Temperament assessment in red deer

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Abstract

To determine whether red deer showed consistent patterns of avoidance of humans, four groups containing 9 deer (June groups, n=2) or 8 deer (July groups, n=2) housed indoors were given three different tests in their home pen each day for six days. All tests began with a human standing at the front wall of the pen for 1 minute, then the human either remained stationary for a further minute (S tests), walked to the centre of the pen and stood for 1 minute (H tests), or walked to the centre of the pen, stood for 30s, then walked to the back of the pen (F tests). Position relative to the back of the pen was scored for each individual, at 0, 30 and 60s prior to testing, and at 0, 30, 60, 90 and 120s after the human stood at the front.

Position scores were highest prior to entry of the human then dropped sharply at the start of the tests. At 90s position scores for H and F were significantly lower than scores for S ($P<0.001$) and at 120s scores were highest for S, followed by H and then F ($P<0.001$). Over the six days, there was an increase in position scores which was greatest for S, followed by H and then F ($P<0.001$), and greater for July groups than for June groups ($P<0.01$). Principal components analysis of mean position scores for a) each day averaged over test types, and b) each test type averaged over days, revealed that positional patterns were consistent over days and test types, and in all cases the first principal component explained a large percentage (66-95%) of the total variation. The study provided evidence for individual variation in avoidance of a human by red deer, relative to the group as a whole. On-going studies include further measurements of human avoidance, responses to drafting and weighing, and adrenal responses to ACTH.

Introduction

Difficulties with handling red deer have led farmers (Beatson, 1986; Yerex, 1982) and others within the New Zealand deer industry (Pearse, 1988) to suggest that tractable animals should be genetically selected. To be successfully selected for, a characteristic must be clearly defined, variable in the population subject to selection, and heritable (Fennessy, 1987). Therefore as a first step, a study was carried out on deer in a range of handling situations to identify responses which could be quantified readily and which showed variability between individuals (Pollard *et al.*, in press).

The above study indicated that there may be variation in the extent to which individual deer avoid humans (Pollard *et al.*, in press). This trait has been equated to tameness (Price, 1984), is highly relevant to the farming situation, and has shown consistent variability between individuals in both goats (Lyons *et al.*, 1988) and cattle (Kerr and Wood-Gush, 1987). The following experiment was carried out to determine whether individual red deer were indeed consistent in avoidance behaviour when they were confronted by a human in a variety of testing situations over several days. Discussion of results is followed by a description of on-going research.

Methods

Animals and Housing

Four groups of red deer aged 7-8 months, wearing plastic collars for individual identification, were studied in their home pens within an indoor deer wintering facility. Two pens (1 and 2) were used, with June groups (n=9 deer in each group) being studied in mid-June and July groups (n=8 deer in each group) studied in late June-early July. Each group was studied for six days (Wednesday-Friday in two successive weeks).

The pens measured 4 x 6m with 2m plywood walls and a sawdust-covered concrete floor. Feed troughs (0.3 x 2m) containing commercial deer nuts were positioned 90cm above the floor of the pens on left and right-hand walls, and a water trough was built into one corner of each pen.

Procedure

The deer were tested three times each day, starting at 1000hr, 1300hr and 1500hr. For each test, a person entered the indoor facility, turned on video cameras placed above Pens 1 and 2, then left the facility for 5 minutes The person then returned and entered each pen in turn (always Pen 1 followed by Pen 2) through a 90cm door in one corner of the front wall. Three different types of test were used each day, with the type of test allocated randomly to the testing times. All tests began with the person standing midway along the front wall of the pen for one minute, then differed as follows.

S: Person remained standing at the front wall of the pen for 1 minute
H: Person moved to the centre of the pen and remained standing in the centre for 1 minute
F: Person moved to the centre of the pen and remained standing in the centre for 30s, then continued to move across the remainder of the pen to the back wall, walking slowly over a 30s period.

Measurements

Videotapes were used to provide, for each individual, positional scores of 1, 2 or 3 (<1,1-2 or >2 bodylengths from the back wall), at 0, 30 and 60s starting 4 minutes after the cameras were turned on ("pre-test" scores), and at 0, 30, 60, 90, and 120s from the start of the test (when the human stood at the front of the pen).

Statistical analysis

Analysis was carried out on the mean position of each group during the four time phases given by a) pre-test, b) 0, 30 and 60s, c) 90s and d) 120s after the human entered the pen The rationale for these divisions was that experimental conditions differed between H and F compared with S at 90s, and between all three test types at 120s. Each of the time phases was analysed by analysis of variance, with the blocking structure defined by test within day within group, fitting treatment terms for month, test type, a linear contrast over days, and the interactions among these

The mean position score over 0-120s after the human entered the pen was calculated for each individual, a) for each day averaged over test types and b) for each test type averaged over days, and a principal component analysis was carried out for mean position score data for each group. Only the first principal component and its scores are presented

Results

Position scores were highest during the pre-test period, then dropped sharply when the human entered the pen. Thereafter scores continued to decline over the next two minutes, with the pattern of decline varying between test types (Figure 1) and reflecting the movement of the human as follows: positions at 60, 90 and 120s were relatively stable for S, while declines from 60 to 90s occurred for both H and F, and a further decline was seen in F from 90 to 120s At 90s, position scores for H and F were significantly lower than scores for S ($P<0.001$), and at 120s, position scores differed significantly between all three test types ($P<0\ 001$)

The linear contrasts over the six days of testing showed an increase ($P<0.001$) in position scores at all time phases (Table 1 (i)). The slope of this increase differed between test types ($P<0.001$; Table 1 (ii)), being greatest for S (at 90 and 120s) and being greater for H than F (at 120s) The increase in position scores also varied between groups, with the increase being greater for the groups tested in July compared with June ($P<0.01$; Table 1 (iii)).

The principal component analysis of position scores, for each day averaged over test types, expressed differences between June and July groups in the pattern of change in position over days (Table 2a). Position scores for the June groups tended to be close to 1 for the first three days of testing, then higher and more variable over the last three days for all animals, leading to small negative coefficients contrasted with larger positive coefficients for these respective periods. The variability in the July groups was evident from the first day of testing, and consistent over days, which is shown by the consistency of the coefficients for these groups. The principal component analysis, for each test type averaged over days, gave similar positive coefficients for all test types in each group, showing that positional patterns were consistent over test types (Table 3a). In all cases (analysis of days averaged over test types and vice versa) the first principal component explained a large percentage of the total variation (Tables 2b and 3b). A ranking was obtained from "tameness" to "shyness" which was consistent over days and over test types, for individuals within all groups (Tables 2c and 3c).

Discussion

Consistent differences in avoidance behaviour of individuals, between days and over test types, were observed, with the deer falling into "shy" or "tame" categories. Therefore this characteristic deserves further scrutiny as an aspect of temperament which might be selected for in red deer. The testing method could be improved by more closely defining the positions of the deer in the pen. It might also be productive to measure other types of behaviour during the test, such as orientation of the head and body, and activities of the deer. Considering the distinctive nature of the dynamics of the different groups, a further improvement would be to incorporate tests on deer isolated from their social group. It would also be necessary to determine whether avoidance responses were consistent across different humans, and whether low avoidance was related to desirable responses in normal handling situations.

Table 1: Slope estimates (+SE) for linear changes in position scores over days, at each time phase for (i) overall scores, (ii) scores for each test, and (iii) scores for each month, and SEDs (in brackets) between different tests and months. Significance of differences between different tests and months at each time phase is indicated (n s. not significant; **P<0.01, ***P<0.001)

	(i) Overall	**(ii) Test**			**(iii) Month**	
		S	**H**	**F**	**June**	**July**
Pre-test	0.15	0.17	0.14	0.12	0.11	0.19
	(0.031)		(0.045)	ns	(0.044)	ns
0.60s	0.19	0.20	0.17	0.20	0.10	0.28
	(0.025)		(0.022)	ns	(0.035)	**
90s	0.12	0.20	0.07	0.09	0.06	0.19
	(0.015)		(0.027)	***	(0.021)	***
120s	0.10	0.17	0.09	0.03	0.04	0.15
	(0.014)		(0.022)	***	(0.019)	**

Figure 1. Mean position scores for deer in S, H and F tests, at 0, 60, 90 and 120s. Vertical bars indicate SEDs between tests.

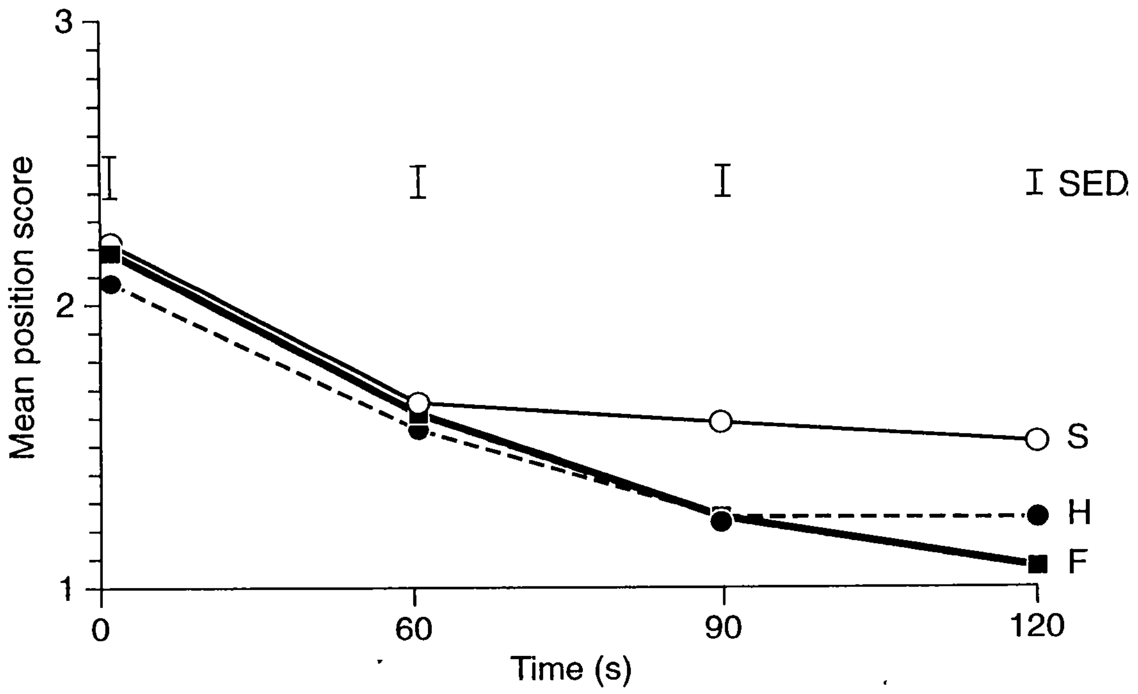

Table 2. Results of the principal component analysis for position scores for each group averaged over tests for each day
(a) loadings for each day; (b) percentage variation accounted for by the first principal component; (c) principal component scores for each animal

Group	June 1		June 2		July 1		July 2	
(a) Day								
1	0.01		-0.08		0.26		0.25	
2	-0.06		-0.01		0.48		0.48	
3	-0.09		-0.26		0.45		0.61	
4	0.34		0.46		0.35		0.48	
5	0.62		0.47		0.42		0.26	
6	0.69		0.70		0.45		0.19	
(b) Percentage variation	80.3		66.1		83.5		76.7	
(c) Collar	Score	Rank	Score	Rank	Score	Rank	Score	Rank
BW	0.66	2	-0.24	5				
BL	0.83	1	-0.32	7	-0.06	4	-0.77	7
BN	-0.39	7	0.85	1	-0.88	7	0.02	4
G	-0.47	8	-0.41	8	0.27	3	0.81	2
N	-0.52	9	-0.28	6	-0.48	5	-1.11	8
O	-0.24	6	0.68	2	1.59	1	1.15	1
R	-0.09	5	0.24	3	-0.94	8	-0.49	6
W	0.16	3	-0.07	4	1.21	2	-0.12	5
Y	0.05	4	-0.45	9	-0.71	6	0.51	3

Table 3. Results of the principal component analysis for position scores for each group averaged over days for each test (a) loadings for each test; (b) percentage variation accounted for by the first principal component, (c) principal component scores for each animal

Group	June 1		June 2		July 1		July 2	
(a) Test								
F	0.40		0.54		0.42		0.59	
H	0.51		0.61		0.56		0.42	
S	0.76		0.58		0.71		0.69	
(b) Percentage variation	82.3		89.9		88.6		95.3	
(c) Collar	Score	Rank	Score	Rank	Score	Rank	Score	Rank
BW	0.29	2	0.14	3				
BL	0.36	1	0.04	5	-0.01	4	-0.46	7
BN	-0.15	7	0.35	1	-0.63	7	0.01	4
G	-0.32	9	-0.32	9	0.08	3	0.61	2
N	-0.29	8	-0.28	8	-0.31	5	-0.80	8
O	0.03	5	0.20	2	1.17	1	0.73	1
R	0.04	4	0.11	4	-0.65	8	-0.30	6
W	0.05	3	-0.13	7	0.84	2	-0.08	5
Y	-0.01	6	-0.11	6	-0.48	6	0.29	3

One interesting aspect of the study was the relationship between "habituation" (increases in position scores over the 6 days of testing) and the different types of test. The greatest degree of habituation was seen in the S tests, where the person remained stationary, and the least was seen in the F tests, where the person walked the full length of the pen (and a moderate degree of habituation was seen where the person walked half the length of the pen (H tests)). Therefore the deer habituated most readily to the least severe challenge. An effect of stimulus intensity on changes over successive trials was also seen in a study on mountain sheep which showed tachycardia when approached repeatedly by a human. No habituation in tachycardia was seen in trials where the human was alone, but the response actually increased in trials where the person was accompanied by a dog (Macarthur *et al.*, 1982). In a different study involving repeated exposures of rats to a novel environment, more rapid habituation in defecation scores occurred in animals exposed at weekly intervals compared with 12-hour intervals (Candland *et al*, 1965).

A second point of note was the greater degree of habituation seen in the groups tested in July compared with the groups tested in June. This was possibly related to the difference in group size, which was nine in June and eight in July However, an association between lower group size and more rapid habituation seems contrary to the finding that the deer habituated most readily to the least challenging test; perception of the human as a threat should be greater in smaller groups compared with larger groups. For instance, in mountain sheep, increases in heart rate during the approach of a human were negatively correlated with group size (Macarthur *et al.*, 1982).

In conclusion, measurement of human avoidance might be usefully incorporated into a system of temperament assessment for red deer. Assessment in a range of social situations, and the use of closely defined positional data to maximise the resolution between individuals, was indicated.

Further Studies

A third study on the temperament of red deer is underway. The aims are to determine whether young animals show characteristic behavioural responses to humans and management techniques, whether these responses remain constant as the deer mature. An attempt has been made to simulate normal farming conditions for management and testing of the deer, so that the results can be related back to the real farming situation. Individual variation in adrenal activity of the deer will also be measured, as this may be related to variation in temperament. For instance, in goats challenged with a stationary or moving human, avoidance of the human was positively correlated with an increase in cortisol levels during the testing period (Lyons *et al.*, 1988) In pigs, levels of movement and vocalisation in a novel environment were positively correlated with peak cortisol levels following administration of ACTH (Von Borrell and Ladewig, 1992). Results from this study will be used to further refine assessment procedures and apply them to determine whether genetic variation in temperament exists in red deer. This will be done by using the measurements which show the most consistent variability between individuals in a comparison between progeny from different sires

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