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The Effect of Visitor Density on the Behaviour of the Captive Fallow Deer (*Dama dama*)

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Abstract: Although several researchers have reported the significant effect of visitors on captive-housed primates, comparatively little research has been done on the behaviorual responses of some wild ungulates animals. To date, the effect of human audience on the welfare of captive fallow deer (*Dama dama*) has been overlooked. This study thus examined the behavior of 7 zoo-housed fallow deer during periods of both high and low visitor density with the aim of exploring whether there was any effect of visitors' density on the animals' well-being. Observational data on various behaviours were obtained through focal animal sampling. These data were analyzed using Paired-samples T-test to estimate the effect of visitor density on fallow deer. The results of analysis indicated that high visitor density encouraged behaviour of relation, with fallow deer spending a significantly more watching and auto-grooming behaviour. By contrast, low visitor density encouraged significantly more foraging and rest. The findings demonstrate that fallow deer, like many other species of captive animals, are disturbed by high number of visitors. In conclusion, visitor density had a significant effect on the behaviour of fallow deer in China park.

Key words: Behaviour, fallow deer, visitor density, captive fallow

INTRODUCTION

The fallow deer, *Dama dama*, the world famous wild ungulates animals, is a primitive ruminant living in Europe. At present they are found only in isolated areas due to habitat degradation and heavy poaching (personal exchange). This species is endangered and threatened with extinction and is now only found in small fragmented populations. It is generally believed that zoos will play a significant role in fallow deer welfare and their conservation in China (Sheng, 1992; Guo and Zheng, 2000). In addition, it is also an urgent to give the species sufficient protection in national parks and wildlife reserves in order to preserve genetic diversity and maintain essential ecological and life support systems.

Fallow deer has imported to China since last century as a pet. They were originally introduced from Europe or Russia (personal exchange) and now they had adapted to the conditions of the zoo. Although a smaller amount stress resulting from the captive environment is inevitable, too much stress is not healthy for the animal (Carlstead and Shepherdson, 1994) and it can even bring about some unusual or stereotypic behaviour. Some authors have reported no effect of the human audience on the animal (Snyder, 1975), while others have revealed just the opposite (Cook and Hosey, 1995; Fa, 1989). To date, more and more scholars suggest that visitors are detrimental to some captive-housed neuropathic animal, resulting in the sense that they bring changes in the animals' behaviour indicative of reduced well-being, e.g. in primates. The visitors affected animals' explorations, increasing intra-group aggression and sterotypies (Birke, 2002; Davis *et al*., 2005; Hosey, 2000, 2005; Skyner *et al*., 2004).

In China, with the development of economic, more and more people take a travel during the National Festival time. It was only about 21.08 million people visit the park or some famous showplace in the 2000 year, but till 2005, the number nearly reached 67.50 million during the period of National Festival (http://www.cnta.gov.cn). Much people abruptly swarm into the park may affect the captive animal well-being in short time, so, it is important and interesting to evaluate whether the people swarm into park disturb the welfare of house-hold animal. A pilot study performed during the spring of 2006 showed that the fallow deer at the Zhu-Yu-Wan Park, Yangzhou, Jiangsu province, China, were reacting to the density of visitors to the exhibit, with a trend to increased amounts of watching and decreased foraging behaviour. This indicated that further study to quantify the effects of

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visitor density on fallow deer behaviour may be necessarily. If visitors do have a significant effect on the behaviour of fallow deer, it may affect the fallow deer's health and welfare in captive environments. We hoped that the determination of the factors which have affected the behaviour and general health of fallow deer would aid in the welfare and health of fallow deer in China parks.

Our general hypothesis was that the amount of watching and foraging behaviour displayed by the fallow deer would increased or decreased as the high and low visitor density in the Zhu-Yu-Wan park during the long holiday of National Festival and usual time.

MATERIALS AND METHODS

Subjects: Seven (3 male, 2 female and 2 young) fallow deer, *Dama dama*, aged between 1 and 5 year old, were employed as subjects marked by ear and collar-tags for easy identification, All of the fallow deer were housed in the paddock at the Zhu-Yu-Wan park in Yangzhou city, Jiangsu province, China. The field consists of an outdoor arena (100 m long ×50 m wide) with grasses, shrubs and trees. Visitors to the park were able to tour the fallow deer between 8 a.m. and 4 p.m. every day through wood-made path with a height of about 1.5 m and width of 2.5 wide at the margin of field.

Procedure: "Visitor density" was defined as a number of visitors to the Zhu-Yu-Wan park. To ensure sufficient data on the effect of visitor density on the fallow deer, this study was conducted as two periodically phases from September 21 to October 10, 2006. A high/low number of visitors admitted to the park, typically reflects a high/low number of visitors to the fallow deer site cause the fallow deer was the most popular animal for the visitors as a foreign animal (Sheng, 1992). The two phases was described as "high density" (the long holiday of National Festival, from Oct. 1-7 (7 days), the mean daily number of visitors to the park was 4572±27 (range =3650-5900) and "low density" (the usual time except the National Festival during the observation periods), the mean daily number of visitors was 85±4 (range=45-120). To control for differing density visitor throughout the day and differing behaviours exhibited by the fallow deer, both before the park opened and after it closed for the afternoon, the exhibit was observed, for total of 200 h. The density of the visitors were recorded at the end of each minute, then confirmed the high/low visitor density conditions.

Each animal was randomly observed using focal-animal sampling to determine length of bout of every behaviour from 7:00 a.m.-17:00 p.m. per day (Altman, 1974) observations were made outside the paddock from a site of path where the fallow deer were not disturbed, behavioural were categorized as either actions or states, each individual was recorded according to an ethogram devised from existing work in this area, using all-occurrence recording method (Altman, 1974; Webster and Matthews, 2006; Whittington and Chamove, 1995) (Table 1). Accurate information on the number of visitors and the degree of noise to the fallow deer exhibit was available; it was recorded at the end of each minute. The animal husbandry and management routines remained constant throughout the study.

Table 1: Ethogram of sika deer behaviours recorded in the study

Behaviour	Description
Foraging	Heading down foraging grass, or standing chewing and swallowing grass
Ruminating	Standing or rest down, regurgitating, chewing and gulping grass
Rest	Dropping down, lying or sleeping
Watching	Heading up seeing or observing novel things
Locomotion	walking, running, trotting or cantering
Auto-grooming	Grooming, licking the body, nibbling or scratching the skin
Others	Drinking, excreting, yawning, tongue flicking

Data analysis: The total times for each animal was recorded performing each behaviour was summed for two condition of visitor density every day (600 min), providing an overall time count per fallow deer per behaviour. Paired-samples T-test was subsequently conducted for each behaviour (e.g., foraging, ruminating, rest, watching, etc.) to determine whether the animals' behaviour was influenced by the two different visitor intensities. Data met the normality and homoscedasticity assumptions of parametric statistical analysis: Test of skewness and homogeneity of variance were insignificant at the $p = 0.05$.

RESULTS AND DISCUSSION

High significant effect of visitor density on 4 of 7 behaviours was recorded (Fig. 1). Animal spent highly significant ($t = 7.715$, d.f.=6, $p<0.01$) more time foraging during periods of low than high visitor density and the same results with behaviour of rest ($t = 2.663$, $p<0.05$). On contrast, high visitor density, encouraged highly significant more watching time ($t = -14.057$, $p<0.01$) and grooming ($t = -3.617$, $p<0.05$). Visitor density has no effect on the amount of time the fallow deer were observed ruminating ($t = -1.057$, ns), locomotion ($t = -0.149$, ns), others ($t = 0.655$, ns).

The findings of this study indicated that captive fallow deer, like many other housed species animal, are significantly influenced by the visitor density. High visitor density encouraged the fallow deer to spend less

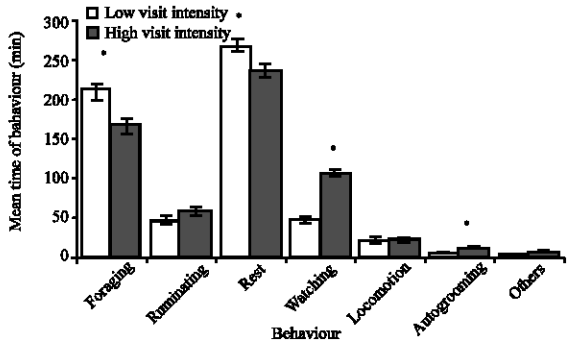

Fig. 1: Total time of 320 h observations (Mean±S.E) that seven fallow deers were recorded, displaying each behaviour during high and low visitor density. (*): Behaviours significantly affected by visitor density

time in foraging and rest behaviour, on contrast, encouraged behaviour more indicative of watching and auto-grooming, we consider watching is a type of behaviour which is less vigilance, it is one kind of indicative of stress, including auto-grooming behaviour, Augmented levels of such behaviours have been noted for other species of primate that have been subjected to the large number of visitors. Humphries *et al.* (1990) indicated the disturbance affect the welfare of fallow deer, which including the group size increased from 105 under low disturbance to 169 under high disturbance, the deers spent about one-third of their time responding to or recovering from disturbance. In this study, the visitor swarmed into the park in a short time may be a type of disturbance to the fallow deer; the responding to the visitor density was some behaviours, such as foraging, watching. Birke (2002) discovered that adult orangutans used paper sacks to cover their heads more during periods of high visitor density. Wells (2005) indicated that gorillas spending significantly greater proportion of time for resting during high visitor density, on contrast, encouraged significantly more intragroup aggression, sterotypies and auto-grooming. Similar results were reported by Mallapur *et al.* (2005) on the behaviour of lion-tailed macaques (*Macaca silenus*). Sellinger and Ha (2005) found that visitor intensity has been shown to have a larger effect on the behaviour of pacing, non-visible on the two captive Jaguars (*Panthera onca*). However, this is on the contrary to the effect found by Wang *et al.* (2000), they studied captive Sambar (*C.unicolor*) in a zoo and found that the budget behaviour of foraging time was not different in all conditions. The differences between these findings may be due to the techniques used to measure density and the methods used to analyze visitor effects. It also might result from the different behaviours exhibited by the species studied. They might not experience the same stress that a primarily solitary animal might show when forced to deal regularly with potential competitors for food and resources (Sunquist and Sunquist, 2002).

It should be noted that this study, was solely concerned with exploring the effect of high versus low visitor density within the park setting on fallow deer behaviour. Exploring the effect of visitors on the behaviour of fallow deer at different times of the day would be valuable. Our findings showed that the visitor presence actually serves as a stressor to captive animal would also be useful (Wells *et al.*, 2006). Research conducted to date, albeit on other species of wild ungulates animals, implicated pen size of red deer (Pollard and Littlejohn, 1996), removed antler (Webster and Matthews, 2006), visual cover of red deer (Whittington and Chamove, 1995) to affect animal health and welfare, but whether this hold true for captive fallow deer further research seems to be necessary.

CONCLUSION

The findings from this study, suggested that fallow deer, like many other captive animals, are affected by high density visitor. Visitors can provide a unique and complex form of stimulation for many species of zoo animals, the reasons for these results from not only by visitor's effect, also from the environments where they live are much different from their natural environments. Further work is necessary to explore the ways of reducing the effect of the human audience, while facilitating zoo-conditions including housing and management.

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