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Development and evaluation of a temperament-scoring system for farmed deer: genetic and environmental components

KE Schütz[a*], JF Ward[b], NR Cox[a] and Asher GW[b]

[a]*AgResearch Ltd, Ruakura Agricultural Centre, Private Bag 3123, Hamilton 3240, New Zealand;* [b]*AgResearch Ltd, Invermay Agricultural Centre, Private Bag 50034, Mosgiel 9053, New Zealand*

**Corresponding author*: E-mail: karin.schutz@agresearch.co.nz

Abstract

A temperament-scoring system for farmed red deer was developed and evaluated. Hinds (n=1102) and their progeny (n=1609) from three farms were repeatedly scored (7867 observations in total) for aggression, agitation in a pen or when confined in a crate, ease of handling, and exit speed from a crate. The animals were scored when yarded for management procedures by one handler. Inter-observer reliability recorded on a separate occasion was between 70 and 82%, measured as percentage agreement. For progeny, heritability was for aggression:0.03±0.024, agitation (pen):0.23±0.077, agitation (crate):0.17±0.056, ease of handling:0.10±0.037, and exit speed:0.04±0.021, with a repeatability of 0.19±0.018, 0.24±0.022, 0.25±0.017, 0.24±0.015, and 0.17±0.013, respectively (estimate±SE of estimate for all preceding values). For hinds, repeatability was for aggression:0.23±0.048, agitation (pen):0.16±0.068, agitation (crate):0.38±0.052, ease of handling:0.45±0.048, and exit speed:0.27±0.061 (estimate±SE of estimate), respectively. Animals that were agitated in a pen were also more agitated in a crate (r=0.352 and 0.479 for progeny and hinds, respectively), all other associations were weak (r≤0.228). Farm, year born, age, and drafting order, but not sex, influenced most temperament scores. Temperament of red deer can reliably be scored in a yard. Agitation showed a moderate genetic component and could, therefore, be included in future breeding programmes.

Keywords: red deer; *Cervus elaphus;* heritability; temperament

Introduction

The temperament of farmed red deer (*Cervus elaphus*) has profound effects on their responses to management practices, such as handling and transport. Calm responses to these events are beneficial for animal welfare, product quality, and human safety (Hemsworth 2003). The way animals react to handling is likely influenced by both genetic components and environmental factors (e.g., management and previous handling experiences). Temperament of farmed deer is a selection trait that most New Zealand deer farmers agree is important, yet there is considerable variation amongst farmers as to which temperament they select for, and little consensus as to what constitutes an ideal deer temperament. Certain deer farmers appreciate some aggression as it is believed to demonstrate vigour, while others cull animals that show any aggressive behaviour. In addition, some cull animals that are flighty and panic when yarded to avoid other animals to become agitated or injured, or if human safety is compromised (Geoff Asher, personal communication).

There is, to our knowledge, no scientific literature describing the temperament of farmed red deer. Whereas the genetic influence of temperament has been documented in other species, such as cattle (e.g., Fordyce et al. 1988, Hearnshaw & Morris 1984, Hoppe et al. 2010) and sheep (e.g., Bickell et al. 2009, Dodd et al. 2012), it is not known how profoundly genotype influence temperament of deer. Therefore, the aim of this study was to develop a temperament-scoring system that has high reliability between observers and repeatability within animals, and to explore genetic and environmental factors that may influence temperament in farmed red deer.

Materials and methods

All animal procedures were approved by the Invermay Animal Ethics Committee under the New Zealand Animal Welfare Act 1999. A scoring system was developed in 2011 and 2012 on the AgResearch Invermay deer farm, using rising yearlings and their mixed-age (MA) red deer dams (rising 4-year olds and older). The animals were observed when they were brought into the yards and into a weigh crate for management purposes. Intra- and inter reliability were assessed before any further data collection was undertaken, to ensure that the scoring system was sufficiently robust to enable multiple people to undertake the scoring. Data collection for the analysis was undertaken in 2013 and 2014 on MA hinds (n=1102) and their progeny (age from rising yearling to rising 3-year olds, n=1609) that were repeatedly brought into the yards for routine management purposes, at three farms involved in the Deer Progeny Test (DPT) project (Ward et al. 2014). A total of 1383 and 6484 observations of MA hinds and their progeny were obtained, respectively.

The temperament scores (Table 1) were developed in a yard, as this is where deer farmers are likely to make any decisions about potential culling of animals due to undesired temperament. The scores describe different degrees of aggressive behaviour towards the handler, agitation in the presence of a handler, and ease of handling. Behaviour in the crate and exit speed were also incorporated in the scoring system as measures of general agitation and response to management procedures. The first two scores (aggression and agitation in a pen) were carried out by the handler in a pen immediately after yarding, before any further handling was carried out. Ease of handling and agitation

Table 1 Description of temperament scores used to assess temperament of farmed red deer (hinds, n=1102, and their progeny, n=1609) from three farms. The animals were assessed by one handler when repeatedly yarded for routine management procedures.

Aggression towards the handler	
1	The deer has no persistent eye contact with the handler
2	The deer's focus is on the handler with persistent eye contact, head/nose slightly up, the deer is 'looking down' at the handler, possible piloerection
3	Same as for 2 plus flared pre-orbitals and/or scrunched up nose (may be grinding teeth)
4	Same as 1 and/or 2, followed by attack (bite or box with front legs)
5	Instant attack (bite or box with front legs) without previous warning signals
Agitation in a pen	
1	Calm and confident appearance, the deer has no focus on the handler, seems 'uninterested', little movement in the pen
2	Light to moderate moving in pen, jostling for position away from handler
3	Rapid movement in the pen, bumping into walls and/or herdmates
4	Jumping up on walls and/or herdmates
Ease of handling	
1	The deer is easily moved in a controlled manner with one or two hands or body guiding the animal - minimal force needed. The animal could also be moving in front of the handler in a controlled manner without any contact
2	The deer is moved with light to moderate force in controlled manner using both hands and/or body
3	The deer is moved with moderate to considerable force using both hands and/or body. Movement is controlled but slower than for 1 & 2
4	Maximal force is needed to move the animal. The animal may have its legs locked
5	The deer is lying down and has to be lifted to move it
Agitation in a crate	
1	Minimal movement in the crate, the deer is relatively still
2	Light to moderate movement, no forceful interaction with side of crate
3	Forceful body movement, slamming into sides of crate
4	Jumping up at walls
Exit speed when leaving the crate	
1	Walking or trotting, in a controlled manner, no human interference needed
2	Fast run or jump, but still in a controlled manner
3	Same as for 2, but with uncontrolled movement
4	Human interference needed for the animal to leave the crate – voice only
5	Human interference needed – physical contact using hands

in the crate were carried out when the handler was moving each individual animal into the crate and when the animal was in the crate, respectively. The way the animal exited the crate when released was also observed. In addition, the last animal in its group was recorded, as this may change its behaviour and not reflect its true response. From the electronic identification system a pen sequence (divided into six groups for analysis purposes; 0-10%, 11-30%, 31-50%, 51-70%, 71-90%, and 91-100%) for each animal was also created in order to assess if the same animals were consistently late to be drafted. All animals were scored by one person (JFW) experienced in handling deer.

Statistical analysis

The temperament scores were analysed using a Restricted Maximum Likelihood (REML) model with the following fixed factors and all their interactions: farm and year born, and, for progeny, sex. Random effects for sire (progeny only), age, pen sequence (%), and the individual were also fitted to account for the repeat observations on the same animals. Heritability (progeny only) and repeatability were calculated from the variance components of these models. There were 758 observations of progeny with no pedigree information (these were excluded from the heritability analysis), and a further four observations with missing sex data (excluded from all analyses). The correlation between the temperament measures was calculated from a REML model with fixed effects of the following factors and all their interactions: farm, year born, pen sequence (%), and, for progeny, sex and age. A random effect for the individual was fitted to account for repeat observations on the same animals. All statistical analyses were conducted using GenStat, version 13.2 (VSN International, Hemel Hempstead, UK).

Results and discussion

Inter- and intra-observer reliability

Two trained people (including the handler collecting all data) scored the behaviour of 88 animals twice from video recordings in order to calculate the inter- and intra-observer reliability (agitation in crate was not measured as the behaviour could not be video recorded and two people could not watch the animal simultaneously). The inter-observer reliability for aggression, agitation in the pen, ease of handling, and exit speed was 82%, 70%,

Table 2 Percentage (%) of total number of observations (in brackets) of each temperament score per group of animal (mixed-age, MA, red deer hinds, and their progeny). Data were obtained by one handler, from three farms, when animals were repeatedly yarded for routine management procedures. A high score indicates increased level of the behaviour (e.g., high aggression score indicates a more aggressive animal), except for ease of handling where a low score indicates that the animal was easier to handle.

	MA hinds	Progeny
Aggression		
1	86.7	95.1
2	8.7	3.6
3	4.0	1.1
4	0.3	0.0
5	0.2	0.1
Total	100 (n=1366)	100 (n=4080)
Agitation (pen)		
1	42.2	31.8
2	38.8	53.2
3	17.9	14.3
4	1.1	0.7
Total	100 (n=1361)	100 (n=4079)
Ease of handling		
1	23.5	29.7
2	35.7	34.3
3	26.6	26.2
4	13.9	6.2
5	0.4	3.6
Total	100 (n=1364)	100 (n=6310)
Agitation (crate)		
1	54.1	62.9
2	34.0	27.2
3	11.4	8.5
4	0.4	1.3
Total	100 (n=1363)	100 (n=6320)
Exit speed		
1	27.9	45.1
2	40.7	27.7
3	27.5	21.1
4	3.9	6.0
Total	100 (n=1340)	100 (n=5501)

70%, and 79%, respectively, as measured as percentage agreement. The intra-observer reliability (% agreement) for aggression, agitation in the pen, ease of handling, and exit speed was 97%, 94%, 91%, and 83%, respectively. The results indicate that temperament can reliably be scored by multiple people, however, scoring should always be undertaken by a person with good animal handling skills and training and calibration with an experienced person is necessary.

Heritability (h^2) and repeatability

In general, when using the developed scoring system, all animals in the present study were relatively easy to handle and showed low levels of agitation and aggression towards the handler (Table 2). This may partly be due to the handler being experienced. It is well-known that poor human-animal interactions may lead to increased fearfulness in animals, which in turn can lead to increased handling times and risk of injury to both animals and handlers, and ultimately to decreased productivity and welfare (Hemsworth 2003, Waiblinger et al. 2006). The handler's skills and behaviour when working with deer is most likely of even greater importance as deer have only been farmed for about 40 years in New Zealand.

The heritability (h^2) and repeatability for the deer progeny are shown in Table 3. The heritability estimates for all traits except agitation in pen (moderate 0.23±0.077, estimate±SE of estimate) were low or very low. For example, the heritability for exit speed was low, compared to values reported for cattle (e.g., Hoppe et al. 2010) and sheep (reviewed by Dodd et al. 2012). This indicates a very large environmental component to the temperament of the deer in this study. Deer farming and farm systems have changed dramatically since the industry inception and a large number of environmental (non-genetic) components could contribute to the temperament of these deer, such as handler skills discussed earlier or learned behaviour mentioned below. The heritability of aggression was only 0.03±0.024 (estimate±SE of estimate). However, as mentioned earlier, very few animals showed any aggressive behaviour towards the handler. Also, we speculate that the onset of aggressive behaviour may occur later in life, and/or have a learned maternal influence (environmental) and, therefore, was not demonstrated in the heritability analysis. Importantly, the large environmental component suggests there are potentially still many ways we can alter deer farming systems to further improve the temperament of farmed deer.

The repeatability of the scores for the deer progeny (i.e., the ratio of the between-animal variation and the total variation), once factors such as farm, sex, age, year born, and pen sequence were taken into account, ranged from 0.17 to 0.25 and is similar to that of beef cattle temperament after calving using a similar scoring system (Morris et al. 1994). However, the repeatability found in the present study is lower than reported across several studies for behavioural reactivity in sheep (reviewed by Dodd et al. 2010). We speculate that factors, such as age and habituation to the yards influenced the repeatability for the progeny in the present study.

The repeatability of temperament scores was numerically higher in MA hinds compared to their progeny except for agitation in the pen; the values were 0.23±0.048, 0.16±0.068, 0.45±0.048, 0.38±0.052, and 0.27±0.061 (estimate±SE of estimate for all preceding values) for aggression, agitation in the pen, ease of handling, agitation in the crate, and for exit speed, respectively. It is likely that the repeatability of the scores for the MA hinds was higher due to the adult animals having a more established temperament than their progeny. The values are within ranges that have been found for temperament of cattle; Fisher et al. (2000) found repeatability coefficients of 0.51 for flight distance in a yard of cattle (a standardised

Table 3 Heritability (h^2) and repeatability (estimate±SE of estimate) of temperament scores of farmed red deer progeny (n=1609) including variance components. The animals were assessed, by one handler, when repeatedly yarded for routine management procedures on three farms.

	Variance component			h^2	Repeatability
	Sire	Progeny	Residual		
Aggression	0.001	0.019	0.079	0.03±0.024	0.19±0.018
Agitation (pen)	0.024	0.077	0.328	0.23±0.077	0.24±0.022
Ease of handling	0.023	0.200	0.695	0.10±0.037	0.24±0.015
Agitation (crate)	0.020	0.098	0.020	0.17±0.056	0.25±0.017
Exit speed	0.012	0.203	1.018	0.04±0.021	0.17±0.013

test of fearfulness of humans) and 0.36 and 0.34 for flight distance in a paddock and sociability, respectively. Fisher et al. (2000) used direct measures, such as flight distance measured in metres, rather than a subjective scoring system that was used in the present study and also by Morris et al. (1994) where a repeatability of 0.20 was found (using a 5-point temperament score). It is possible that differences in methodology could contribute to the different findings, as using a continuous scale rather than a discrete scale may potentially provide better discrimination. However, a subjective scoring system has other advantages, such as it is fast and can easily be used on a large number of animals.

Other factors influencing temperament

Farm (P≤0.022 for four out of five scores) and year born (P<0.001 for three out of five scores) influenced the temperament scores for the deer progeny, and this is likely due to physical variation between farms and years (e.g., in yard design and handling set up). There was a significant effect of age for all temperament scores (P<0.001); animals habituated to being handled and to the crate with age, however, there was no clear pattern for agitation in the pen and aggression. Age was confounded with number of handling occasions and it was, therefore, not possible to tease apart the effect of age and the effect of repeated handling and possible habituation. We speculate that number of observations per age could possibly influence this and further analysis might be needed. There was a significant effect of pen sequence (the order the animals were drafted from the pen, P<0.001) for all temperament scores except for aggression (P=0.197); progeny that were left last in the pen were seemingly more agitated but easier to handle. Sex of the deer progeny did not influence temperament for most traits (P≥0.225) except for ease of handling (P=0.052); females tended to be easier to handle than males.

For MA hinds, there was a significant effect of birth year on aggressive behaviour (P=0.006); older MA hinds were more aggressive than younger animals. However, as mentioned previously, the levels of aggression were very low and number of animals showing aggression scores >3 was very low. There was no other effect of age on any temperament scores (P≥0.124). There was also a significant effect of pen sequence on ease of handling (P<0.001); animals that were left last in a pen (before filling up the pen with new animals) were more difficult to handle.

Correlation between temperament scores

The correlation matrix between temperament scores, and associated P-values, for MA hinds and their progeny are shown in Table 4. In general, animals that were agitated in the pen showed the same behaviour in the crate. Agitation scores showed some association with ease of handling; agitated animals were easier to handle. As most animals did not show extreme levels of agitation, the results may suggest that a certain level of flight distance is beneficial when it comes to moving deer easily. Animals that want to maintain a certain distance from the handler are likely easier to move than animals that are either too tame or panic. There were also weak associations between agitation and aggression, which indicates that agitated animals are somewhat more likely to be aggressive, but again, very few animals showed any real aggressive behaviour towards the handler.

For the deer progeny, there seems to exist an association between exit speed and ease of handling for the deer progeny; animals that were difficult to move were less likely to leave the crate in a calm and controlled manner. For the MA hinds, there were weak relationships

Table 4 Correlation (r) matrix of temperament scores for farmed red deer mixed-age (MA) hinds (n=1102) and their progeny (n=1609). A high temperament score indicates increased level of the behaviour (e.g., high aggression score indicates a more aggressive animal), except for ease of handling where a low score indicates that the animal was easier to handle. The animals were assessed, by one handler, when repeatedly yarded for routine management procedures on three farms. *P<0.05, ***P<0.001.

	Aggression	Agitation (pen)	Ease of handling	Exit speed
MA hinds				
Agitation (pen)	0.172***			
Ease of handling	0.033	-0.144***		
Exit speed	0.047	0.228***	0.040	
Agitation (crate)	0.072*	0.479***	-0.173***	0.198***
Progeny				
Agitation (pen)	0.119***			
Ease of handling	0.010	0.038*		
Exit speed	0.008	0.095***	0.101***	
Agitation (crate)	0.127***	0.352***	-0.185***	0.034

between agitation (both in the pen and the crate) and exit speed; animals that were agitated in the pen and in the crate were less likely to leave the crate in a calm and controlled manner.

Recommendation

Temperament of farmed red deer can be reliably assessed in a yard. It is recommended that three behavioural variables are incorporated into a scoring system for future use; agitation and aggression in the pen, and ease of handling. Agitation in the pen showed a moderate genetic component and can, therefore, be used in breeding programs. Animals that were agitated in the pen were also more agitated in the crate, and there is, therefore, no need for the two separate agitation scores. In addition, crate and yard designs often vary between farms and it can be difficult to observe the animal; we, therefore, recommend that agitation in crate and exit speed are not included in the scoring system. Aggressive behaviour towards the handler had low heritability, however, we recommend that aggression is still incorporated into the scoring system due to its important component of deer behaviour. For similar reasons, it is recommended that ease of handling is included in the scoring system due to the importance of maintaining a good flow when handling deer. Lastly, it is recommended that further testing of the refined scoring system is undertaken to further assess the genetic and environmental components of temperament. Better understanding of the large environmental components of farmed deer temperament could lead to improved welfare outcomes for the animals, safety outcomes for the handlers, and possibly product improvement for producers and processors.

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References

Bickell S, Poindron P, Nowak R, Chadwick A, Ferguson D, Blache D 2009. Genotype rather than non-genetic behavioural transmission determines the temperament of Merino lambs. Animal Welfare 18: 459-466.

Dodd CL, Pitchford WS, Hocking Edwards JE, Hazel SJ 2012. Measures of behavioural reactivity and their relationships with production traits in sheep: a review. Applied Animal Behaviour Science 140: 1-15.

Fisher AD, Morris CA, Matthews LR 2000. Cattle behaviour: comparison of measures of temperament in beef cattle. Proceedings of the New Zealand Society of Animal Production 60: 214-217.

Fordyce G, Wythes JR, Shorthose WR, Underwood DW, Shepherd RK 1988. Cattle temperament in extensive beef herds in northern Queensland 2. Effect of temperament on carcass and meat quality. Australian Journal of Experimental Agriculture 28: 689-693.

Hearnshaw H, Morris CA 1984. Genetic and environmental effects on a temperament score in beef cattle. Australian Journal of Agricultural Research 35: 723-733.

Hemsworth PH 2003. Human-animal interactions in livestock production. Applied Animal Behaviour Science 81: 185-198.

Hoppe S, Brandt HR, König S, Erhardt G, Gauly M 2010. Temperament traits of beef calves measured under field conditions and their relationships to performance. Journal of Animal Science 88: 1982-1989.

Morris CA, Cullen NG, Kilgour R, Bremner KJ 1994. Some genetic factors affecting temperament in Bos taurus cattle. New Zealand Journal of Agricultural Research 37: 167-175.

Waiblinger S, Boivin X, Pedersen V, Tosi M-V, Janczak AM, Visser EK, Jones RB 2006. Assessing the human-animal relationship in farmed species: A critical review. Applied Animal Behaviour Science 101: 185-242.

Ward JF, Archer JA, Asher GW, Everett-Hincks JM, Mathias-Davis HM 2014. Design and implementation of the Deer Progeny Test (DPT). Proceedings of the New Zealand Society of Animal Production 74: 220-225.