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The effects of visitor density on sika deer (Cervus nippon) behaviour in Zhu-Yu-Wan Park, China

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Abstract

*Visitors to zoos are a source of potential stress to certain captive-housed animals. Much research has focused on Europe and America, whereas the effect of human audiences on the behaviour of captive animals in Chinese parks has so far not been investigated. Sika deer (*Cervus nippon*) housed in Zhu-Yu-Wan Park, Yangzhou City, Jiangsu Province, China, were studied to determine the effect of different visitor density levels on the animals' activity. From June 21 to December 10, 2006, and again from February 21 to July 10, 2007, 21 subjects were observed for 10 h per week for a total of 44 weeks. Continuous focal animal sampling was used to quantify behaviours, and visitor density was recorded every minute. Friedman's tests were used to examine the effects of visitor density on the behaviour of sika deer. Results showed that high visitor density was significantly related to foraging, resting, watching and 'non-visible' behaviours. The findings demonstrate that high numbers of visitors have an effect on the welfare of sika deer.*

Keywords: *animal welfare, behaviour, China, effects, sika deer, visitor density*

Introduction

The sika deer (*Cervus nippon*) originally comprised 13 subspecies (Whitehead 1993) distributed across eastern Asia from Japan to Taiwan; including six found in China (Sheng 1992). The two surviving subspecies are found only in isolated areas due to habitat loss and heavy poaching (Nagata *et al* 1998; Guo & Zheng 2000). Poaching is driven by demand for antlers, which are prized as an (expensive) traditional medicine. Management efforts in China are focused primarily on zoos or wildlife parks, where sika deer have been kept for more than 80 years. It is believed that these facilities play a significant role in sika deer conservation (Sheng 1992) whereby the species is given total protection in national parks and wildlife reserves in order to preserve genetic diversity and maintain essential ecological integrity.

Sika deer are highly nervous animals and can be easily excited or frightened. Although captive sika have been kept in parks for decades and may be more tame than wild conspecifics, it is known that deer in general, even when reared and enclosed in deer farms, may not become as tractable as other species (Humphries *et al* 1990). The captive environment and/or human presence may result in undesirable stress to sika deer, expressed potentially as abnormal or stereotypic behaviour (Carlstead & Shepherdson 1994) or reduced fertility. Some studies have determined no effect of human visitors on captive animal behaviour (eg Snyder 1975), while others have reported the opposite (Fa 1989; Cook & Hosey 1995; Todd *et al* 2007). Generally, the evidence suggests that visitors affect captive-housed animals, resulting in changes in the animals' activity that sometimes indicate reduced welfare. In primates, for instance, the presence of visitors has been shown to affect exploration, feeding and observation behaviour, as well as increasing intra-group aggression and stereotypic behaviour (Hosey 2000, 2005; Birke 2002; Skyner *et al* 2004; Davis *et al* 2005; Todd *et al* 2007). Birke (2002) observed that adult Sumatran orangutans (*Pongo abelii*) used paper sacks to cover their heads more during periods of high visitor density. Wells (2005) found that gorillas (*Gorilla gorilla*) spent a significantly greater proportion of their time resting during high visitor density, but also noted significantly more intra-group aggression, stereotypic behaviour and self-grooming. Similar results were reported by Mallapur *et al* (2005) on the behaviour of lion-tailed macaques (*Macaca silenus*). Very few studies, however, have explored the effect of visitors on non–primates (eg Burrell *et al* 2004; Owen 2004; Sellinger & Ha 2005) with no published examples focusing on sika deer.

As China develops economically, more and more people choose to travel during the weekends and national holidays.

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Table 1 Ethogram of sika deer behaviour.

Behaviour	Description
Foraging	Head down foraging on grass or fodder: standing, chewing and swallowing grass or fodder
Ruminating	Standing or resting, regurgitating, then chewing cud
Resting	Lying with eyes open or closed
Watching	Head up and observing environment, other deer, or human visitors
Locomotion	Walking, running, trotting or cantering
Self-grooming	Grooming, licking of body, nibbling or scratching of skin
Non-visible	Animal could not be seen, thus state could not be determined

Table 2 Density classes.

Level	Class	Definition
Quiet	1	1 to 15 people
Low	2	16 to 30 people
Moderate	3	31 to 45 people
High	4	46 to 60 people
Extreme	5	61 or more people

This has led to increasing numbers of visitors to parks, and it is important thus to determine their effect on captive animal welfare. A pilot study performed during April 2006 showed that sika deer at the Zhu-Yu-Wan Park, Yangzhou, Jiangsu Province, China appeared to react to the density and behaviour of visitors to the exhibit, with deer spending more time being watchful and less time foraging. These results suggested that further research to quantify the effects of visitors on sika deer behaviour was warranted.

Materials and methods

Subjects

The subjects were 21 sika deer (12 males, 9 females), aged between 2 and 6 years, all of which were marked by ear notches and collar tags for easy identification. The animals roamed freely in a fenced paddock of grasses, shrubs and trees (120 × 80 m; length × breadth) at the Zhu-Yu-Wan Park in Yangzhou City, Jiangsu Province, China. Grass and fodder (maize, bean, bran, mineral, vitamin and salt) were supplied to the animals each day at 0800 and 1500h and water was available *ad libitum*. At the front edge of the paddock was a raised wooden walkway, 1.5 m high and 2.5 m wide, from which visitors to the park were able to observe the deer between 0830 and 1630h.

Data collection

The study was conducted in two phases: from June 21 to December 10, 2006, and again from February 21 to July 10, 2007, during all weather conditions. Focal-animal sampling was used to determine the period of time spent on each behaviour (Altman 1974). Each sampling lasted for a period of 30 min, and approximately 10 h per week were spent collecting data, including weekdays, weekends, and national holidays. To reduce inter-observer variability, after 15 days of training, three observers collected all animal behaviour data. The observations were conducted at the same time each day from 0900 to 1400h and subjects were sampled in a different order each day (using random numbers). Each individual was studied for 20.48 (± 0.29) h and a total of 430 h were spent observing these animals across the two phases. Observations were made outside the paddock from a position that provided a good vantage point but did not disturb the subjects. All behaviours were recorded and categorised as either actions or states (Table 1) according to an ethogram devised from existing work in this area (Whittington & Chamove 1995; Webster & Matthews 2006). One person recorded visitor numbers observing the field of sika deer at one-minute intervals; the visitor density data were subsequently arranged into five classes (Table 2).

Data analysis

The total time each animal was observed performing a behaviour was calculated for each class of visitor density during every 30-min period; the 30-min periods were treated as replicates for analysis as sampling periods were separated by at least 24 h. Friedman's test was performed to examine the effect of the predictor variables, visitor density and weather on behaviour. Pairwise comparisons were examined with *post hoc* Mann-Whitney *U*-tests. Significance was set at $P = 0.05$ and all analyses were performed on SPSS (Version 11.5).

Results

Among classes of visitor density there were significant differences in foraging behaviour ($n = 96$, $df = 4$, $\chi^2 = 6.08$, $P < 0.001$; Figure 1), time spent being watchful ($n = 96$, $df = 4$, $\chi^2 = 3.39$, $P = 0.009$), resting ($n = 96$, $df = 4$, $\chi^2 = 3.59$, $P = 0.007$) and non-visible ($n = 96$, $df = 4$, $\chi^2 = 3.04$, $P = 0.016$). *Post hoc* Mann-Whitney *U*-tests showed that significantly more resting occurred at density class 4 (Figure 1) and significantly less foraging at classes 4 and 5. The pattern for watching is less clear, nevertheless, significantly more time was spent on this activity at density class 5 compared to classes 1 and 4 (Figure 1). Visitor density had no effect on locomotion or the amount of time the sika deer were observed ruminating and self-grooming. Weather had no significant effect on behaviour.

Discussion

It has been argued that the presence of humans may be enriching for zoo animals (reviewed by Hosey 2000), but there is evidence that visitors can also be a cause of stress

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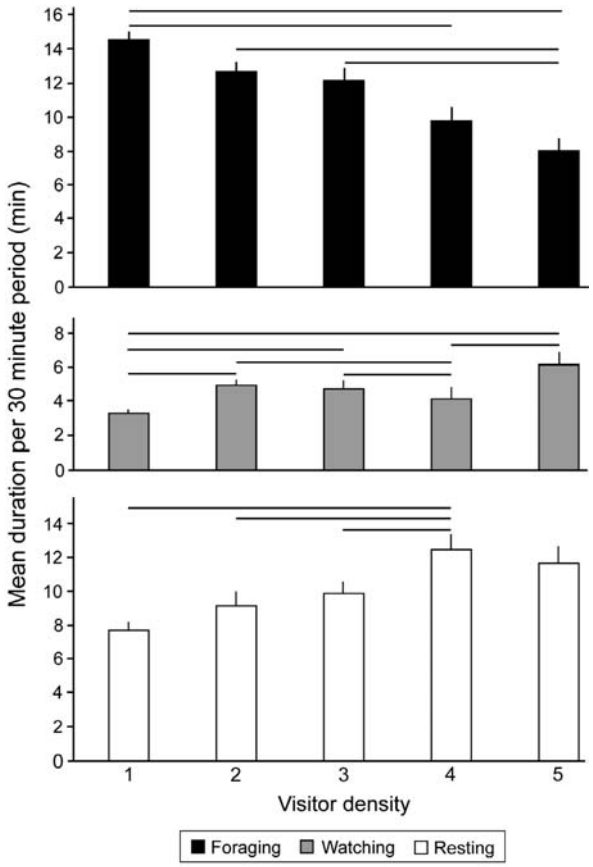
Figure 1

Effects of visitor density class on the mean (± SE) time spent foraging, watching and resting. Horizontal bars indicate significance differences ($P < 0.05$).



(Hosey 2000). The findings of the present study indicate that the behaviour of captive sika deer, like many other captive-housed species of animal, is influenced significantly by the presence of visitors. High visitor density led to deer spending less time foraging and more time being watchful, resting and 'non-visible'. Similar results have been noted in other species subjected to large numbers of visitors (eg Birke 2002; Skyner *et al* 2004; Hosey 2005; Todd *et al* 2007), and increased watching is potentially indicative of stress. Although it can be difficult to demonstrate cause and effect, ie rather than visitors inducing behaviours, visitors may simply be drawn to animals behaving in certain ways (Mitchell *et al* 1992; Birke 2002), activities such as watchfulness and being 'non-visible' are unlikely to attract crowds.

Previous studies that have shown the effects of visitor presence on behaviour include Humphries *et al* (1990), who determined that fallow deer (*Dama dama*) spent approximately one-third of their time responding to, or recovering from, human-induced disturbance. In a study of captive lion-tailed macaques (*Macaca silenus*), higher visitor numbers were found to be related to increased levels of stereotypic behaviour (Mallapur *et al* 2005). Conversely, in captive sambar deer (*Cervus unicolor*), Wang *et al* (2000) established no differences in foraging behaviour under all visitor conditions. Margulis *et al* (2003) also found no visitor presence effect on six felid species. The disparities among these findings may be due to the techniques used to measure visitor density and the methods used to analyse visitor effects. They could also result from the different behaviours exhibited by the species studied, for instance, a primarily solitary animal forced to deal regularly with perceived competitors for food and resources may not react in the same way as a more social species (Sunquist & Sunquist 2002).

Animals that can predict events in their environment can prepare for them by modifying their behaviour (Broom 1985); however, if the stimulus is unpredictable, it can become a welfare issue. It seems that, during the five years of being housed in Zhu-Yu-Wan Park, resident sika deer have not habituated to high visitor density. This may be exacerbated by the fact that large crowds tend to be sporadic, generally occurring at weekends and on public holidays. Most deer do not passively accept situations associated with danger (Humphries *et al* 1990). In the present study, high visitor numbers caused sika deer to group together and face the crowd with ears pricked forward and tails raised. These periods of increased vigilance (watchfulness), plus resting,

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appear to be at the expense of time that would normally be spent foraging, and are thus a cause for concern.

Reducing the effect of visitors, for instance, by allowing the deer to move out of view more easily or by increasing the distance between visitor and exhibit (Hosey 2000), may be important in maintaining the health and general well-being of sika deer. Some form of screening or partition that partially conceals visitors while allowing them to observe the exhibit, may also be beneficial (Birke 2002). Wells (2005) discusses the control of crowd size, and such a management strategy would seem to be appropriate for captive sika deer. For instance, significant differences in behaviour were found only at higher visitor densities, ie class 4 (46 to 60 people) and class 5 (> 61 people); thus, restricting numbers to below 45 people viewing at any given time should limit their impact. Furthermore, large crowds were often noisy, with people shouting, whistling or otherwise trying to disturb the animals. Thus, education via signs or literature on appropriate conduct while near deer exhibits is recommended. Any such measures should be tested for their effectiveness and the present study provides good baseline data for such monitoring.

This study, like many others, shows that visitor numbers and captive animal behaviour are related. If the link is causal, and there is mounting evidence it is, then visitor presence must be taken into account for any zoo-based behavioural study (Mitchell *et al* 1992). The relationship between abnormal behaviours and animal welfare is complex (Mason 1991), but changes in the type and time of activity can provide clues to help understand potential welfare problems (Mench & Mason 2000). Here, it is clear that visitor numbers have a significant effect on sika deer behaviour, but future work is needed to identify what aspect of visitor presence, such as noise levels, produces the greatest stress. With this information, more tailored amelioration strategies can be designed.

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