EFFECT OF AGE AND TEMPERAMENT TYPE ON REPRODUCTIVE PARAMETERS OF FEMALE RACCOON DOGS (*NYCTEREUTES PROCYONOIDES* GRAY)*

Stanisław Łapiński[1]♦, Joanna Bzymek[1], Piotr Niedbała[1], Łukasz Migdał[1], Andrzej Zoń[2], Marcin Lis[1]

[1]Department of Poultry and Fur Animal Breeding and Animal Hygiene, University of Agriculture in Krakow, al. Mickiewicza 24/28, 30-059 Kraków, Poland
[2]Experimental Station of the National Research Institute of Animal Production, 39-331 Chorzelów, Poland
♦Corresponding author: s.lapinski@ur.krakow.pl

Abstract
The aim of the study was to determine the relationship between age and temperament as well as reproductive results in female raccoon dogs. The study was carried out at two raccoon dog breeding farms located in south-eastern Poland. A total of 189 foundation stock females were evaluated for temperament using a modified behavioural empathy test. Animals were classified into five temperament groups: very fearful (VF), fearful (F), confident (C), aggressive (A) and very aggressive (VA). The animals with calm temperament (C) formed the largest group (49.9%) whereas the smallest number of animals was classified as VA (5.6%). The influence of age on the temperament of raccoon dog females and the number of young born and weaned (P≤0.01) was revealed. At the same time, temperament did not affect reproductive parameters (P>0.05). Summing up, the results of this study indicate lack of correlation between temperament and reproductive parameters. It can be assumed that the elimination of aggressive animals from the foundation stock will not compromise production results and can help to facilitate handling and improve animal welfare.

Key words: raccoon dog, reproduction, temperament, behaviour

The raccoon dog (*Nyctereutes procyonoides*, Gray, 1834) is a medium-sized member of Canidae family. The domestication process of this species began relatively late in comparison with other farming animals. The raccoon dog started to be reared commercially for the fur trade since the early 1970s (Kauhala and Auttila,

2010). With development of breeding, studies and preliminary observations of that species began for better understanding of its biology (Helle and Kauhala, 1991) as well as exploring the possibility of adapting it to farm conditions. It was observed that among traits significantly affecting welfare of raccoon dogs, an important role was played by their temperament (Korhonen, 1988; Fortuńska and Gacek, 2001). An excessive release of glucocorticoids resulting from stress leads to impairment of bodily functions, compromised immune function, reproductive disorders, sterilization and changes in reproductive organs. It also increases severity of infections and diseases and lowers animals' productivity (Kania et al., 2001).

Researches have shown that it is possible to select for temperament-related hereditary behaviour towards humans with the help of simple tests conducted under farm conditions (Trapezov, 1987; Gacek, 1999; Trapezov, 2000; Malmkvist and Hansen, 2001). An important reason for including temperament in selection procedure was that there is a negative correlation between anxiety and welfare and because stress significantly influences reproduction (Rekila, 1999; Korhonen et al., 2000). Confident silver and blue foxes have better reproductive parameters than fearful individuals (Kristensen, 1989; Henderson et al., 1996; Rekila, 1999). This difference appears to be due to a higher rate of kit loss in the fearful females than confident ones (Korhonen and Niemela, 1996). Many behavioural, physiological and morphological changes have been found in silver foxes selected for tameness (Kolesnikova et al., 1985; Osadchuk, 1992). In blue foxes, reducing stress levels seems to be connected with fear decrease (Rekila, 1999).

The aim of the study was to determine the relationship between age and temperament as well as the reproductive results of female raccoon dogs.

Material and methods

The study was carried out from November to October of the next year on two raccoon dog breeding farms (Farm A and Farm B) located in south-eastern Poland. A total of 189 foundation stock females (29 on Farm A and 160 on Farm B) were evaluated for temperament (Permission No 32/2010, First Local Ethical Committee on Animal Testing at the Jagiellonian University in Kraków).

On both farms animals were caged in sheds. During the experiment each female was examined eight times. The temperament of raccoon dogs was investigated using a modified empathy test developed by Gacek (1999). This is one of more accurate and fairly noninvasive methods of animal temperament measurement. An investigator attempts to experience the feelings of an animal when a novel object (a stick with a red ribbon tied to the end) is introduced into the animal's space. The stick should be placed at a nose height, within the sight of the animal. The animal's first reaction (15–20 s) is analysed.

During the measurements, raccoon dogs were assessed on the basis of a scale ranging from –2 (very fearful) to +2 (very aggressive). The assigned numerical values were used to calculate mean coefficients of temperament (truncated mean) and

animals were classified into five temperament groups, according to the following forms of behaviour:

– 2, very fearful (VF) – Immediate attempt to escape after introducing the stick with a knot into a cage. Searching for escape route in the cage corner or climbing the cage walls. Turning the head away avoiding eye contact.

– 1, fearful (F) – Going away from the stick, turning the head away; watching the knot but not coming up to the object. Showing both fear and curiosity.

0, confident (C) – Approaching, sniffing and licking the stick, following the stick, displaying willingness to play.

+ 1, aggressive (A) – Moving nervously at the sight of a stick, biting the knot, attacking it.

+ 2, very aggressive (VA) – Attacking the stick immediately after inserting it inside the cage. Growling and hissing very aggressively. Biting and tearing the knot and the stick.

The results were statistically analysed by means of two-way analysis of variance followed by Tukey's multiple range test. The statistical analyses were performed using Statistica 9.1 software (Statsoft, 2010). The results were presented as means ± S.E.M. and considered significant at P<0.05 and highly significant at P<0.01.

Results

Statistical analysis showed that farm had no effect on temperament coefficient (P=0.423) and reproductive parameters: number of kits born (P=0.816) and weaned (P=0.577). Therefore, further analyses were done for both farms. This study revealed that animals with calm temperament (C) formed the largest group (49.9%) while those classified as very aggressive (VA) formed the smallest group (5.6%) (Table 1).

This places the raccoon dogs in the calm group, although the coefficient of variation for this parameter was relatively high. Analysis of variance showed statistically significant differences in the number of young born and weaned by females of different ages (P≤0.01, Table 1).

The two way ANOVA revealed a statistically significant influence of female age on the temperament (P≤0.001). Statistically significant differences were found between the temperament of one-year-old females and those aged two (P≤0.01), three (P≤0.001) and five years (P≤0.05). Despite these differences, animals generally showed confident temperament. It was attested by the mean values of coefficient of temperament which were near zero and the percentage of animals representing different temperament types in successive age ranges (Table 1).

Taking birth litter size into consideration, statistically significant differences between one-year-old females and those aged two (P≤0.05), three (P≤0.01) and five years (P≤0.05) were stated. In the number of the young weaned, statistically significant differences were observed between one- and three-year-old females (P≤0.01). The ANOVA revealed no statistically significant influence of female raccoon dog temperament on reproductive parameters (P>0.05, Table 2).

Table 1. Reproductive and temperament parameters of female raccoon dogs of different ages. VF – very fearful, F – fearful, C – confident, A – aggressive, VA – very aggressive

Age (year)	N	Born Mean ±SE	Weaned Mean ±SE	Coefficient of temperament Mean ±SE	Distribution of temperament type (%)				
					VF	F	C	A	VA
1	78	2.53±0.456 a	1.95±0.437 a	0.15±0.119 a	5.1 a	12.8 ab	52.6 c	16.7 b	12.8 ab
2	46	4.39±0.568 ab	3.50±0.545 ab	−0.48±0.149 b	17.4 b	21.7 b	50.0 c	8.7 ab	2.2 a
3	23	5.57±0.787 b	4.87±0.755 b	−0.71±0.206 b	21.7 bc	26.1 bc	47.8 c	4.4 ab	0.0 a
4	27	3.93±0.774 ab	3.78±0.743 b	−0.41±0.203 b	7.4 a	29.6 bc	51.9 c	11.1 ab	0.0 a
≥5	24	5.30±0.797 b	4.68±0.765 b	−0.65±0.209 b	12.5 ab	41.7 c	37.5 bc	8.3 a	0.0 a
Total	198	3.85±0.262	3.21±0.252	−0.22±0.98	11.1	22.2	49.5	11.6	5.6

a, b, c – values in columns with different letters differ significantly ($P<0.05$).

Table 2. The reproductive parameters of female raccoon dogs with different temperament

Temperament	N	Born	Weaned
		Mean ±SE	Mean ±SE
VF	22	4.18±0.710	3.59±0.738
F	44	3.86±0.537	3.57±0.532
C	98	4.02±0.387	3.15±0.362
A	23	3.26±0.828	2.83±0.784
VA	11	2.82±1.007	2.27±0.965
Total	198	3.85±0.262	3.21±0.252

VF – very fearful, F – fearful, C – confident, A – aggressive, VA – very aggressive.

Discussion

Observations made during this study show that raccoon dogs are animals with calm temperament. This was particularly noticeable on Farm B where older females were maintained. From the information gathered from the breeder it appears that very aggressive animals are culled on this farm. Due to small herd size, this type of culling is not practised on Farm A.

Research performed by Barabasz et al. (2011) on raccoon dog farms in Poland and Finland demonstrated that confident animals were in the majority (72.5–74.2% in Poland, 69.4% in Finland). These authors grouped animal temperament into three categories, concluding that raccoon dogs are animals with a considerable degree of domestication and cause no breeding problems. The present results are comparable with those reported by Barabasz et al. (2011). The lower percentage values for the group of calm animals result from the use of a 5-point scale and more detailed classification of temperament of the tested animals.

The age structure of the females on the investigated farms was estimated on the basis of the data collected from farm records. Most one- and two-year-old females were kept on Farm A. The oldest female was four years old. This may be due to the fact that mainly young females were raised on the farm and older females were removed by culling. On Farm B, young animals also formed the largest group but the oldest female was 8 years old. Later it was shown that temperament is a trait that depends highly significantly on female age (P<0.001). There is a noticeable difference between one- and two-year-old animals. This may result from animals' adapting to farm conditions and procedures. Repeated treatments may progressively evoke less aggression of the animals. Similar conclusions were made by Korhonen (1988) who observed that younger raccoon dogs are characterized by greater excitability and activity than older animals.

In the evaluation of reproductive parameters, three-, four- and five-year-old females demonstrated the best performance. Older animals from Farm B were also characterized by good reproductive performance, as a result of which they were retained in the herd, although animals of this age are generally culled. Good results obtained by older females do not reflect the general trend because these animals were

outstanding. The poorest results were found in one-year-old females which had not been subjected to selection and therefore they had large percentage of abortions or killed their litters.

Research related to silver foxes (Socha et al., 2005), which analysed the mean number of young born from mothers representing different age groups, showed that the smallest mean number of kits born was found in one-year-old (4.36) and six--year-old females (4.30), and the smallest number of kits weaned was observed in one-year-old (3.85) and two-year-old females (4.07). The highest values were obtained for females aged five years (4.85 and 4.66, respectively). Kubacki et al. (2005) found the highest prolificacy in three-, four- and five-year-old females. The present study shows that reproduction peaks in both raccoon dog and fox females occur between three and six years of age.

Litter size obtained on both farms was similar and did not differ significantly. On Farm A, females gave birth to and weaned an average of 4.76 and 4.30 young, respectively. On Farm B, the corresponding values were 4.78 and 4.10. Szeleszczuk and Żurek (2006) investigated reproductive performance after raccoon dogs from Finland were introduced to the farm. Finnish animals appeared to improve fertility percentage considerably. The number of young born decreased and the number of females destroying their litters increased. The results of this experiment may suggest that in raccoon dogs, genotype is the main factor affecting reproduction.

Although the present study demonstrated no statistically significant effect of temperament type on reproductive parameters, certain trends could be observed. Aggressive females gave birth to and weaned the smallest number of young whereas females with very fearful temperament were characterized by the greatest number of young born and weaned. This may be related to the fact that they were more cautious in their reactions and less trustful towards handlers. Females with calm temperament were ranked second in reproductive performance. These results were also reflected in the percentage of young weaned. Unlike the present study, Zoń et al. (2004) who investigated the effect of temperament of female arctic foxes on parameters of reproductive performance showed poorer weaning performance in aggressive and fearful foxes.

Summing up, farmed raccoon dogs are calm and curious animals that show interest rather than fear towards people. Reproductive parameters of raccoon dogs are closely related to their age which was confirmed by earlier studies. No strong correlations between temperament and reproductive performance of raccoon dogs were observed, which leads to a conclusion that animals with low tolerance for farm conditions should be removed from breeding. Calm animals adjust more easily to farm living conditions and accept handling procedures which facilitates the work and improves welfare of animals.

References

B a r a b a s z B., Ł a p i ń s k i S., F o r t u ń s k a D. (2011). Productive value of Finn raccoons (*Nyctereutes procyonoides* Gray 1834) with confident temperament. Ann. Anim. Sci., 11: 165–170.

F o r t u ń s k a D., G a c e k L. (2001). Study of behaviour of raccoon dogs (*Nyctereutes procyonoides*). Rocz. Nauk. Zoot. Supl., 12: 365–372.

G a c e k L. (1999). The proposal of new behavioural test for the polar fox. Empathic test. Scientifur, 23: 201–205.

H e l l e E., K a u h a l a K. (1991). Distribution history and present status of the raccoon dog in Finland. Holarctic Ecol., 14: 278–286.

H e n d e r s o n M., R o u v i n e n K., T e n n e s s e n T. (1996). Behaviour related to reproductive performance in silver fox vixens. Anim. Prod. Rev. Appl. Sci. Rep., 29: 53–57.

K a n i a B.F., M a t c z u k J., C i e c i e r a M. (2001). Neuropharmacological basis of stress moderation Med. Weter., 57: 719–722.

K a u h a l a K., A u t t i l a M. (2010). Habitat preferences of the native badger and the invasive raccoon dog in southern Finland. Acta Theriologica, 55: 231–240.

K o l e s n i k o v a L., L u c e n k o N., T r u t L., J u r i s o v a M., B e l y a e v D. (1985). Selection of silver foxes for domestic type of behaviour: morphological and functional characteristics of organ systems. In: Evolution and morphogenesis. Mlikovsky J., Novak V.J.A. (eds). Praha, Academia, pp. 663–670

K o r h o n e n H. (1988). Activity and behaviour of farmed raccoon dogs. Scientifur, 12 (1): 27–37.

K o r h o n e n H., N i e m e l a P. (1996). Temperament and reproductive success in farmbred silver foxes housed with and without platforms. J. Anim. Breed. Genet. 113: 209–218.

K o r h o n e n H., H a n s e n S.W., M a l m k v i s t J., H o u b a k B. (2000). Effect of capture, immobilization and handling on rectal temperatures of confident and fearful male mink. J. Anim. Breed. Genet. 117: 337–345.

K r i s t e n s e n M.P. (1989). An evaluation of exploratory and fear motivated behaviour as a predictor of reproductive success in silver fox vixens. Scientifur, 12: 199–205.

K u b a c k i P., S m e k t a ł a I., K u b a c k i S. (2005). The analysis of reproduction traits of polar foxes in relation to the age of females and the type of vaginal mucus resistance curve. Acta Sci. Pol., Zootechnica, 4: 67–76.

M a l m k v i s t J., H a n s e n S.W. (2001). The welfare of farmed mink (*Mustela vison*) in relation to behavioural selection: a review. Anim. Welfare, 10: 41–52.

O s a d c h u k L.V. (1992). Endocrine gonadal function in silver fox under domestication. Scientifur, 16: 116–121.

R e k i l a T. (1999). Behavioural tests in welfare research of foxes. Kuopio University Publications C. Nat. Environ. Sci., 92, 52 pp.

S o c h a S., K o ł o d z i e j c z y k D., G o n t a r z A. (2005). The impact of the whelping season and the age of females on the reproduction results of the common silver fox (*Vulpes vulpes* L.). Acta Sci. Pol., Zootechnica, 4: 129–138.

S z e l e s z c z u k O., Ż u r e k H. (2006). Characteristic of raccoon dogs reproduction on Władkowice farm. LXXI Zjazd PTZ, Sekcja Chowu i Hodowli Zwierząt Futerkowych, 2, p. 15.

T r a p e z o v O.V. (1987). Selected transformations of defensive reactions to man in the American mink (*Mustela vison* Schreb). Genetika, 23: 1120–1127.

T r a p e z o v O. (2000). Behavioural polymorphism in defensive behaviour towards man in farm raised mink (*Mustela vison* Schreber, 1777). Scientifur, 24: 103–109.

Z o ń A., B i e l a ń s k i P., F r i n d t A. (2004). Effect of additional cage accessories on the welfare of juvenile arctic foxes showing different behavioural patterns. Zesz. Nauk. AR Wrocław, Zootechnika, 505: 313–318.

STANISŁAW ŁAPIŃSKI, JOANNA BZYMEK, PIOTR NIEDBAŁA, ŁUKASZ MIGDAŁ,
ANDRZEJ ZOŃ, MARCIN LIS

**Wpływ wieku i temperamentu na parametry rozrodcze samic jenota
(*Nyctereutes procyonoides* Gray)**

STRESZCZENIE

Celem badań było określenie zależności między wiekiem i temperamentem samic jenotów a ich parametrami reprodukcyjnymi. Badania przeprowadzono na dwóch fermach hodowlanych znajdujących się w południowo-wschodniej Polsce. Łącznie przebadano 189 samic stada podstawowego oceniając ich temperament przy pomocy zmodyfikowanego testu empatycznego. Zwierzęta podzielono na pięć grup temperamentu: bardzo bojaźliwe (VF), bojaźliwe, (F), spokojne (C), agresywne (A), bardzo agresywne (VA). Zwierzęta o temperamencie C stanowiły najliczniejszą grupę (49,9%), a VA najmniejszą (5,6%). Stwierdzono wpływ wieku samic jenotów na ich temperament oraz liczbę młodych urodzonych i odsadzonych (P≤0,01). Jednocześnie nie wykazano wpływu temperamentu na parametry rozrodu (P>0,05).

Reasumując, wyniki niniejszych badań wskazują na brak zależności pomiędzy temperamentem a wskaźnikami rozrodu. Na tej podstawie można przypuszczać, że eliminacja z hodowli osobników agresywnych, a tym samym gorzej znoszących warunki fermowe, nie pogorszy wyników produkcyjnych, a może ułatwić obsługę i poprawić dobrostan zwierząt.