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Differences in the hiding behaviour of new-born red deer and hybrid 1/4 Père David's × 3/4 red deer calves

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Abstract

The behaviour of six pure red deer and six hybrid 3/4 red deer × 1/4 Père David's deer calves born to pure red deer hinds, was observed from 1 to 24 days of age. Young calves (1 to 8 days of age) spent most time hiding, with neither genotype regularly observed in open view (red deer 11 (s.e. 2·0) % and hybrids 14 (s.e. 2·0) %). However, between 9 and 16 days the hybrid calves were in open view more than twice as often as the red deer calves (38 (s.e. 3·2) % v. 18 (s.e. 2·6) %, respectively; P < 0·01). Both genotypes spent over half (both 54 (s.e. 3·5) %) of their time in open view from 17 to 24 days of age. As they grew older, the hybrid calves also spent significantly less time prone and more time standing, compared with the red deer calves.

These results indicate that the behaviour of the hybrids, is somewhat precocious compared with pure red deer calves, and furthermore provide evidence that a component of neonatal behaviour in deer may be inherited.

Keywords: *behaviour, neonates, Père David's deer, red deer.*

Introduction

Newborn ungulates may employ two different behavioural strategies, hiding or following, presumably in response to the selection pressures of predation (Lent, 1974; Carl and Robbins, 1988). Neonates of the follower species accompany their mothers from soon after birth, whereas neonates of hider species separate intermittently and attempt to remain inconspicuous in seclusion. Red deer (*Cervus elaphus*) usually exhibit hiding behaviour for up to a week after birth. Thereafter they will quickly flee when approached by people or predators (Clutton-Brock, Guinness and Albon, 1982). In contrast, although little is known about the rare Père David's deer (*Elaphurus davidianus*), calves may possibly hide less than red calves and more quickly develop social bonds with other members of the herd, often in a creche-like system where four to five hinds mind approximately 60 calves (C. Thomson, personal communication). This more rapid development of the neonate perhaps reflecting the supposedly migratory nature of Père David's deer (Altmann and Scheel, 1980).

Although separate genera, red deer and Père David's can successfully interbreed, and natural hybridization of captive animals has been recorded (Gray, 1972; Jones and Manton, 1983). However most recent successful hybridizations have been produced through artificial insemination (Asher, Adam, Otway, Bowmar, van Reenan, Mackintosh and Dratch, 1988). There is considerable interest in Père David's deer × red deer hybrids for their potential of increased growth rate, hybrid vigour, earlier seasonal mating patterns (Fennessy and Mackintosh, 1992) and opportunity to use a unique model for mapping the cervine genome (Tate, Mathias, Fennessy, Dodds, Penty and Hill, 1995; Tate, Mathias, Hill and Fennessy, 1996).

When different species interbreed, particularly those with markedly different phenotypic characteristics, the resultant hybrids may display traits resembling either of the parents or they may be intermediate. For example, the hybrids of some parrots with species-specific nesting behaviour, have difficulty nest-building since they attempt to perform a compromised behaviour (Dilger, 1962; Buckley, 1969).

The objective of the present study was to describe and quantify differences in the hiding behaviour of neonatal pure bred red deer and 1/4 Père David's × 3/4 red deer hybrids ((PD × R) × R). This was

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prompted by anecodotal observations of hybrid calves appearing to spend less time hiding, and vocalizing and struggling more when ear-tagged compared with red deer calves (A. J. Whaanga, personal communication).

Material and methods

Animals and management

The study used progeny from 16, 3-year old farmed red deer hinds (mean weight at mating 99 (s.e. 1·9) kg at Invermay Agricultural Centre, New Zealand (45°53'S, 170°21'E), in their second calving (all had conceived to a red stag in their first mating season but four failed to raise calves as first calvers due to abortions or stillbirths). All had been artificially inseminated, as part of a larger programme, with semen from F1 1/2 Père David's deer × 1/2 red deer males on 18 March 1994 (for details see Fennessy and Mackintosh, 1992), and either conceived to that insemination or to the subsequent natural mating to a pure red deer stag approximately 18 days later. Calf genotype was determined by rectal ultrasonic pregnancy scanning 32 and 45 days after artificial insemination, and subsequently confirmed by biochemical means (Tate, Buchanan and Crawford, 1990; Tate, Dodds, Thomas and McEwan, 1991) from blood samples (10 ml, heparinized whole blood) collected at the end of the study (January 1995). In each of the calf genotypes, lineage's from three sire stags were represented.

Observations

The hinds were fitted with identification neck collars (Cross Range Animal Identification Collars, Te Pari Products Ltd, Palmerston North, New Zealand), and on 11 November 1994, prior to calving, were moved into a 1·7-ha quadrangular grass paddock (165 m × 126 m × 138 m × 104 m), with a central observation tower (5·7 m high). Artificial cover for the calves was provided by introducing cut pine branches, placed regularly around the paddock. In addition the paddock corners (comprising approx. 0·2 ha) were left unmown allowing grass to grow rank with full seed head. In order fully to habituate the hinds to human presence for observations, small amounts of concentrates were offered beginning 25 days prior to the first birth, during which 5 days of sham observations were undertaken. Observers' entry and exit from the paddock were always undertaken by farm motorbike, with which the hinds were familiar. Additionally, the observers always wore the same outer clothing, and followed a quiet and unhurried routine. Routine daily monitoring was undertaken during the calving period, during which coloured identification collars were attached to new-born calves.

Observations, aided by binoculars (12 × 50) and a spotting scope (20 × 50), were made 5 days a week for 5 weeks beginning on the 21 November 1994. Three main calf behavioural categories were recorded: (1) hiding (either hiding in grass or pine branches or in open view); (2) activity (either prone which included prone with ears up, or sitting, standing, walking, running, sucking, or being groomed); and (3) spatial separation (either alone, or within 10 m of other calves and/or hinds). These observations were made using instantaneous scan sampling at 5-min intervals for 2 h twice per day, morning and afternoon. All observations commenced after a settling down period of at least 30 min after the observers had entered the tower or any other person had left the paddock.

Statistical analysis

The date of parturition was defined as the day the calf was first seen and the hind was visually assessed as having calved. Sometimes, calves were not visible (4·1% of total observations), usually when hiding but occasionally when obscured by hinds. Thus the data on hiding are expressed in terms of open view, making the assumption that it was the converse of hiding, since most of the non-visible calves could be defined as hiding. The proportion of time an individual calf displayed a specific behaviour was calculated for each 2-h observation period, and this mean value was used in the analyses. A preliminary analysis of hiding behaviour, looking at proportion of deer hiding with age, showed three distinct periods (days 1 to 8, 9 to 16 and 17 to 24), and thus all data were analysed from this model. The results are expressed as percentage means with standard errors. Comparison between genotypes (red deer and Père David's deer × red deer hybrids) and between morning and afternoon observations were undertaken by analysis of variance and Student's *t* test after the data had been divided into the three periods each of 8 days.

Results

Data are presented for 12 hind-calf pairs, six of each genotype. Although 14 of the 16 hinds calved, one hybrid calf was stillborn and the hind removed from the paddock, and a red deer calf was born too late to contribute to the observations. The mean date of birth was similar for each genotype (27 November for red deer calves, range 21 November to 7 December, and 26 November for hybrid calves, range 21 November to 10 December). Approximately 120 h of observations, including over 70 h scan sampling of calf activity, were completed on 18 days.

On the day of, or after birth, the calves spent most of their time with their mothers, either sucking or being

groomed, or were hiding alone. In the first 8 days of life, most hiding occurred in long grass (68 (s.e. 3·3) %) although a percentage (21 (s.e. 2·4) %) was spent in the pine branches. When the calves were older (9 to 24 days of age) and the grass had grown higher, nearly all hiding (77 (s.e. 2·9) %) was in the long grass with little (5 (s.e. 1·5) %) in the pine branches. (Hiding also occurred beside a trigonometric station, at the perimeter of the paddock, but this accounted for only 2 (s.e. 0·7) % of all observations.) As they grew older, calves of both genotypes spent more time in open view (that is they hid less), mainly sitting and standing (Table 1 and Figure 1), usually in the company of other calves and often playing together. However, this pattern differed significantly between the genotypes (Figure 1). Whilst from 1 to 8 days of age, neither genotype spent much time in open view (red deer 11 (s.e. 2·0) % and hybrids 14 (s.e. 2·0) %), between 9 and 16 days of age, the hybrids were in open view more than twice as often as the red deer calves (38 (s.e. 3·2) % *v.* 18 (s.e. 2·6) %, respectively; $P < 0·01$). Older animals of both genotypes spent an identical percentage of their time, over half, in open view (54 (s.e. 3·5) % for each genotype). As they grew older, the hybrid calves also spent significantly less time prone and more time standing, compared with the red deer calves (Table 2).

Table 1 *The percentage (mean ±s.e.) of time all calves spent in open view, and the main activities (either prone, sitting or standing) of all calves during periods 1 (days 1 to 8), 2 (days 9 to 16), and 3 (days 17 to 24)*

	Time (%) spent in each period					
	1		2		3	
	Mean	s.e.	Mean	s.e.	Mean	s.e.
Behaviour						
Open view	12	2·0	32	3·1	54	3·5
Activity						
prone	60	2·5	44	2·2	25	1·4
sitting	15	1·2	22	1·3	41	1·2
standing	6	0·8	14	1·1	19	0·9

Other behaviours (walking, running, sucking, and being groomed) accounted for only 8% of all observations with no significant effects of genotype. On a few occasions, differences were found between the morning and afternoon sampling sessions for walking, as was the interaction of genotype and time of day for running on one occasion, but no significant patterns were evident. When young (period 1), calves spent most of their time alone (63 (s.e. 3·0) %), but as they grew older, spent more time with other calves and hinds (35 (s.e. 2·4) % and 71 (s.e. 1·7) % during periods 2 and 3, respectively) a pattern which did not differ with genotype. Interestingly, calves spent significantly more time in the company of other calves and/or hinds in the afternoon (78 (s.e. 2·0) %) than the morning (63 (s.e. 2·6) %) during period 3 ($P < 0·01$).

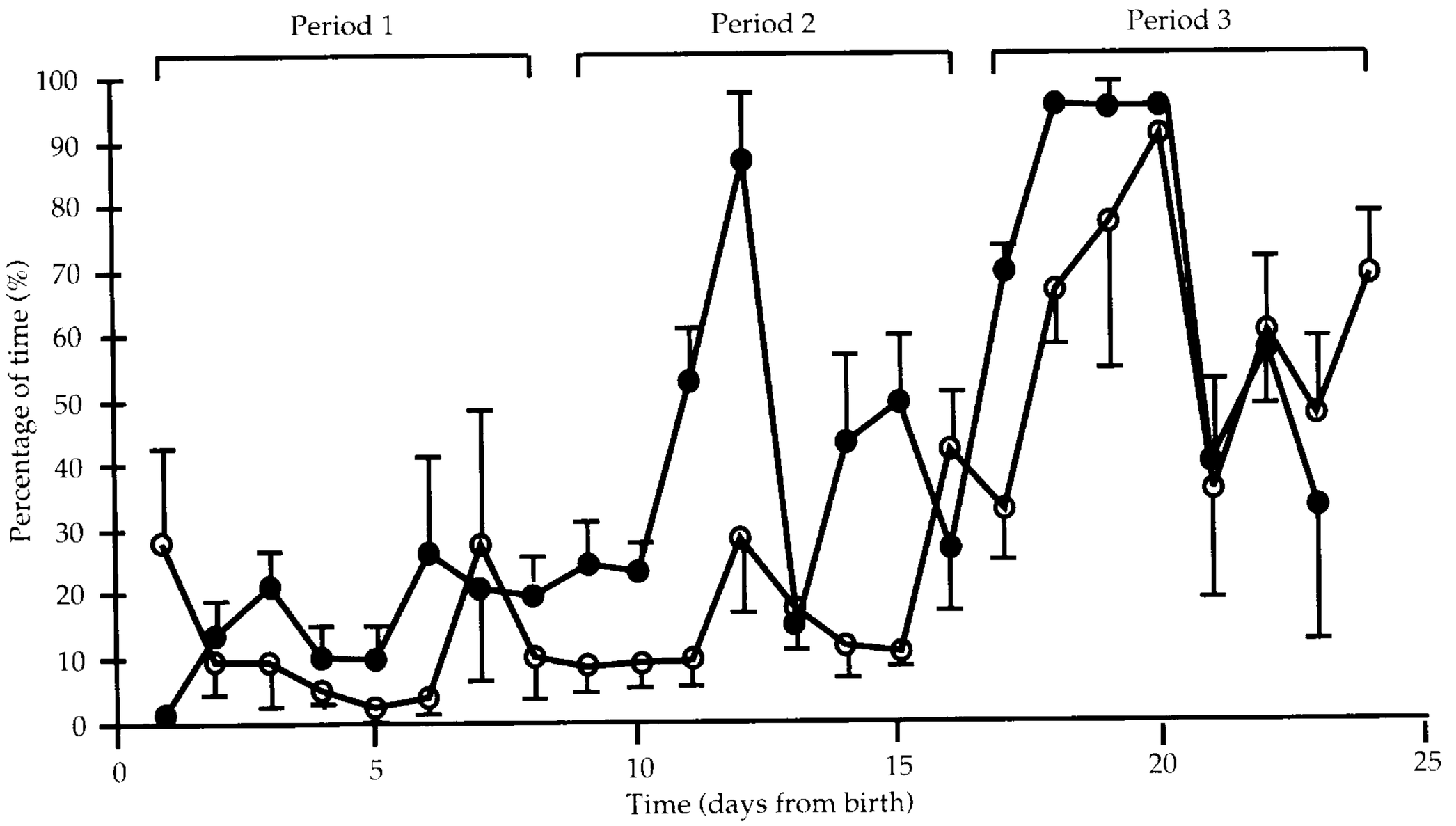

Figure 1 The percentage of time (mean ± s.e.) red deer (○) Père David's deer hybrid (●) calves spent in open view from 1 to 24 days of age (periods 1 to 3).

Table 2 *The activity and spatial separation of red deer and Père David's deer hybrid calves, expressed as a percentage of the time observed, during periods 1 (days 1 to 8), 2 (days 9 to 16) and 3 (days 17 to 24)*

Category	Behaviour	Period	Time (%) performing behaviour: Red calves	Hybrid calves	Genotype s.e.d.	Genotype effect
Calf activity	Prone	1	54	70	7·8	
		2	52	33	7·3	**
		3	30	20	4·0	**
	Sitting	1	14	13	4·2	
		2	25	18	3·5	
		3	42	36	3·6	
	Standing	1	8	4	2·1	
		2	10	21	4·6	**
		3	17	21	1·8	*
Spatial	Alone	1	59	66	10·3	
		2	20	28	7·6	
		3	11	5	5·2	
	With calves	1	5	5	3·6	
		2	11	21	4·9	
		3	3	5	1·7	
	With hinds	1	13	16	4·4	
		2	19	10	5·6	
		3	8	9	2·3	
	With calves and hinds	1	4	3	2·2	
		2	35	25	6·8	
		3	73	63	5·8	

Discussion

This study demonstrates that the hiding behaviour of hybrid neonatal 1/4 Père David's × 3/4 red deer calves differs significantly from purebred red deer calves when both were born and raised by pure red deer dams. The hybrid animals appeared more precocious, hid less, spent more time in open view, and stood for a greater proportion of time. Generally, both genotypes displayed the same range of behaviour, but the progression from hiding in relative isolation to being a herd mate of a social species occurred at an earlier age in the hybrid animals. Although data on purebred Père David's deer are relatively scarce, this somewhat 'intermediate' behaviour is not surprising given the behaviour recorded for the two parental species. Furthermore, it indicates that a component of neonatal behaviour in deer is inherited rather than learned. Although there is evidence for the inheritance of behavioural traits in animals (for example see Hohenboken, 1986), it is often difficult to distinguish innate from acquired behaviour, since genotype may be confounded by the environment, including maternal affects. Since, in the present study both genotypes experienced identical environmental conditions, the differences in behaviour must be largely inherited.

However, some of the differences may have been indirectly inherited by virtue of the larger body size of the hybrid deer. Although birth weights were not recorded in the present study, 1/4 Père David's × 3/4 red deer hybrid animals on our farm are about 12%, or approximately 1 kg, heavier than red calves (Fennessy and Mackintosh, 1992). In red deer, larger calves flee from humans earlier than lighter calves (Kelly and Whateley, 1975), and therefore birth weight might be expected to influence the pattern of hiding behaviour. However, based on Kelly and Whateley's (1975) observations, such differences in birth weight could account for some, but not all the differences in hiding behaviour noted between the genotypes.

There are few studies which have investigated the behaviour of hybrid deer. Pollard, Littlejohn and Webster (1994), working with animals similar to those in the present study, found that although Père David's hybrid calves tended to be less active in human presence, and avoid humans more, than did red deer calves during housing associated with weaning, there was no obvious influence of genotype. Lingle (1992) investigated the locomotory traits of white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), and their hybrids. Whilst mule deer stott (a gait in which all four limbs land nearly simultaneously) or gallop and white-tailed deer gallop when alarmed, the F1 hybrids displayed novel gaits, such as bounding, quantitatively intermediate between the gallop (white-tailed behaviour) and the stott (mule deer behaviour). Backcross animals had more varied gaits, tending towards gaits of either parental species, or were intermediate.

The presence of herdmates during the first few weeks of life is, at least in red deer, a consequence of modern farming practices. In natural or wild populations, parturition occurs in comparative isolation, the hind and calf returning to the herd after a period of 1 to 2 weeks (Clutton-Brock *et al.*, 1982). On some farms, small paddock size, fence containment and stock densities may prevent this behaviour. It is worth speculating on the effect that inclusion of calves with Père David's deer genotypes might have on these behavioural patterns. For example, a more precocious calf could disrupt hind-calf bonding, and increase hind vigilance, but may require less cover for hiding. Sufficient natural or artificial cover for hiding may aid in preventing calf losses through misadventure or mismothering (Cowie, Moore, Fisher and Taylor, 1985). Insufficient cover may also affect the energy intake and therefore

productivity of the mother since the frequency of alerting response increases if the calf is conspicuous (Clutton-Brock and Guinness, 1975). It should be noted, however, that cover was provided for all calves in the present study and that the results might have been different if cover had been inadequate, as is the case in some commercial operations.

The evidence for a genetic difference in hiding behaviour demonstrated in this study, raises the possibility that other behavioural differences may exist, some of which may require modifications to existing farm management to suit the biology of these animals.

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