes throughout the study and therefore behavioural observations were only recorded for birds visible in the enclosure in each observation block. Individual bird identity was not recorded. The distance of each visible bird from the visitor viewing window (m) was also recorded using a laser range finder (Bosch PLR 50 Digital Laser Rangefinder, Bosch, Stuttgart, Germany) at every 5 min sample point. Group aggression was continuously sampled throughout each 30 min block, recording all bouts of aggression within the group. If aggression was seen or heard while the instantaneous point sampling was being conducted, the instantaneous point sampling was interrupted, the bouts of aggression recorded and the instantaneous point sampling then continued.