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RESPONSE OF FARMED FALLOW DEER TO HUMAN PRESENCE

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Abstract

Direct behavioural responses to human presence are a very important consideration in red deer and fallow deer farming. Farm employees performing daily operations and visitors (agritourism) can trigger unexpected animal behaviours, elicit antagonistic responses or even contribute to accidents. Therefore, the aim of this study was to describe the behavioural responses of farm-raised fallow deer to the presence of strangers in the direct vicinity of the grazing paddock. Two independent behavioural tests were designed to analyse the responses of individual animals to a person or a group of people in the immediate vicinity. The results of a three-way analysis of variance revealed a significant main effect of the number of observers, which points to differences between groups, regardless of the animal's sex and observation date. Fallow deer were more agitated in the presence of individuals than groups of people. It is important for the maintenance of animal welfare, both during routine work on the farm and during the observation of their health.

Introduction

Deer farming differs from the production of other livestock species because red deer and fallow deer exhibit different behavioural responses and are more susceptible to stress (FLETCHER 2002, WILSON 2002). To reduce animal stress, deer farms should be well-designed and furnished, and fallow deer should be handled appropriately during routine farming operations in grazing paddocks and farm buildings (MATTIELLO 2009, JANISZEWSKI et al. 2008). These considerations play a particularly important role during routine farming operations and veterinary treatments,

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including feeding, handling, antler cutting (hard bone) and deworming (GREEK and STOWE 2000). For instance, a thorough knowledge of feeding behaviours and eating habits of different sex and age groups is needed to design effective feeding plans (MATTIELLO et al. 1997).

Research suggests that direct human presence induces negative physiological (stress) and behavioural (escape, anxiety) responses in animals (MACARTHUR et al. 1982, GEIST et al. 1985, RUSHEN et al. 1999). Animals subjected to chronic stress are more susceptible to disease (BULLOCK et al. 1993) because high corticosteroid levels decrease immunity (BROOM and JOHNSON 1993) and energy expenditure increases when animals are startled and disturbed (MACARTHUR et al. 1992). Stress can also compromise livestock performance and the quality of the end product (HEMSWORTH 2003), and it can lead to quality defects in venison which is characterised by high nutritional value. The presence of other livestock species in neighbouring enclosures can also undermine the welfare of farmed cervids (ABEYESINGHE and GODDARD 1998).

Human presence can be a source of stress, and it can lead to aggressive responses in farmed red and fallow deer (CARRAGHER et al. 1997). Farm employees, veterinarians, etc. performing daily operations and visitors (agritourism) can trigger unexpected animal behaviours, elicit antagonistic responses or even contribute to accidents. Therefore, the aim of this study was to describe the behavioural responses of farm-raised fallow deer to the presence of strangers in the direct vicinity of the paddock.

Material and Methods

The study involved 15 fallow deer (8 females and 7 males) aged about 13 months at the beginning of the experiment. The animals were separated from the herd and located in an experimental paddock. The animals were previously placed in a large paddock with other individuals of farmed herd, among others with their hinds. This ensured that in the group of animals subjected to experimental observations, there was no strong social structure, which could interfere with the results. The experimental paddock had an estimated area of 2.0 ha, and it was surrounded by a secure fence that prevented the animals from escaping.

Video footage recorded by 10 camera traps and a digital video camera (x 20 optical zoom) was analysed. Camera traps were distributed to cover the entire area of the experimental paddock. The camera operator remained hidden in an observation tower outside the experimental paddock. The location of the observation tower and entry and exit times were carefully planned to avoid any disruptions in the animals' behaviour.

The aim of behavioural tests was to determine the animals' responses to the presence of a stranger or a group of strangers (observers) talking in a "normal" voice outside the paddock in the immediate vicinity of the fence.

Each day, observations and video recording began at 5.30 p.m. and ended at 7.30 p.m. At around 6.00 p.m., when standard farming operations had been completed and the animals were calm, an observer/observers slowly approached the experimental enclosure, paused for approximately 30 seconds by the fence and looked at the animals. The behaviour of the observer/observers was identical each time. Fallow deer's responses were monitored from the moment the observer/observers approached the fence until they walked away and disappeared from sight.

Two independent behavioural tests were designed to analyse the responses of individual animals to a person or a group of people in the immediate vicinity of the paddock. The animals' responses were evaluated on an 8-point scale in each test, where 1 point denoted the most desirable behaviours, and 8 points denoted the least desirable behaviours in fallow deer farming (Table 1).

Table 1

Description of scores in behavioural tests

Score	Test 1 – one observer	Test 2 – group of observers
	description	description
1	the animal completely ignores the observer	the animal completely ignores the observers
2	the animal raises/turns its head, gazes at the approaching observer, but does not walk away to a different part of the paddock	the animal raises/turns its head when it hears the approaching observers, but does not walk away to a different part of the paddock
3	the animal raises/turns its head, gazes at the approaching observer and after a while, follows other retreating animals and walks away to a different part of the paddock	the animal raises/turns its head, gazes at the approaching observes and after a while, follows other retreating animals and walks away to a different part of the paddock
4	the animal raises/turns its head, gazes at the approaching observer and after a while, calmly walks away from the fence	the animal raises/turns its head, gazes at the approaching observers and after a while, calmly walks away from the fence
5	the animal gazes at the observer and runs away together with other animals when the observer approaches the fence	the animal gazes at the observers and runs away together with other animals when the observers approach the fence
6	the animal gazes at the observer and runs away when the observer approach-es the fence	the animal gazes at the observers and runs away when the observers approach the fence

cont. Table 1

7	the animal walks away from the fence when other animals spot the observer and walk/run away	the animal walks away from the fence when other animals spot the observers and run away
8	the animal runs away from the fence immediately after spotting the approaching observer	the animal runs away from the fence immediately after spotting or hearing the approaching observers

The experiment began on 2 July 2020 and ended on 7 September 2020. Fallow deer were monitored and recorded during the entire experimental period. Each behavioural test was conducted in ten replicates at weekly intervals. The tests were performed alternately at intervals of several days to rule out any interactions between the results. The dates on which each test was performed during the experiment are presented in Table 2.

Table 2

Dates on which behavioural tests were performed during the experiment (year 2020)

Observation	1	2	3	4	5	6	7	8	9	10
Test 1	6.07	13.07	20.07	27.07	3.08	10.08	17.08	24.08	31.08	7.09
Test 2	2.07	9.07	16.07	23.07	30.07	6.08	13.08	20.08	27.08	3.09

Because the study relied on observations only, without direct contact with the man was not needed the consent of the Local Ethical Committee.

The results were processed with the use of three-way mixed model analysis of variance with 2 x 2 x 10 factorial design. The results were regarded as statistically significant at $\alpha = 0.05$. Statistical analyses were performed in the IBM SPSS Statistics 26 package.

Results

The effects of observation date, number of observers and the animal's sex on fallow deer responses were determined by three-way mixed model ANOVA with 2 (between-subjects factor – observer: one person vs. a group of persons) x 2 (between-subjects factor – animal's sex: male vs. female) x 10 (within-subjects factor – observation date: 1 to 10) factorial design. The results of the analysis are presented in Table 3.

Table 3

The results of three-way mixed model ANOVA with 2 x 2 x 10 factorial design testing the effects of observation date, number of observers and the animals' sex on fallow deer responses

Item	MS	df	*F*	*P*	η^2
Observation	4.08	9.234	16.30	< 0.001	0.385
Number of observers	25.38	1.26	66.79	< 0.001	0.720
Animal's sex	0.03	1.26	0.08	0.776	0.003
Number of observers * animal's sex	0.22	1.26	0.58	0.452	0.022
Observation * number of observers	4.15	9.234	16.58	< 0.001	0.389
Observation * animal's sex	0.18	9.234	0.70	0.705	0.026
Observation * number of observers * animal's sex	0.18	9.234	0.70	0.707	0.026

The analysis revealed that the number of observers was a significant main effect, which points to differences between groups, regardless of the animal's sex and observation date. Fallow deer were more agitated in the presence of an individual observer (M = 5.84; SD = 1.59) than a group of observers (M = 5.25; SD = 2.17). This factor explained 72% of the variance of the dependent variable (η^2 = 0.72).

The effect of observation date was also statistically significant, which implies that stress levels (mean value of the test result) differed across observation dates regardless of the number of observers and the animal's sex. This difference explained 38.5% of the variance of the dependent variable (η^2 = 0.385). The Bonferroni pairwise comparison test revealed several dozen significant differences. These differences cannot be fully described due to space constraints, but they demonstrated growing levels of stress in the studied fallow deer. The animals were most apprehensive during the last three observations and during observations No. 5 and 6. The descriptive statistics for each observation are presented in Figure 1.

The interaction effect of the number of observers and observation date was also statistically significant, which facilitates an interpretation of the differences in stress levels. An analysis of simple effects demonstrated that stress levels remained unchanged in the presence of a group of observers (the results of the post-hoc test for all observations were not significant). In turn, differences were noted when a single observer approached the fence. Several dozen differences were also observed, and mean values were highest during the last three observations, followed by observations No. 5 and 6. The descriptive statistics for this interaction effect are presented in Figure 1.

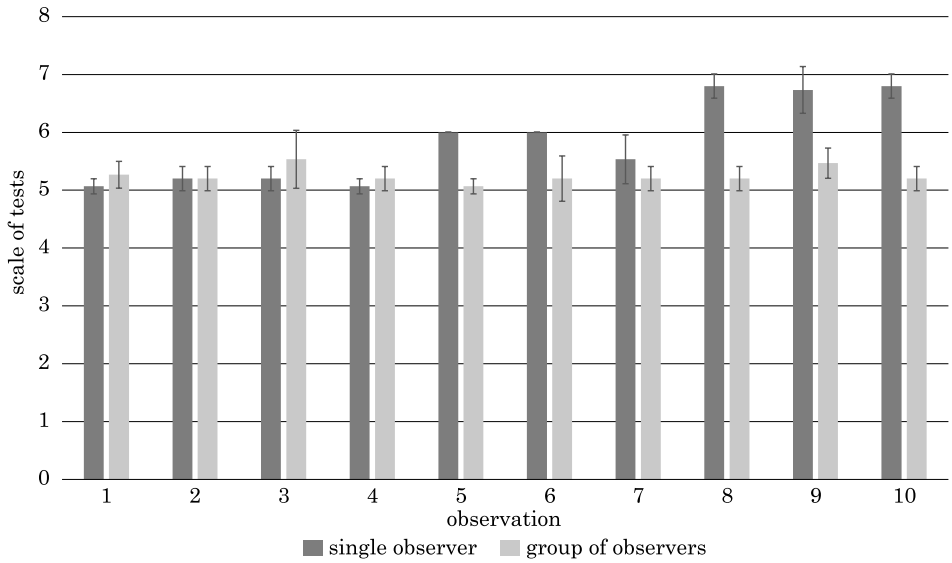

Fig. 1. Mean values and 95% confidence intervals for stress levels in fallow deer on each observation date, depending on the number of observers

As shown in Figure 1, when fallow deer were observed by a group of people, the mean value of the behavioural test ranged from 5 to 6 points during the entire experiment (10 weeks). When a single observer approached the fence, the mean value of the behavioural test exceeded 6 points on several occasions, and it was close to 7 points at the end of the experimental period. These scores imply that fallow deer fled from the fence when they spotted an approaching individual, but they calmly observed an approaching group of people and fled only when the observers reached the fence line. These responses were not affected by the animals' sex.

Discussion

Various definitions and methods have been proposed to measure temperament, including susceptibility to stress or anxiety, in livestock (BURROW 1997). However, most definitions rely on observations of animal responses to the presence of farm employees or strangers. Observations of livestock behaviour should be performed routinely in daily farming practice. Research studies have demonstrated that daily interactions between breeders and animals can compromise productivity and animal welfare (CARRAGHER and MATTHEWS 1996). Despite the fact that many interactions and handling operations occur routinely, some of them can be

a source of stress and anxiety, which was also indirectly confirmed by the results of the present study. Stress-inducing farming operations should be identified, and human-animal interactions that produce positive responses should also be analysed to minimise the negative consequences of handling operations that are necessary in livestock production (HEMSWORTH 2003). Behavioural observations also support the identification and assessment of pain in individual animals (STAFFORD and MELLOR 2002).

Red deer and fallow deer are characterised by low levels of domestication (FLETCHER 2020), which is why stressors and factors that elicit undesirable responses should be minimised in deer farms. Animal temperament and behaviour are influenced by both genetic and environmental factors (HEARNSHAW and MORRIS 1984), including breeding practices, handling experience and the behaviour of farm employees. The temperament of farmed deer and negative anthropogenic factors should be thoroughly analysed because fear, aggression and stress exert an adverse impact not only on meat quality, but also compromise the safety of humans and other farm animals (RUSHEN et al. 1999). SCHÜTZ et al. (2016) proposed a system for assessing the behaviour (temperament) of farm-raised red deer (hinds and their offspring) based on the following key traits: aggression, agitation in a pen or when confined in a crate, ease of handling, and exit speed from a crate. The results of the current study indicate that an animal's response to the presence of an individual or a group of people is also an important criterion in assessing the temperament of farmed red deer and fallow deer. The study demonstrated that fallow deer were more agitated in the presence of one person than a group of observers.

Animal responses to external factors, including stress factors, can be passed onto the offspring, which has significant implications for breeding practice, for example during the selection of breeding stock. In farmed deer, traits such as apprehension and anxiety can be passed from the mother to the offspring not only genetically, but also through imitation and imprinting (SCHÜTZ et al. 2016). Temperament is a trait with low heritability, but animal behaviours and responses to human presence should be taken into account in deer farming programs because calm deer are easier and safer to handle, and they grow more rapidly than hyperactive and agitated animals (WARD et al. 2019).

According to POLLARD (1983), animal welfare standards can be improved based on regular observations of the behaviour of farmed red deer. Changes in animal behaviour could be indicative of new stress factors or the elimination of the existing stressors. The cited author also suggested that individual responses to external factors associated with breeding and daily farming operations constitute valuable inputs for selective

breeding in deer farms. GRIGOR et al. (1998) examined the responses of one-year-old red deer hinds in five situations: transport, immobilization in a crush, human presence, visual isolation from the herd, and free escape (control group). Stress responses were assessed based on how fast the animals entered a narrow race in a handling pen. The highest stress levels were reported after 5 minutes of immobilization in a crush and after 5 minutes of transport. Hinds that were not subjected to other stressful procedures entered the race most quickly. However, the cited authors did not note the effect of employee behaviours or handling procedures (which should be standardised) on the responses of different animal groups.

Animal responses to stress factors can differ subject to individual experiences and perceptions of safety in the surrounding environment. The habituation of behavioural reactions occurs in response to frequent and predictable disruptions that are repeated, often localised and can be avoided (GEIST et al. 1985). According to BULLOCK et al. (1993), deer kept in parks can become accustomed to the presence of humans, which decreases the stress associated with human interactions. Behavioural responses to disturbances can also be analysed based on other factors that determine the animals' ability to escape from a potential threat. Stress responses can be reduced when animals have higher perceptions of safety, for example in large herds or in locations with an easy escape route (MACARTHUR et al. 1982). However, the "habituation" effect was not confirmed in the present study, where stress responses to the presence of individual observers were intensified in the second part of the experimental period (Fig. 1). It should be noted that the studied animals had had previous contact with farm employees, but routine farm operations differed from the observer's/observers' behaviour during the experiment.

MANTEUFFEL et al. (2009) hypothesised that the use of rewards in the process of training animals to perform simple tasks can improve animal welfare, decrease fear of humans and facilitate animal handling. Animals that learn to approach the trainer when given a visual or verbal cue can be rewarded with food. Individual animals can be regularly and frequently called during eating. Individual cows or groups of cows can be rewarded for coming to the milking unit in response to a particular command. Horses kept in boxes can be shown patterns on a screen before they are fed oats. According to the cited authors, animals that are trained to positively respond to specific situations will be less stressed by changes in their environment or handling operations. In the current study, the presence of an observer or a group of observers near the experimental paddock did not elicit a positive response.

It is difficult to explain why a single person approaching a fence caused a more stressful reaction to a fallow deer on a farm than a group of observers approaching. Perhaps the basis of this phenomenon should be the social structure of animals and permanent living in groups (CHAPMAN and CHAPMAN 1975). As noted in the Material and Methods chapter, young fallow deer over 13 months of age were involved in the behavioural experiment. Thus, they constantly lived in smaller or larger herds, and the presence of a single "external" individual was something new to them, and thus – stressful. However, this is only a hypothesis that should be subjected to further scientific analysis based on analogous studies of a larger number of farmer fallow deer herds.

HEMSWORTH (2003) argued that cognitive and behavioural training should be organised for animal breeders in the livestock industry. The ability to observe and interpret animal behaviours can be valuable not only in the process of recruiting farm employees, but also in discriminating between experienced and inexperienced workers that should be trained. According to the above author, extensive research is needed to identify the full range of interactions between farm employees that affect livestock.

In conclusions, the present study demonstrated that the presence of strangers in the vicinity of a grazing paddock is a stressful experience for farmed fallow deer. Regardless of sex, the animals were more inclined to run away from the fence when a single observer rather than a group of three observers approached the paddock, and this effect was intensified over time. Therefore, to minimise stress, the farm should have a layout that prevents strangers from approaching the animals. The response of farmed fallow deer to the close presence of individuals or groups of people can be also regarded as an important criterion in assessments of animal temperament and welfare in deer farms.

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