ENRICHMENT VALUE OF WOODEN BLOCKS FOR FARMED BLUE FOXES (*ALOPEX LAGOPUS*)

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Abstract *Animal Welfare 2000, **9:*** 177-191

*The barren housing conditions of farmed blue foxes (*Alopex lagopus*) provide few stimuli to motivate exploration and interaction with the physical environment. In the present study, wooden blocks (30x7 cm [*lxdia*]) were employed to clarify how such inanimate objects might serve to enrich the barren wire-mesh cages. Two separate experiments were carried out. In experiment 1, behavioural reactions of eight male blue foxes to wooden blocks were videotaped between January and May. In experiment 2, 16 male blue foxes were housed singly in cages with wooden blocks and 16 without between January and June. Pencil, confrontation, feeding and open field tests were carried out. Furthermore, 50 female blue foxes were kept singly in cages with wooden blocks and 49 without from January to July. Both groups were bred and the whelping result was recorded. In-cage behavioural tests were performed three times. Results showed that interactions with the wooden blocks were frequent, averaging 77 interactions fox^{-1} day^{-1}. Interactions with blocks decreased slightly with time. Blocks were mainly used for carrying, chewing, poking and sniffing. In the confrontation test, male foxes housed without blocks were more passive than those with blocks. No differences were found between the groups in the pencil, feeding or open field tests. Whelping success tended to be better for vixens housed with than without blocks. It can be concluded that wooden blocks have enrichment value by providing more choices for foxes in a barren cage and stimulating more variable behaviour.*

Keywords: *animal welfare, behaviour, enrichment, farm fox, inanimate object*

Introduction

A monotonous housing environment can cause frustration, apathy or stereotypic or aggressive behaviour in domestic animals, and may thus adversely affect welfare (Arnone & Dantzer 1980; Gonyou 1986). A logical solution to this problem would be to enrich the animals' environment by providing them with more complex housing facilities, for instance by adding inanimate objects that could be used to promote exploration and play or enhance aggression-reducing behaviour (Lorenz 1963; Alcock 1975; Kilgour & Dalton 1983; Wemelsfelder & Birke 1997). Known examples of such objects employed in animal husbandry are playing and chewing toys, balls, sticks, rubber hoses, ropes, chains and blocks (Jeppesen & Falkenberg 1990; Kaliste-Korhonen *et al* 1994; Newberry 1994; Lidfors 1997).

Such inanimate objects have been found to be beneficial enrichments, for example by decreasing aggressive behaviour (Schaefer *et al* 1990; Apple & Craig 1992) and fear towards humans (Grandin *et al* 1987), and increasing exploration (Pearce *et al* 1989; Pearce & Paterson 1993).

Farmed blue foxes (*Alopex lagopus*) have traditionally been housed in cages with few stimuli to motivate the animals to explore and interact with the physical environment. Recently, the Standing Committee of the European Convention on the Protection of Animals Kept for Farming Purposes has emphasized the importance of enriching the environment of farmed foxes to better meet their species-specific needs (Council of Europe 1991). For example, the Committee recommended that the cage environment should include a secluded area such as a platform or nest box, and objects providing suitable gnawing stimuli. Until now, ethological research on farmed foxes has concentrated on evaluating the enrichment value of nest boxes and resting platforms (Harri *et al* 1991; Bakken *et al* 1994; Korhonen *et al* 1995, 1996; Mononen *et al* 1996b). No studies have been conducted on gnawing objects, although these could be expected to be beneficial to foxes for a number of reasons. Firstly, the blue fox is a dog-like carnivore whose diet in the wild consists mainly of items requiring much mastication (Fay & Stephenson 1989; Prestrud 1992). On farms, however, food is given as porridge, which cannot be chewed. A gnawable object would therefore give foxes the chance to masticate. Secondly, an inanimate object might also work as an enrichment to motivate foxes to play and explore in their otherwise barren cages. Thirdly, foxes might use the chewing object as a channel for redirecting aggression or coping with stress. Food restriction is a common means of avoiding the risk of obesity in farm foxes during autumn and winter. Unfortunately, it is also a stressful situation for the animals. Foxes have, for example, been observed chewing their wooden platforms when their food supply is highly restricted (Korhonen & Niemelä 1993). However, in the absence of a wooden platform or other gnawable object, foxes may also bite their fur or tails.

In the present study, wooden blocks were provided to farmed blue foxes as enrichment. The aims were: i) to determine to what extent and for what purpose the foxes used the blocks in their cages; ii) to test the hypothesis that wooden blocks enhance exploration and confidence; and iii) to evaluate the beneficial effects of wooden blocks on blue foxes' reproductive performance. It was assumed that if environmental enrichment with wooden blocks enhanced the general welfare of the animals, it might also result in increased reproductive success. Explorative and fearless farmed foxes have been found to have better reproductive success than fearful and passive ones (Bakken 1994; Bakken *et al* 1994). Thus, the reproductive success of blue foxes housed in cages with and without wooden blocks was compared in this study.

Materials and methods

General management

The experiments were carried out at the Fur Farming Research Station of Kannus (63.54°N, 23.54°E) in western Finland, between January and July 1997. The experimental animals were farm-bred blue foxes born in May 1996. They were randomly selected from the research farm's breeding stock, comprising 450 males and 550 females. None of the experimental foxes had been previously exposed to toys or other inanimate playing or chewing objects. Before and during the experiments the foxes were housed in a traditional Finnish two-row shed. Each fox was kept individually in a wire-mesh cage measuring 120x105x70 cm (*l*x*w*x*h*). A wire-mesh platform (105x30 cm [*l*x*w*]) was located inside the cage, about 23cm from the ceiling (Figure 1a). The platforms were parallel to the shed aisle. Freshly mixed fox feed manufactured by the local feed kitchen (Kannuksen Minkinrehu Ltd, Kannus, Finland) was provided to the foxes by machine 6 days a week at about 1300h. According to conventional farming practice, feeding was omitted on Sundays. The diet was mainly composed of slaughterhouse offal, fish and cereals, and its composition was based on Scandinavian standards (Berg 1986). The ingredients were mixed as a porridge according to conventional practice. Water was freely available from an automatic dispenser system. The health of the animals was inspected daily. The foxes were weighed on a Lario 30kg balance (Como, Italy) accurate to within ± 20g. The experimental wooden blocks were specially designed for this study (Sorvipojat Ltd, Sievi, Finland). They were made of lathed hardwood (birch) and measured 30x7 cm (*lxdia*; Figure 1b). The dry blocks were weighed before the start of the experiment (January). At the end of the experiment (July), the blocks were collected from the cages, dried at room temperature for 1 week, and re-weighed.

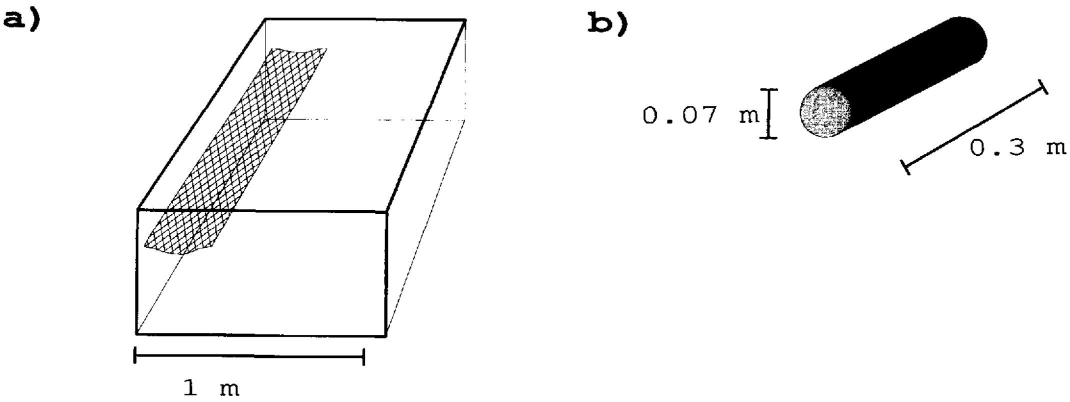


Figure 1 **a) Schematic diagram of experimental cage with platform. b) Drawing of experimental wooden block.**

Experiment 1

The subjects were eight male blue foxes, all from different litters. They were placed in the experimental cages in January. The actual measurements started on 27 January, when the foxes were provided with unused wooden blocks, one cage^{-1}. The behaviour of the foxes was videotaped using a continuous recording method (Fraser & Broom 1997). Non-stop recordings were made for 24h periods using a video system comprising eight black and white video cameras (Computer FC-55; Computar, USA) equipped with wide-angle lenses, two quads (Computer QS-MX; Quadtronic, Germany) enabling transmission of each simultaneous recording from the four cameras into a time-lapse video recorder (Hitachi VT-L2000E; Hitachi Ltd, Japan), and two black and white monitors (Computer CEM-12; Computar, USA). The videograms were recorded at a frequency of 1.25s^{-1}. During darkness, each cage was lit by two dim red lights (Philips E27ES, 60W). During the first 4 study weeks (27 January–21 February), the foxes were videotaped from Monday–Friday each week. After a 2-week break, the foxes were recorded for another 2-week period, likewise lasting from Monday–Friday each week (10–21 March). After a 3-week break, they were again recorded for a 2-week period (14–25 April). This was followed after a 3-week break by the final, 4-day recording period (Monday 19–Friday 23 May).

The videotapes were analysed by three researchers using a continuous analysis method (Martin & Bateson 1986). The analyses were done between February and September by means of video recorders (JVC video cassette recorder HR-D560E; Victor Company, Japan) and TV monitors (Philips, France). Before beginning the tape analyses, the researchers were carefully taught to analyse the tapes in the same way and with equal accuracy. For each day recorded, there were tapes from eight foxes to be analysed. These were randomly divided among the researchers. After an initial examination of the videotapes, the following behaviours were selected for analysis: i) fox poking the block with nose (short-term contact, duration of contact 1s); ii) sniffing block (duration 2s or more); iii) carrying block in mouth; iv) playing with block (using front legs or nose); v) urinating on block; vi) urinating elsewhere; vii) defecating on block; viii) defecating elsewhere; ix) chewing block; x) staying inactive on cage floor; and xi) staying inactive on platform. Inactivity was defined as follows: i) sitting or ii) standing motionless whilst performing no other activity; iii) sleeping; or iv) lying awake. Options x) and xi) enabled the researchers to calculate total active time.

Experiment 2

The experimental groups were set up at the beginning of January. The animals in Group 1 had wooden blocks inside their cages, but Group 2 animals (controls) were housed without blocks. Each group comprised 16 males, and 49 and 50 females in the control and wooden block groups, respectively. The experimental blocks were similar to those in experiment 1.

The test animals were naturally mated within the groups in March. Females were allowed access to breeding nest boxes (70x40x40 cm *lxwxh*) 3–4 weeks before whelping. Litter size was recorded on the first day after parturition and at weaning (6 weeks). Males were housed without nest boxes throughout the study. The animals were weighed in January, February, March and May.

Pencil and confrontation tests were undertaken four times (9 January, 4 March, 22 April, 28 May) and feeding tests three times (13 January, 3 March, 22 April). For the pencil test, the researcher noted the location of the fox in the cage, then approached the cage and inserted a 15cm long pencil halfway through the cage side towards the head of the fox for 10s (Korhonen & Niemelä 1996). The fox's reactions were recorded as either curiosity (approaching and sniffing towards researcher), fear (fleeing or withdrawing from the researcher) or non-reacting, passive state (sleeping or not interpretable in relation to fear or curiosity), according to its body posture, facial expression and ear positions (see Fox [1970]; Pedersen & Jeppesen [1990]). In the confrontation test, the researcher opened the cage door and reached for the fox with his hand (Pedersen 1992). The animal's reactions were recorded as in the pencil test. Before the feeding test, food was withheld from the animals for 48h. The test began with the researcher giving the daily feed portion to the fox, after which he withdrew 50cm from the cage door. It was recorded whether or not the animal started to eat within 30s (curious or fearful; Rekilä *et al* 1997).

Males were exposed to an open field test on 2 June. The open field arena was constructed of wire-mesh forming a runway 4x2x1.5 m *lxwxh*. It had an earth floor and was divided into eight fields of equal size by field marks drawn lightly on the ground. Field eight contained a large red bucket which was unknown to the foxes and served in the test as a novel object. The open field test began when the animal was placed inside a wooden test nest box (70x40x40 cm *lxwxh*). The entrance from the nest box to the open field arena was opened for 1min, providing the test animal free access to the field. Latency to emerge from the nest box into the open field arena was then recorded. If the animal did not emerge within 1min, it was gently pushed out. Each test animal spent 5min in the open field arena. The number of fields crossed was calculated to give a measure of open field activity (Korhonen *et al* 1997). The occurrence of defecation in the arena, and number of contacts and latency to initial physical contact with the novel object were also recorded. The earth floor of the open field was cleaned every time before the entrance of another fox.

Statistical analyses

The SAS Statistical Package (SAS Institute Inc 1990) was used for the analysis of experimental data. After examination of the data using graphs, the following statistical analyses were made: i) the whelping and open field test data were not normally distributed, therefore, differences between these groups were statistically analysed using the Mann-Whitney *U* test; ii) the Friedman two-way ANOVA was used for comparing the initial and final weights of the wooden blocks; iii) the chi-square test was employed for testing differences in frequency of foxes' behavioural response (curious, passive, fearful) in pencil, confrontation and feeding tests. A probability level of $P = 0.05$ was chosen as the limit of statistical significance in all analyses.

Results

Use of wooden blocks

Foxes were found to rest on the platform for 779 ± 40 min day^{-1} (mean of total study period ± SEM) and on the cage floor for 268 ± 36 min day^{-1}. They were active for, on average, 393 ±

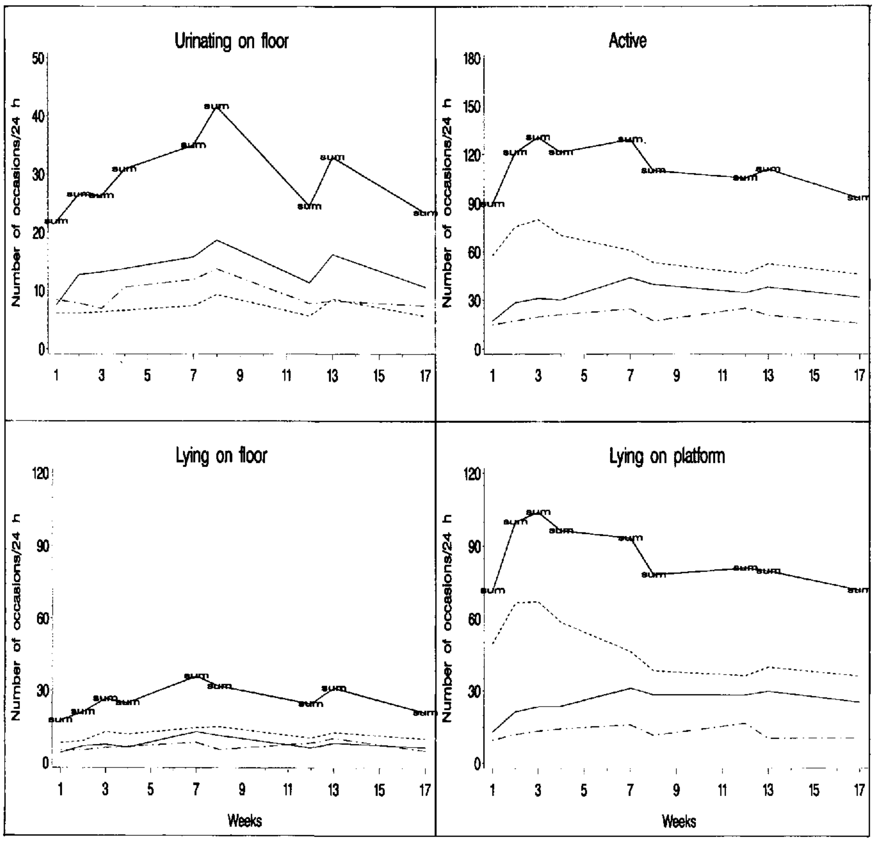


Figure 2 **Activity, rest and urination on floor or platform. Weekly mean of eight male blue foxes. Sum = sum of each 24h. Dark line 0000–0800h; short broken line 0800–1600h; long broken line 1600–0000h.**

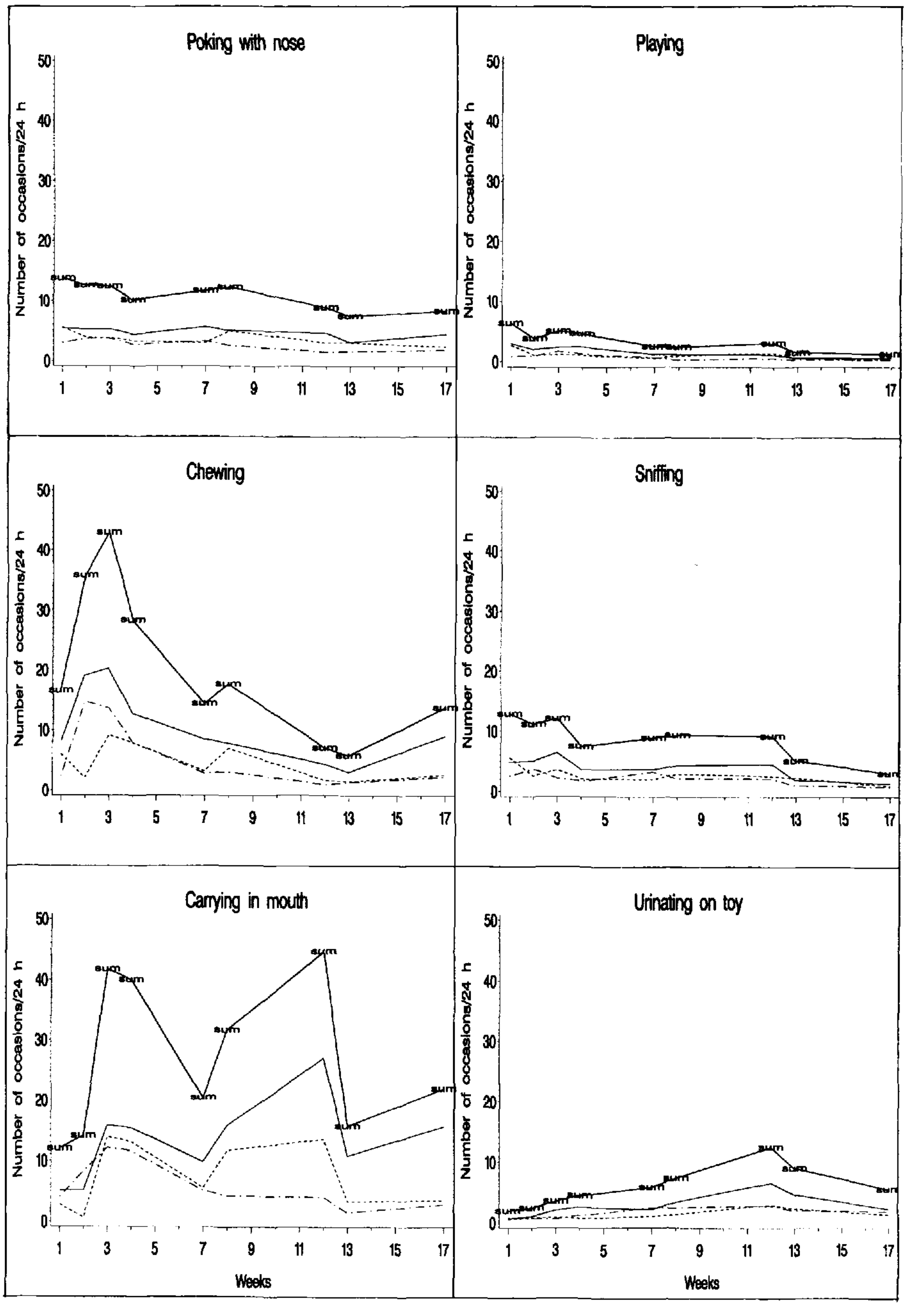


Figure 3 **Number of daily episodes of various behaviours with wooden blocks. Results are the mean of eight male blue foxes for consecutive weeks. Line codes are the same as in Figure 2.**

10 min day^{-1}. Activity was highest between 0800h and 1600h and lowest between 1600h and 0000h (Figure 2). Of the total active time, foxes were observed to interact with wooden blocks for 16.4 ± 2.9 min day^{-1}.

The mean daily number of block interactions fox^{-1} was 77. During the first study week, there was a mean of 63 interactions with blocks day^{-1}. Thereafter, the number of interactions increased, peaking during the third study week at 118 interactions fox^{-1} day^{-1}. During the seventh study week, the number of interactions declined to 64. Another peak was recorded during the 12th week, with 85 interactions fox^{-1} day^{-1}. During the final study week, week 17, the mean number of interactions was 54.

Brief carrying episodes were the predominant behaviour with blocks. Blocks were carried a mean of 27 times day^{-1}. The next most common activities with blocks were chewing (20 times fox^{-1} day^{-1}), poking (11 times fox^{-1} day^{-1}) and sniffing (9 times fox^{-1} day^{-1}).

The numbers of poking, playing and sniffing episodes changed very little throughout the study. Moreover, there were only slight variations in these activities at different times of the day (Figure 3). Carrying the block in the mouth increased after the start of the experiment, peaking during week 12, and occurring most often between 0000h and 0800h. Chewing the block was most pronounced during the first 4 study weeks, most often between 0000h and 0800h. The blocks were most preferred for urination during study weeks 11 and 12. Foxes urinated on the cage floor a mean of 29 times day^{-1}, and on the block 6 times day^{-1}. Defecation on blocks was not observed. Foxes normally defecated on the cage floor once or twice day^{-1}.

Figure 4 summarizes the number of interactions with blocks during each hour. These data are from the total study period. Typically, interactions with blocks were concentrated during the night and morning. Contacts with blocks were most frequent between 0500h and 0700h.

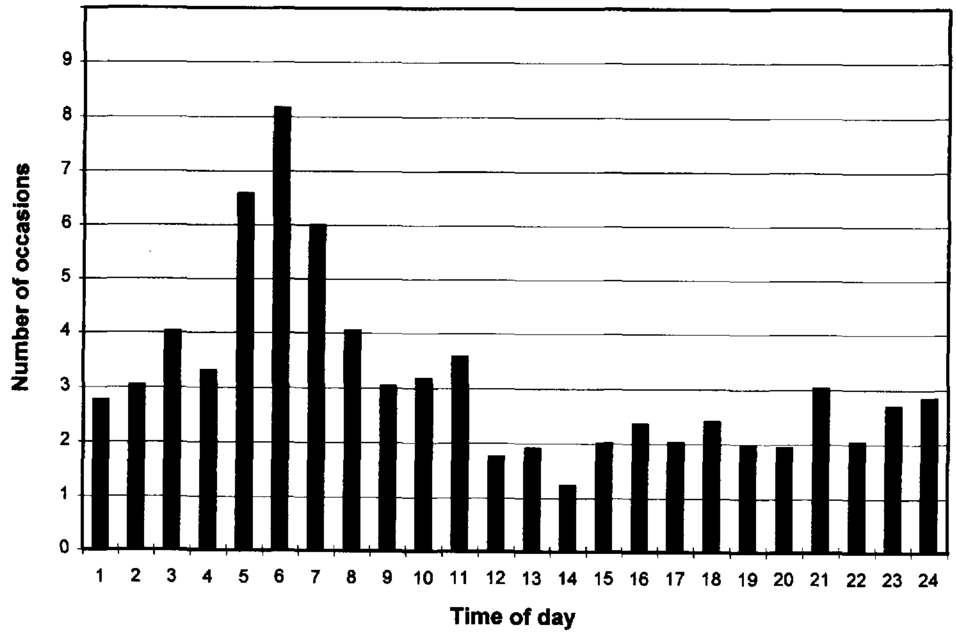


Figure 4 **Number of episodes with wooden blocks during each clock hour. Data are the sum of all study weeks.**

Measurement of block weight

Usage of wooden blocks was also evaluated by measuring the decline in weight during the experiments. In experiment 1, the initial and final weights of the dry wooden blocks (n = 8) were (mean ± SEM) 810 ± 19 g and 742 ± 25 g, respectively. Thus, the mean weight loss was 68g ($F_{1,7}$ = 9.02, $P < 0.01$). At the beginning of experiment 2, the weights of dry wooden blocks from males (n = 16) and females (n = 50) were 786 ± 8 g and 796 ± 6 g, respectively, and at the end of the experiment 698 ± 19 g and 733 ± 14 g, respectively. Thus, the mean weight decline of the wooden blocks from males and females was 88g ($F_{1,31}$ = 1.06, ns) and 63g ($F_{1,98}$ = 3.82, $P < 0.05$), respectively.

In-cage and open field tests

The pencil and feeding tests did not reveal any significant differences in behavioural response of the foxes between the study groups (Table 1). Nor were there any marked differences in the confrontation test between the females. In males, however, the confrontation test results showed significant differences between the groups. Even during the first test episode at the very beginning of the experiment (9 January), there were more passive animals in the group housed without than with wooden blocks. The differences between the groups, however, did not increase during the experimental period.

Table 1 Number of foxes with (BL) and without (NO) wooden blocks being curious, passive or fearful in behavioural in-cage tests.

Test	Date	Curious		Passive		Fearful		*P*
		BL	NO	BL	NO	BL	NO	
Males								
pencil	9 Jan	3	1	12	13	1	2	ns
	4 Mar	3	3	10	9	3	4	ns
	22 Apr	2	0	12	15	2	1	ns
	28 May	5	1	11	15	0	0	ns
confrontation	9 Jan	4	0	6	14	6	2	< 0.05
	4 Mar	4	0	3	9	9	7	< 0.05
	22 Apr	5	1	6	13	5	2	< 0.05
	28 May	5	1	8	14	3	1	< 0.07
feeding	13 Jan	14	13			2	3	ns
	3 Mar	14	10			2	6	ns
	21 Apr	12	11			4	5	ns
Females								
pencil	9 Jan	4	6	43	44	3	0	ns
	4 Mar	6	4	40	39	4	7	ns
	22 Apr	2	2	46	43	2	4	ns
confrontation	9 Jan	8	13	30	32	12	5	ns
	4 Mar	6	7	31	33	13	10	ns
	22 Apr	8	8	39	35	3	6	ns
feeding	13 Jan	36	38			14	12	ns
	3 Mar	31	33			19	17	ns
	21 Apr	25	26			25	23	ns

A summary of the open field test results is given in Table 2. The number of fields crossed in the open field arena was similar in males with and without wooden blocks (z = -0.577, df = 1, ns). Nor were there any observable differences between the groups in the other open field test parameters measured.

Body weights and reproductive success

The body weights of breeding animals in each study group were similar (Figure 5). The whelping result tended to be somewhat better for vixens in the block group than for those

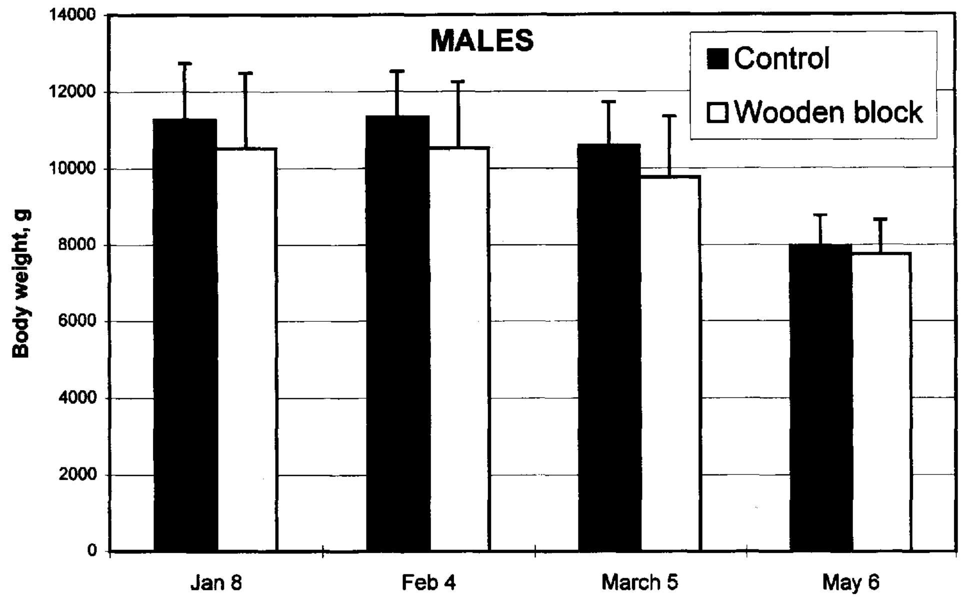
Table 2 **Summary of the open field test results. The results are given as medians (with 1st and 3rd quartile intervals in parentheses). Differences between the groups were not statistically significant.**

Variable	With block	Without block
Number of animals:		
emerging from the start box	4	5
pushed out from the start box	11	11
having one contact with the novel object	9	12
having two contacts with the novel object	8	9
having three contacts with the novel object	6	6
defecating once during the test	1	3
defecating twice during the test	0	1
Latency (s) to:		
emerge from start box	18 (11, 37)	26 (4, 32)
contact 1st time with the novel onject	84 (35, 183)	102 (54, 176)
contact 2nd time with the novel object	112 (84, 183)	163 (150, 270)
contact 3rd time with the novel object	204 (139, 260)	215 (207, 224)
Number of fields crossed	48 (41, 62)	50 (36, 79)

without wooden blocks (Table 3). However, the differences between the groups were not statistically significant. The benefit in terms of the mean number of kits was highest for animals in the block group when calculated per breeding vixen (n = 50) at birth (+ 2.2 kits, z = -1.402, df = 1, ns). The number of pups per mated and whelped vixen at birth was also slightly higher for females in the block group. At weaning (at age 6 weeks), the average whelping result as calculated per breeding and mated vixen tended to be slightly higher for animals in the block group. The whelping result per whelped vixen was, however, very similar in both study groups.

Table 3 **Comparison of whelping results between females housed with and without wooden blocks. Litter sizes are given as medians, with 1st and 3rd quartile intervals in parentheses. Differences between the groups were not statistically significant.**

	With block	Without block
number of breeding females	50	49
number of mated females	48	45
number of whelped females	41	34
mated %	96.0	91.8
whelped %	85.4	75.5
litter size at birth:		
kits per breeding vixen	11 (7, 13)	9 (0, 13)
kits per mated vixen	11 (8, 13)	10 (1, 13)
kits per whelped vixen	12 (10, 13)	11 (8, 14)
litter size at 6 weeks:		
kits per breeding vixen	9 (0, 12)	7 (0, 11)
kits per mated vixen	9 (3, 12)	7 (0, 11)
kits per whelped vixen	10 (7, 12)	9 (6, 12)



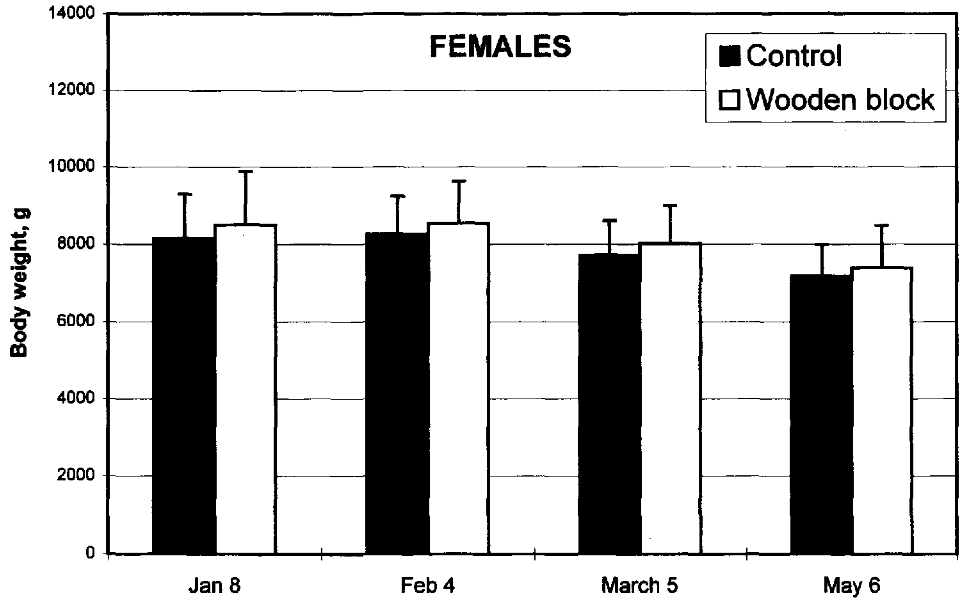


Figure 5 Body weights of males (n = 16 for each group) and breeding females (n = 49 for control and n = 50 for wooden block groups). Data are given as mean ± SEM.

Discussion

Environmental enrichment can be considered as the addition of environmental features that enhance the complexity of the captive animal's environment, resulting in beneficial effects on behaviour and other aspects of biological function (Newberry 1994). Methods of environmental enrichment can range from the addition of a single stimulus into an existing environment to incorporation of a myriad environmental features into a new housing system. In the present study, the enrichment involved the addition of wooden blocks to the barren cages of farmed blue foxes.

Our video recording method enabled the analysis of four different parameters with which to evaluate the use of wooden blocks by blue foxes. These were: i) time spent with blocks; ii) frequency of interactions; iii) hourly distribution of interactions; and iv) weekly variations in use over a long period, ie between January and May. However, the foxes' behaviour with wooden blocks was videotaped only in experiment 1, and therefore we have no accurate data on the use of wooden blocks in experiment 2. We can nevertheless estimate the use of wooden blocks from the decline in weight of the blocks. In experiment 1 (males only) the weight decline was a little less than in experiment 2 (differences not significant). Thus, it appears that the foxes used the wooden blocks in experiment 2 about as much as they did in experiment 1.

Video recording results showed the mean daily time spent by foxes in interactions with wooden blocks to be rather brief, only 16.4min. Contact time with toys for pigs has been found to be several times greater (Apple & Craig 1992). Laboratory rats (*Rattus rattus*) and farmed mink (*Mustela vison*), on the other hand, interacted with toys no more than the foxes in the present study (Jeppesen & Falkenberg 1990; Kaliste-Korhonen *et al* 1994). It is not necessarily the actual length of time spent with toys or blocks that is crucial for animals; as our results show, despite the low total time spent with wooden blocks, the foxes had a high frequency of interactions with them.

A housing environment which is devoid of enrichments may produce poorly motivated, passive animals. Passive behaviour often implies reduced welfare. It can be, for example, a sign of learned helplessness or frustration. As the video results showed, the provision of wooden blocks motivated the foxes to interact with them. Thus, it can be expected that foxes housed with blocks might be less passive in the tests than foxes without blocks. The behavioural in-cage tests used in the present study are assumed to elicit the conflicting motivations of exploration and fear in farmed foxes (Korhonen & Niemelä 1996). These tests should also discriminate between passive and reactive animals. However, the power of each test is different. Confrontation and pencil tests evaluate foxes' reactions to hand and hand-held novelty when it is inserted into the cage. The confrontation test, however, is assumed to be the more powerful of these two tests as the cage door is opened and the animal reached for. Our pencil test results did not reveal any differences between the groups. The confrontation test, on the other hand, showed that males housed without blocks were more passive than males with blocks. The number of both curious and fearful animals tended to be higher in the block group. Thus, animals with blocks were more reactive in the test situation. This result was, unfortunately, not confirmed by the test performed on females. This sex difference is somewhat difficult to explain. One reason might be that the breeding season affected the behaviour and wooden block reactions of females differently to males. On the other hand, the confrontation test with males was the only in-cage behavioural test that showed any differences between the groups. The feeding test, which is considered a valid method of measuring fear and confidence (Rekilä *et al* 1997), did not reveal any differences either. Nor were there any significant differences in open field behaviour between the study groups. While males' behavioural responses in the confrontation test were found to differ even in early January, it is also possible that the response differences observed were not due to the present experimental set-up or blocks. Thus, the present behavioural test results do not provide enough evidence that wooden blocks in the cages of farmed blue foxes increase exploration or decrease fear and passiveness.

Our foxes were most active between 0800h and 1600h, ie during farm working hours. Parallel results have been obtained in previous studies (Mononen *et al* 1996a; Rekilä *et al* 1996; Korhonen & Niemelä 1998). Undoubtedly, general farm work activities keep the animals active and, together with the feeding pattern, serve as the set point for the circadian clock. Our foxes were least active between 1600h and 0000h. Thus, after an active period during working hours, the foxes fell asleep and rested. A second activity peak was observed between 0000h and 0800h. In the wild, foxes are typically nocturnal, as over 50 per cent of their activity appears to occur between 1700h and 0900h (Ables 1969). Our foxes had the greatest number of interactions with wooden blocks between 0000h and 0800h. Obviously the most active time, ie working hours, already provided plenty of stimulus. At night, on the other hand, when there were no personnel or any out-of-cage activities on the farm, the foxes appeared to seek most of their stimulation from the wooden blocks.

The present breeding and whelping results revealed that vixens housed with wooden blocks tended to have better reproductive success than those housed without blocks. The difference between experimental groups was not statistically significant and, therefore, it is difficult to say what the actual reason for the observed tendency was. However, some possible explanations can be given. Firstly, given the high frequency of use, the blocks obviously stimulated the foxes. Animals that are active and in good physical condition are typically considered good breeders. The other possible explanation is that blocks enhanced welfare in other ways and thus had a positive effect on reproduction.

The motivational state underlying the use of the objects can vary depending, for example, on the novelty of the objects or the age of the animals (Newberry 1994). In an experiment by Jeppesen and Falkenberg (1990), two plastic balls were placed in mink cages as motivational objects. During the first study week, the mink spent some time manipulating the balls, but within 1 month this behaviour practically ceased. In the present study, the total time spent interacting with wooden blocks varied between weeks but no dramatic decline in interactions was noted. However, the foxes' interest in the wooden blocks varied over time for different behaviours. This was most pronounced for chewing, which peaked during the third week. It is possible that there was a repressed need to chew which was released during these 3 weeks. However, there are many other possible interpretations of this time course, eg chewing could simply be the response the foxes direct towards a novel object, or it could be what they do to an object until it has become a suitably absorbent item for urinating on, or it could represent a seasonal aspect of behaviour, since all animals were first introduced to the blocks at the same time of year. Urination on the block was most pronounced between weeks 8 and 13. This was clearly due to the breeding season, which occurred at that time. Wooden blocks serve as a good urination object, enabling scents to be spread around (Henry 1977). The breeding season also tended to induce restlessness, which might explain the increase in block carrying activity during that time.

It is known that farmed foxes are most sensitive to certain stress-reducing activities before 9 weeks of age (Belyaev *et al* 1985). This is also the specific time when exploration develops and the foxes learn new skills. The present enrichment experiment started in January, when the animals were 7–8 months old. Thus, they were already mature. The beneficial effects of motivational objects like blocks might be more pronounced at these specific younger ages and the aim of further investigations should be to evaluate the enrichment value of such objects to juvenile animals.

Animal welfare implications

The recent European recommendations (Council of Europe 1991) demand that the housing environment of farmed foxes be enriched with objects that provide suitable stimuli to gnaw and other occupational material. According to the present results, it is obvious that wooden blocks give foxes in a barren cage more choices and stimulate more variable behaviour, like exploration, chewing, etc. The frequent use of blocks showed that foxes were motivated to interact with them.

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