

Short communication

Visitor-associated variation in captive Diana monkey (*Cercopithecus diana diana*) behaviour

Peter A. Todd^{a,*}, Charlotte Macdonald^b, Dorcas Coleman^c

^a Department of Biological Sciences, National University of Singapore, 14, Science Drive 4, Singapore 117543, Singapore

^b Edinburgh Zoo, Edinburgh, Scotland EH12 6TS, UK

^c School of Life Sciences, Napier University, 10 Colinton Rd, Edinburgh EH10 5DT, UK

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Abstract

This research examines the relationship between visitor numbers and the behaviour of Diana monkeys (*Cercopithecus diana diana*). A family group of two adult and four juvenile captive Diana monkeys was studied intensively for 10 days at Edinburgh Zoo, UK. The six subjects were scan sampled every 5 min for 7 h per day; their behaviour, and visitor numbers, were recorded. Chi-squared analysis revealed a highly significant association between Diana monkey behaviour and visitor group size, where the amount of time spent grooming and sleeping/resting decreased with greater visitor numbers whereas time spent playing and feeding/chewing increased. Results are discussed in the context of recent findings regarding visitor presence and zoo animal welfare.

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1. Introduction

Although the presence of visitors is an integral part of zoo life, our understanding of how captive animals react to varying levels of visitor numbers remains relatively poor. Human presence may positively stimulate captive animals, not have any discernable effects, or cause them stress (see Hosey, 2000, 2005; Wells, 2005 and references therein). The latter is of particular concern as caring for the well-being of animals is a zoo axiom and yet there is a potential conflict

* Corresponding author.

E-mail address: dbspat@nus.edu.sg (P.A. Todd).

if the visitors that support, and benefit from, these institutions themselves create a welfare problem (Hosey, 2000). Clear examples of visitor-induced stress include captive orang utans, *Pongo pygmaeus*, covering their heads with paper sacks, and infants clinging to adults more often, when visitor numbers were high (Birke, 2002), and increased levels of urinary cortisol (a hormone indicative of stress) in spider monkeys, *Ateles geoffroyi rufiventris*, exposed to high visitor densities (Davis et al., 2005).

As highlighted recently, however, care has to be taken when interpreting results from research examining the interactions between visitors and zoo animals (Hosey, 2005; Ross et al., in press). For instance, actual cause and effect is difficult to demonstrate as it is possible that visitors are simply attracted to subjects when they are behaving in certain ways, as opposed to the visitors inducing the behaviours (Mitchell et al., 1992; Birke, 2002). Visitor numbers may be correlated with other variables, such as time of year (Ross et al., in press) and, ideally, the behaviour of the visitors should be recorded (Hosey, 2005) as this is known to influence animals beyond simple presence (Hosey and Druck, 1987).

The present study examines the relationship between visitor numbers and the behaviour of Diana monkeys, *Cercopithecus diana diana*. Diana monkeys are slender, long-limbed and long-tailed, and weigh approximately 5 kg when fully grown (Chamove et al., 1988). In the wild, they are diurnal and arboreal, living in the lowland primary rain forest and secondary forests of West Africa (Cords, 1987; Scerif et al., 2004). Groups tend to be small, consisting of a single male, a number of adult females and whatever offspring the females have produced (Zuberbühler, 2000).

2. Methods

The Diana monkeys observed in this study were a captive-bred family group comprising an adult male and female both aged 14, and 4 female juveniles aged between 2 and 6 yr old. The subjects were housed at Edinburgh Zoo, Scotland, UK, in a double exhibit: ca. half indoors and half outdoors, separated by a short passageway. The woodchip on clay outdoor section was enclosed within a 9.0 m diameter cylindrical cage that tapered to a 7 m peak. This was surrounded by an additional 1.8 m high fence to keep the public at a distance of at least 1.0 m from the main area. The indoor section was 2.5 m high, 4 m deep and 18.3 m long, artificially lit with a glass viewing panel comprising one of the 18.3 m walls; the concrete floor was covered in straw. Both parts of the enclosure contained various enrichment elements, such as logs, pipes, tree stumps/branches and ropes. The subjects were fed four times a day and had access to water ad libitum.

2.1. Observation methods

During a 10-day period in June 2002, between 09:00 and 13:00 h and 14:00 and 17:00 h (within regular opening times), an instantaneous scan-sampling technique (Altman, 1974; Owen, 2004) was used to observe and record the behaviour of each subject at 5 min intervals; the number of visitors was also noted at these time periods. The behaviours were originally classified into nine types but, to reduce zero counts for subsequent analysis, most were pooled into the following five categories: observing (watching activity both inside and outside the enclosures), feeding and chewing (including foraging), playing (solitary and social, object-using), grooming (solitary and social), resting and sleeping. One behaviour, pacing, accounted for <1% of the overall activity budget and was therefore excluded from the analysis (as was “out of view”).

2.2. Statistical analysis

Associations among behaviours and visitor group sizes were analysed with a χ^2 -test. For this, the total pooled behavioural data for all six subjects were partitioned according to the size of the visitor group present (Hosey and Druck, 1987), i.e. none (0), small (1–5) or large (>5).

3. Results and discussion

The 5100 observation points collected indicate a highly significant association between Diana monkey behaviour and visitor group size ($\chi^2 = 162.082$, d.f. = 8, P -value = <0.001) with clear shifts in activity budgets. Increase in visitor group size is positively related to more active-type behaviours, i.e. playing and feeding/chewing and negatively related to less active behaviours, i.e. grooming and sleeping/resting (Fig. 1). Time spent observing remains relatively stable. These results correspond to previous findings from a range of primate research, for instance, Chamove et al. (1988) found similar trends in their study of visitor effects on Diana monkeys with a reduction in grooming and affiliation behaviour when visitors were present. A positive relationship between locomotory activity and visitor numbers was identified for various primate species by Mitchell et al. (1992) and it has been reported that gorillas rest less when exposed to high visitor densities (Wells, 2005). Wood (1998) noted that grooming in captive chimpanzees decreased with increasing visitor numbers but, contrary to our results, so did time spent foraging, object-using and playing. Among these studies, only Chamove et al. (1988) and Wells (2005) concluded that visitors were having a negative affect on the subject animals.

Hosey (2000) reviewed the proposition that human presence may be enriching (increase stimulation) together with the hypothesis that visitors are a stressful influence and found considerably more evidence for the latter. If the presence of visitors does induce stress in captive primates, and there is now some physiological data indicating this (Davis et al., 2005), efforts should be made to negate any deleterious effects (Mallapur et al., 2005). Potential ameliorative options include providing opportunities for animals to move out of public view (Hosey, 2000), e.g. using screens with gaps for visitors to peek through (Birke, 2002); introducing barriers, such as moats to increase the distance between subject and visitor (Hosey, 2000); species/enclosure-specific visitor number control (Wells, 2005) and, for arboreal species, arranging enclosures so that the animals are higher than the audience (Chamove et al., 1988).

Our research demonstrates a relationship between visitor numbers and the behaviour of the Diana monkeys studied. If the link is causal, visitor presence should be considered whenever research is conducted on *C. d. diana* in zoos (Mitchell et al., 1992; Hosey, 2000). The implications of visitor-induced changes in behaviour merit greater study (Mitchell et al., 1992;

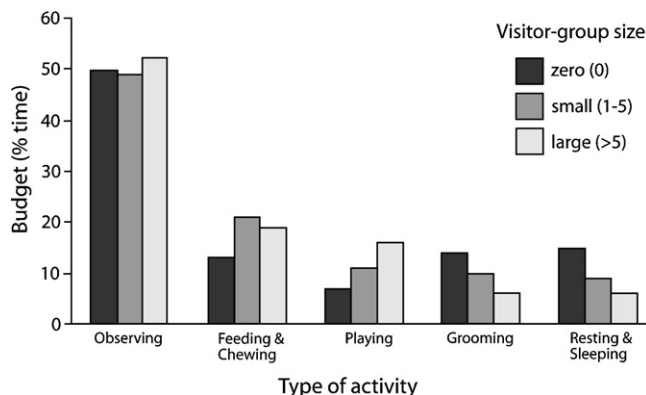


Fig. 1. The relationship between visitor-group size and the total pooled behavioural data for all six subjects. Note, although the χ^2 -test was performed on raw data, for ease of interpretation, this figure is presented as % of total activity in each visitor-group size category.

Hosey, 2005; Ross et al., in press) and, when welfare is compromised, remedial steps should be implemented.

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