

EFFECT OF WOOD-PILE FEEDERS ON THE BEHAVIOUR OF CAPTIVE BUSH DOGS (*SPEOTHOS VENATICUS*)

R Ings¹, N K Waran¹ and R J Young^{2†}

¹ Institute of Ecology and Resource Management, University of Edinburgh, King's Buildings, West Mains Road, Edinburgh, EH9 3JG, UK

² Animal Department, Edinburgh Zoo, Murrayfield, Edinburgh, EH12 6TS, UK

† Contact for all correspondence and request for reprints

Final acceptance: 6 September 1996

Abstract

Animal Welfare 1997, 6: 145-152

The influence of an environmental enrichment programme on the searching behaviour of separate groups of male and female bush dogs at Edinburgh Zoo was evaluated. The enrichment programme involved hiding food in specially constructed wood-piles and other appropriate places in the bush dogs' enclosures. Behavioural data were recorded morning and afternoon for 20 consecutive experimental days and were compared to pre- and post-enrichment programme data, representing basal conditions. Data were collected over a 10-day period for both pre and post enrichment phases. Activities were recorded under seven behavioural categories. There was no significant difference between sexes in the proportion of time spent performing searching behaviour so data were pooled. The enrichment programme appeared to cause an increase ($P < 0.01$) in searching behaviour from initial basal conditions of 2.7 per cent to 6.1 per cent of total recorded data points. There was a subsequent decrease in searching behaviour ($P < 0.01$) to 2.5 per cent when basal conditions were reinstated. All dogs showed increases in searching behaviour when enrichment and basal data were compared. The effectiveness of the enrichment programme in terms of increasing the proportion of time spent in searching behaviour showed a significant decline ($P < 0.005$) over time, probably relating to the dogs increasing proficiency at finding food. It is suggested that the enhanced levels of searching behaviour represent an improvement in welfare.

Keywords: *animal welfare, bush dog, environmental enrichment, exploration, foraging*

Introduction

The bush dog (*Speothos venaticus*) is a rare, small, South American canid (Druwa 1983). Knowledge of its behavioural ecology is scant and anecdotal (Rao 1994). Habitat destruction and human encroachment constitute the main threat to wild populations. The captive breeding of bush dogs is considered essential to ensure their conservation. However, breeding success has been limited and an overall cub mortality rate of 60 per cent has further reduced captive recruitment (Ginsberg & Macdonald 1990).

Morris (1964) and Fox (1968) suggest that canids, due to their neophilic nature and opportunistic food acquiring behaviour, are likely to find impoverished, barren environments particularly aversive. Few systematic behavioural studies have been conducted on the

psychological well-being of zoo-housed canids. Stereotypic pacing has been observed in wolves (*Canis lupus*), dingos (*Canis familiaris dingo*) and coyotes (*Canis latrans*) (Forthman-Quick 1984; Duncan & Poole 1990). No published material could be found documenting stereotypic behaviour in grouped, housed bush dogs (which may reflect a lack of research in this area) but there have been references to stereotypies where bush dogs have been kept alone (Druwa 1983).

Recent studies have suggested that environmental enrichment can make a positive contribution to successful captive breeding of species (Carlstead & Shepherdson 1994; Kleiman 1994). Hiding food in the enclosure of zoo carnivores has been shown to reduce inactivity, increase exploratory behaviour and stimulate greater utilization of enclosure space (Carlstead & Seidensticker 1991; Shepherdson *et al* 1993). An effective feeding enrichment programme provides not only a cognitive challenge to the animal but also tests manipulative skills (Law *et al* 1990). The existing feeding routine at Edinburgh Zoo involved chunks of meat being thrown into the enclosure twice daily. The aim of this study was to employ a feeding enrichment programme that would increase time spent foraging.

Methods

The subjects

Two separate single-sex groups of bush dogs kept at The Royal Zoological Society of Scotland, Edinburgh (Edinburgh Zoo) were studied. The dogs were originally kept as one group consisting of an adult pair and 10 of their offspring from two litters bred at Edinburgh Zoo. They were divided into an all-male group (5 individuals) and an all-female group (6 individuals), when the breeding female died, to avoid inbreeding. At the end of the pre-enrichment phase of data collection one of the older females was transferred to another zoo, therefore the data pertaining to this dog were eradicated.

Housing and maintenance

Each group had access to outdoor (50m² and 98m² for female and male enclosures, respectively) and indoor enclosures (10m² for both). The perimeter of the outdoor enclosures consisted of stone wall and glass observation windows. Material covering the ground of the enclosure included soil, sand, woodchip and gravel. There were patches of vegetation in the outdoor enclosure such as shrubs, grasses, small bushes and trees, as well as hollow logs, tree-stumps and small rocks. The indoor enclosures were heated in cold weather and, apart from two or three logs, were devoid of any furnishings or materials covering the floor. Each indoor enclosure had a cubbing box, which was large enough to comfortably accommodate all dogs sleeping together.

All enclosures were cleaned daily and the water was also changed daily. Chunks of meat (at least one piece per dog) were thrown into the enclosure twice a day, the first at approximately 0900h and the second at 1500h. The most common food item was raw, skinned and gutted chicken on the bone. Other meals consisted of week-old chicks, unskinned rabbit and horse meat. The dogs had access to the outdoor enclosures at night.

The feeding enrichment programme

The dogs' entire food allowance was chopped into 20-30 small meat chunks. Some of the pieces were hidden around the outdoor enclosures in vegetation, rock crevices and under

logs. Exact locations were varied on a daily basis. The remaining chunks were placed under and within three specially constructed wood-piles in the outdoor enclosure, (see Law *et al* 1990) consisting of sticks and branches of various sizes. Experience showed that making the pile into a 'bonfire' shape rather than laying sticks parallel, provided the greatest challenge to the dogs' manipulative skills. This procedure was carried out in both outdoor enclosures for both feeds of the day throughout the enrichment period. The dogs were ushered into their indoor enclosures and remained there while wood-piles were reconstructed and food hidden. This took between 5 and 10 minutes. The dogs were then released into the outdoor enclosures.

Data collection

The standard protocol used in environmental enrichment studies for collecting data during pre-enrichment (10 days, PRE), enrichment (20 days, EXPT) and post-enrichment (10 days, POST) conditions (see Shepherdson *et al* 1993), which were considered as separate treatments, was followed. Each of the 10 dogs was observed for 30 minutes per day and its behaviour recorded on a check-sheet using instantaneous time sampling with 15-second intervals (Martin & Bateson 1993). The sequence of observing the dogs was balanced to counter time of day effects, ie each dog's behaviour was sampled for an equal number of times at each time of day period. Data recording was divided into three sessions: 0900-1100h, 1200-1300h and 1400-1600h. This gave totals of 50 hours observation for pre- and post-enrichment phases, and 100 hours observation for the enrichment phase. The dogs were observed through the large glass windows at the side of each outdoor enclosure. The different behaviour types were classified into seven broad categories (see Table 1).

Table 1 Ethogram of recorded behaviours.

Behaviour	Description
<i>Social positive</i>	Social play, social object play, positive interaction (eg allo-grooming)
<i>Social negative</i>	Involves actual attacks, aggressive chasing and snarling. Body posture shows flattened ears, erect tail and bared teeth
<i>Searching</i>	Foraging, exploring
<i>Solo play</i>	Playing with an object without the participation of any other dog
<i>Inactive</i>	Laying with group, laying solo
<i>Other behaviours</i>	Digging, sniffing, eating, drinking, comfort, eliminate, scent marking, vocalization, moving, filing (walking in Indian file), static, other
<i>Out of sight</i>	Focal animal not in view. In virtually all cases this meant that the dog had moved into the indoor enclosure

Statistical analysis

Data were tabulated daily for each animal's behavioural activities. Frequency scores were totalled for each behavioural category and then converted to mean proportions of the total

possible data points for each dog within a treatment (PRE, EXPT and POST). A Mann-Whitney *U* test was used to evaluate differences between the two single-sex groups. For those behavioural categories where no significant difference in behaviour between the sexes was found, data for males and females were pooled. Where a difference in behaviour was significant further analysis was conducted separately on both sexes. Variation in behavioural categories due to treatments was assessed using a Kruskal-Wallis one-way non-parametric analysis of variance (ANOVA) test and where this was significant a post-hoc Wilcoxon matched pairs test was used to analyse inter-treatment differences. Temporal trends were analysed using a Pearson's correlation test. Data were previously tested for normality and found to meet the requirement for parametric statistics.

Results

Differences between single-sex groups

During the initial basal conditions, ie without enrichment, there were no significant differences between sexes in any behavioural categories. For the enrichment period the mean proportions (of total possible data points) of negative social interaction were significantly higher ($P < 0.05$) for females than for males (see Table 2). Following a return to basal conditions female positive social interactions were significantly lower ($P < 0.05$) than males (Table 2) and female negative social interactions were significantly higher ($P < 0.05$) than males (Table 2). There were no significant differences between the sexes for other behavioural categories.

Table 2 Mean (\pm SEM) proportions of total number of data points for each behavioural category.

Behavioural category	Pre-enrichment		Enrichment		Post-enrichment	
	Females	Males	Females	Males	Females	Males
<i>Social positive</i>	0.063 ± 0.017	0.058 ± 0.009	0.028 ± 0.001	0.037 ± 0.004	0.026 ± 0.002	0.040 ± 0.003
<i>Social negative</i>	0.011 ± 0.002	0.007 0.002	0.024 ± 0.004	0.002 ± 0.001	0.031 ± 0.004	0.004 ± 0.001
<i>Searching</i>	0.033 ± 0.005	0.021 ± 0.004	0.064 ± 0.006	0.059 ± 0.007	0.027 ± 0.004	0.024 ± 0.004
<i>Solo play</i>	0.014 ± 0.004	0.022 ± 0.005	0.017 ± 0.002	0.029 ± 0.004	0.012 ± 0.004	0.023 ± 0.006
<i>Inactive</i>	0.547 ± 0.042	0.549 ± 0.027	0.516 ± 0.026	0.544 ± 0.030	0.541 ± 0.024	0.528 ± 0.048
<i>Other behaviours</i>	0.288 ± 0.031	0.317 ± 0.029	0.292 ± 0.016	0.287 ± 0.019	0.280 ± 0.018	0.342 ± 0.040
<i>Out of sight</i>	0.045 ± 0.010	0.025 ± 0.008	0.059 ± 0.007	0.040 ± 0.004	0.085 ± 0.019	0.039 ± 0.003

The effect of treatments on behavioural categories

There were no significant differences in male social interactions due to enrichment treatments. However, for females, both positive ($H = 8.62$, $df = 2$, $P < 0.05$) and negative ($H = 8.94$, $df = 2$, $P < 0.05$) social interactions showed significant differences. Post-hoc pairwise analysis of treatments did not establish significant differences, although the combinations of PRE versus EXPT and PRE versus POST treatments for both positive and negative social interactions were approaching significance ($P = 0.059$ in both cases).

The removal of the female bush dog at the end of initial basal conditions coincided with a reduction in positive (Table 2) and a rise in negative social interactions (Table 2). There was no significant effect of treatment on any other behavioural categories, except searching.

The effect of the environmental enrichment programme on searching behaviour

Of the five behavioural categories only searching behaviour showed a significant difference due to treatments ($H = 17.56$, $df = 2$, $P < 0.001$). Post-hoc pairwise analysis of treatments using a Wilcoxon matched pairs test found no significant difference between the two basal treatments PRE and POST. However, a significant difference was found between EXPT and both basal treatments (EXPT versus PRE, $P < 0.01$; EXPT versus POST, $P < 0.01$). This would indicate that changes in the time spent in searching behaviour during the observation period were due to the effect of the enrichment programme and not a result of temporal influences.

Searching behaviour during the EXPT conditions (6.1%) was more than twice the level of searching behaviour found in basal PRE conditions (2.7%) and POST conditions (2.5%). There was slightly less searching behaviour in POST compared to PRE conditions but the difference was not significant.

Variation between individuals

For all dogs, the amount of searching behaviour was highest during EXPT conditions. Variation in individual responses is illustrated in Figure 1. Only for dog 3 did changes due to enrichment appear to be marginal.

Changes in searching behaviour with duration of treatment

For PRE and POST treatments time spent searching did not correlate significantly with time ($r = 0.400$, $n = 10$ and $r = -0.381$, $n = 10$, respectively). For the EXPT treatment a significant negative correlation was established between time spent searching and time ($r = -0.675$, $n = 20$, $P < 0.005$).

A decline in searching behaviour as the treatment progressed, with a possible plateau effect in the last half of the programme is shown in Figure 2. Analysing the first ten days of searching behaviour against time and the second ten days of searching behaviour against time during the EXPT conditions did not reveal significant correlations ($r = -0.575$ and $r = -0.381$ for first and second ten-day periods, respectively; $n = 10$ in both cases). Thus, the suggestion of a plateau effect was not confirmed.

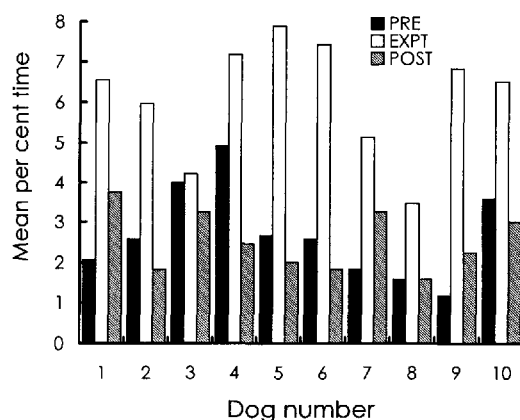


Figure 1 Variation between individuals in proportion of observed time spent performing searching behaviour across the three treatments (PRE = pre-enrichment, EXPT = enrichment, and POST = post-enrichment period).

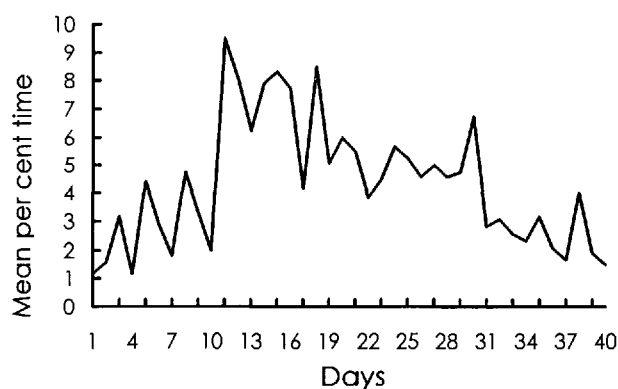


Figure 2 Changes in proportion of observed time spent in searching behaviour for combined data on both sexes (Days 1 to 10 = pre-enrichment, days 11 to 30 = enrichment, and days 31 to 40 = post-enrichment).

Discussion

This study has shown that a relatively simple enrichment programme can be successful in making significant changes to the amount of searching behaviour expressed by captive bush dogs. The techniques used here have been effective in stimulating the foraging and exploratory behaviour of other carnivores (Law *et al* 1990; Carlstead *et al* 1991; Forthman *et al* 1992; Shepherdson *et al* 1993). The magnitude of increase in searching behaviour from

2.7 per cent to 6.1 per cent of observed time is comparable with the results for leopard cats (*Felis bengalis*), which increased their searching behaviour from 5.5 per cent to 14 per cent of time when food was hidden in small brush-piles (Shepherdson *et al* 1993).

The bush dogs were more 'purposefully' active in comparison to baseline conditions and would continue to search for food for some time after most of it had been found, although this tendency showed a decline as the study progressed. The feeding enrichment programme appears to have succeeded in providing more occupational opportunities for the bush dogs and also added an element of structural diversity and novelty by the provision of constructed wood-piles in the enclosure. The action of hiding and concealing food stimulated the search and locate phases of the predatory sequence in bush dogs.

Exploration and manipulation of wood-piles to gain access to food items was initially tentative during the first few days of the enrichment programme. As the enrichment programme continued the dogs became more vigorous in their movement of sticks, reducing the time taken to exhaust the hidden food supply. They also became increasingly proficient at locating food hidden around the enclosures and more systematic in their movements to find food. As the enrichment phase progressed further there was a significant decline in searching behaviour because the dogs had learnt the limited number of places where food could be hidden.

One criterion of a successful enrichment strategy is the degree to which all the individuals within a group benefit from its implementation. Chamove and Anderson (1989) found that a foraging task for macaques reduced abnormal behaviours in low and high ranking members of the group, but increased it in intermediate ranking members. The results for individual dogs in this study show that searching behaviour of every dog increased when data on basal and enrichment conditions were compared. The nature of the feeding enrichment programme precludes monopolization by dominant individuals, which can sometimes occur with localized feeding devices and result in fighting (Markowitz 1982). In the case of dog 3, the effectiveness of the enrichment was marginal, probably because it was frequently attacked by other group members.

The enrichment programme did not make any significant difference to general levels of activity, which remained relatively constant during the study period (ranging from 51.6% to 54.9% of the total amount of active behaviour respectively for sex and treatment combinations). Because little is known about the time budgets of wild conspecifics no meaningful comparison of activity levels between captive and wild bush dogs can be made.

Animal welfare implications

Despite the use of small enclosures and lack of vegetation, the procedure used offers a cheap and effective method of behavioural enrichment. That dogs become adept at finding food could be countered by increasing the complexity and changing the location of wood-piles, or providing some wood-piles with no food. The technique has a potential for use with other canids.

Acknowledgements

We would like to thank John Hanning, Head Carnivore Keeper and Dr Miranda Stevenson, Curator of Edinburgh Zoo, for allowing the use of the bush dogs for the enrichment study.

We are very grateful for the practical help of Raymond, Keith, Lucy, Karen, Claire and Nicky, the carnivore keepers who were always full of good humour and enthusiasm for this study despite the inconvenience it must have caused them. Thanks also to fellow bush dog devotees Shaila Rao for initial discussions and advice, and Samantha McKeown for helping with individual dog identification. This work was conducted while Ray Ings was financially supported by the RSPCA to undertake a MSc in 'Applied Animal Behaviour and Animal Welfare' at the University of Edinburgh. Finally, we thank Beverley Williams for her comments on the manuscript.

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