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A NOVEL ARRANGEMENT OF BREEDING SETS HAS A POSITIVE EFFECT ON SOME REPRODUCTIVE PARAMETERS IN FEMALES OF THE AMERICAN MINK (*NEOVISON VISON*)

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Abstract. The study was aimed to determine the effect the arrangement of males in breeding sets on the level of selected reproductive parameters. The experiment consisted in alteration of the standard arrangement of animals in breeding sets prepared prior to mating. The modification consisted in an arrangement of males in cages so that each male was placed in the immediate vicinity of two females. The following parameters were analyzed: fertility, prolificacy, litter size, weaning success, and the average number of mating encounters per female. It was found that the average number of matings per one male from the treatment group, in which males were placed alternately with the females, was higher compared to the control group (males in a standard set). A higher percentage of mating males was observed in the treatment group compared with the control group of males. Significant differences in favor of the treatment group were observed within the parameters such as average number of born and live born kits, the mean number of mating encounters, and the length of pregnancy. The results distinctly show the beneficial effects of the modified arrangement of a reproductive mink set, in which males alternate with females, on the overall reproductive performance.

Keywords: American mink, mating sets, reproduction

INTRODUCTION

The monoestrous character of reproduction in the American mink (*Neovison vison*) requires the breeder to search for the most efficient methods to mate the animals. A lack of proper diligence during the short-lasting mating season may result in mistakes on the breeder's side that will not be later compensated for. The sexual cycle of the animals occurs only once per year, therefore lack of attension in any of the determinants of fertility

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can lead to significant losses to the farm. The breeding season in Poland begins in March, and is marked with the onset of the oestrus. The oestrus is triggered by the changing length of day [Travis and Pilbeam 1980, Wehrenberg et al. 1992], which is associated with the fact that the photoperiod is the most constant, recurrent, and undistorted environmental factor, unchanging from year to year [Wayne et al. 1989, Chemineau et al. 1992]. The rhythm of mammalian physiological functions is controlled by the hypothalamic suprachiasmatic nucleus (SCN) [Inouye and Kawamura 1982]. The following sequence of the process has been recognised: retina-stimulating light impulse, with the participation of melatonin, activates the pulse generator through SCN. This in consequence synchronizes the secretion of endogenous melatonin of the pineal gland, which in turn affects receptors in the central nervous system [Ebling and Hastings 1992]. The three mentioned structures, namely the retina, the suprachiasmatic nucleus of the hypothalamus, and the pineal gland, form a kind of a timing system.

Optimal reproductive performance depends on many factors that can be grouped as either genetic, under improvement by the use of appropriate breeding methods, and environmental. The latter group include the maintenance and feeding conditions, which – if optimized – allow achieving excellent reproductive indices.

Mating on a farm is organised in the form of so called breeding sets, in which a group of males (5 to 8 males, siblings and semisiblings) are paired with five groups of females (5 to 8 females, also siblings or semisiblings). In this arrangement, males are placed one by one, all between two groups of females. Van Loo et al. [2000] postulate that such a placement of males results in their elevated aggression and, in consequence, increased risk of fights and injuries. Grouping animals into breeding sets before the mating season and optimum planning of the mating process is a key factor of a satisfactory reproduction.

The aim of this experiment was to determine the effect of the arrangement of males in mating sets on the level of some reproduction parameters.

MATERIAL AND METHODS

The research was conducted on a mink farm located in Western Pomerania in 2009. Animals were maintained on the farm and were fed a standard according to generally accepted standards. The experiment consisted in application of changes in the standard arrangement of breeding sets prepared prior to breeding.

Modification of the standard arrangement of the animals (Fig. 1) consisted in placing the males in cages alternatively with females, so that each male was in the immediate vicinity of two females (Fig. 2).

We analysed selected reproduction parameters, including fertility, prolificacy, litter size, weaning rate, and mean number of matings. The treatment group of animals consisted of one-year-old Mahogany females mated to one-year-old Standard Brown males. The animals were gathered in 6 groups, of which two (groups Ia and Ib) were designed as follows (male groups):

– group I a, 148 males kept in the experimental shed, placed in the immediate vicinity to females (Fig. 2);

– group I b, 148 males kept in the control shed, without immediate access to females, the standard arrangement (Fig. 1).

The remaining four groups (IIa, IIb, IIIa, IIIb) were composed of females:

– goup II a: 264 females kept in the experimental shed, placed without the immediate accsess to males (Fig. 2);

– group II b: 264 females kept in the control shed without the direct access to males (Fig. 1);

– group III a: 296 females kept in the experimental shed, placed in the immediate vicinity to males (Fig. 2);

– group III b: 296 females in the control shed, the standard arrangement (Fig. 1).

The resulting data were statistically processed using the MS Excel® spreadsheet and the Statistica®PL software package.

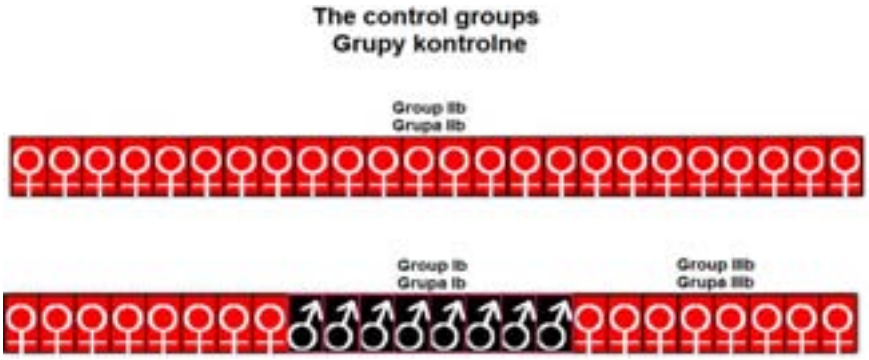

Fig. 1. The standard arrangement of males and females in the control groups of the breeding set
Rys. 1. Standardowe rozmieszczenie samców i samic grup kontrolnych w zestawie rozrodczym

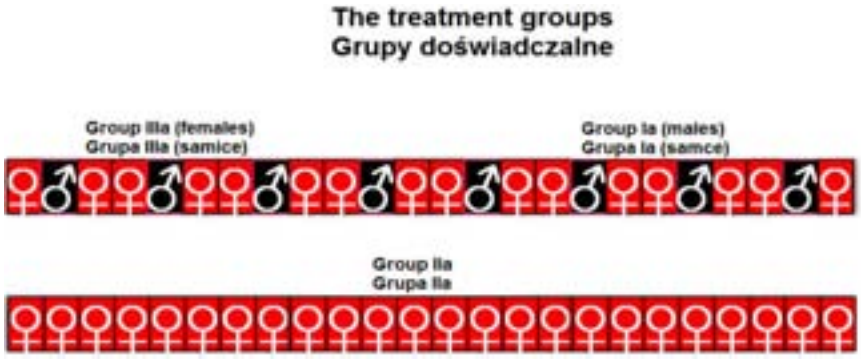

Fig. 2. The alternating arrangement of males and females in the treatment groups of the breeding set
Rys. 2. Przemienne rozmieszczenie samców i samic grup doświadczalnych w zestawie rozrodczym

RESULTS AND DISCUSSION

The reproduction of the mink is characterised by provoked ovulation. A copulation encounter is the stimulus for ovulation, which occurs in 36 to 72 hours after mating [Wehrenberg et al. 1992]. Cases described by Adams [1981] indicate a possibility of spontaneous ovulation in mink, which is observed in females after a brief contact with a male even without copulation.

Just before the onset of the breeding season, it is important to make the proper selection of individuals for reproduction (both males and females), composing breeding sets, and the arrangement of the mating plan. On farms, breeding sets usually consist of five groups of females and a group of males. Females and males within the groups are usually related (siblings and semi siblings), which allows, if necessary, replacing the male on the repeated mating, which does not affect the previously established plan of matings. A common practice on large farms is grouping cages with males in a single place of the breeding set, shown in Fig. 1 (standard arrangement). The experiment proposed locating males in close proximity to females, which is depicted in Fig. 2 (alternate arrangement), and the impact of such settings on reproductive performance was analyzed. It was expected that the close proximity of an individual of the opposite sex will result in enhanced libido of males and accelerated oestrus in females.

The analysis of mating males (Table 1) revealed that the average number of mating encounters per one animal of the experimental group, in which males were placed alternately with the females, was 11.8, while in the control group (males in standard arrangement) it was 10.3. These values differed statistically significantly at $P \leq 0.05$.

Table 1. The mean number of mating encounters per male of the treatment group (alternate arrangement) and control goup (standard arrangement)

Tabela 1. Średnia liczba kryć przypadająca na jednego osobnika z grupy doświadczalnej (zestawienie naprzemienne) i kontrolnej (zestawienie standardowe)

Males – Samce	Mean number of mating encounters Średnia liczba kryć
Group Ia (treatment) Grupa Ia (doświadczalna)	11.8[a]
Group Ib (control) Grupa Ib (kontrolna)	10.3[a]

The numbers marked by the same lowercase letters differ significantly at $P \leq 0.05$.
Liczby oznaczone tymi samymi małymi literami różnią się istotnie przy $P \leq 0{,}05$.

The date of mating in mink depends on the color and age. One-year-old females are usually mated earlier, often begining March, whereas two-year-old and older females are bred later, about 9–10th of March [Lagerkvist et al. 1994]. A higher percentage of mating males was observed in the experimental group compared with the control group of males at the beginning of the breeding season (Fig. 3). In the first analyzed period, more than 60% of the male experimental group began actively breeding, while at the same time these males in the control group comprised only slightly above 40%. Therefore one can conclude the positive effect of proximity of females which intensifies the male sexual activity.

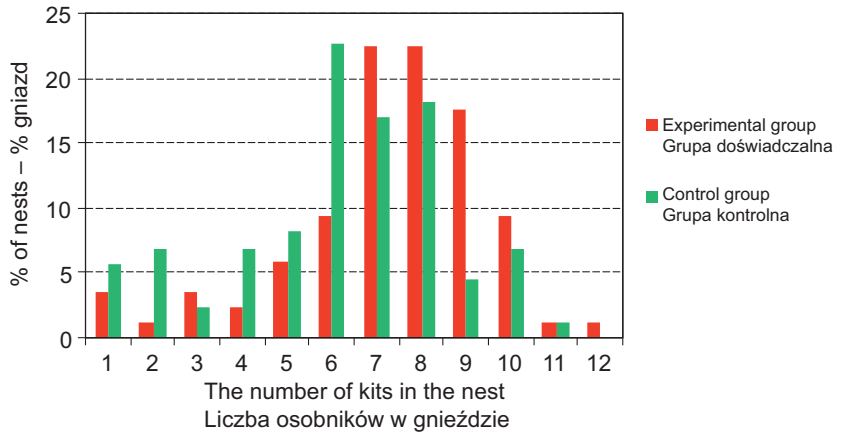

Fig. 3. Percentage of males startping mating activity in subsequent days of the breeding season
Rys. 3. Procentowy udział samców rozpoczynających aktywność kopulacyjną w kolejnych dniach sezonu rozrodczego

Analyzing the effect of different arrangement of males in breeding sets on the performance of females, we observed a significant influence of more actively mating males from the experimental group (Table 2). Females in the experimental group scored significantly better in the average number of born and live born kits. In the experimental group, the number of young born was on average 6.6 individuals, whereas in the control group 6.1, the number of live-born young was, respectively, 6.3 and 5.5. It should be emphasized that differences in the results obtained were confirmed statistically. Females of the experimental group were on average mated more often (2.8), as compared with the control group of females (2.3). There were no major differences between the analyzed groups of animals in gestation length and the percentage of females actually delivering young.

Figure 4 shows the percentage of nests containing different number of young in the experimental and control groups. The analysis indicates a higher percentage share of nests with 7 and 8 young in the IIa experimental group females, as compared with the control group, II b.

Analyzing the reproductive parameters of group III a females, arranged in experimental sets alternating with males and mated with those males, it should be emphasized that the results obtained are even more different from the results obtained for the control group III b (Table 3). Statistically significant differences in favor of the experimental group were observed within the parameters such as average litter size and live births, and the average number of mating encounters and length of pregnancy. Namely, the average litter size in the experimental group was 7.3 individuals, whereas in the control group 6.2; respectively, the average number of live births in either group was 6.7 and 5.8. Highly significant differences also occurred in the average number of mating encounters per female. Slightly worse, a compared with the control, was the percentage of females that actually gave birth in the experimental group, the differences, however, were not confirmed statistically. The results indicate that, most likely, better performance in the experimental group may prove the beneficial, cumulative impact of better mating males and more aroused, due to the close proximity of a male, females of the experimental group.

Table 2. Selected reproductive parameters of treatment group females (mated to males of the treatment group, arranged alternately with females) and the control (mated to contrl group males in standard arrangement)

Tabela 2. Wartości wybranych parametrów rozrodczych samic grupy doświadczalnej (krytych samcami z grupy doświadczalnej – zestawione naprzemiennie z samicami) i kontrolnej (krytych samcami z grupy kontrolnej – zestawione standardowo)

Females Samice	Mean no. of mating encounters Średnia liczba kryć	Mean litter size Średnia liczba urodzonych młodych	Mean no. of live births per litter Średnia liczba żywych młodych	Mean gestation length, days Średnia długość ciąży, dni	Percentage of females that gave birth Procent wykoconych samic
Group Ia (treatment) Grupa Ia (doświadczalna)	2.8^{A}	6.6^{b}	6.3^{C}	51.8	80.0
Group Ib (control) Grupa Ib (kontrolna)	2.3^{A}	6.1^{b}	5.5^{C}	51.9	79.5

The numbers marked by the same lowercase letters differ significantly at $P \leq 0.05$.
The numbers marked by the same uppercase letters differ significantly at $P \leq 0.01$.
Liczby oznaczone tymi samymi małymi literami różnią się istotnie przy $P \leq 0{,}05$
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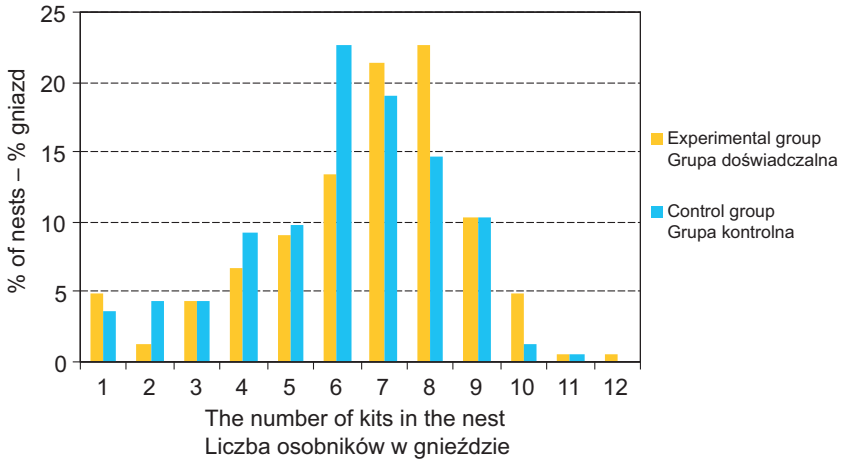

Fig. 4. Percentage distribution of nests by number of kits for females of the experimental group II a (mated with males from the experimental group – arranged alternately with females) and control II b (mated with males in the control group – default arrangement)

Rys. 4. Procentowy udział gniazd z różną liczbą młodych dla samic grupy doświadczalnej II a (krytych samcami z grupy doświadczalnej – zestawione naprzemiennie z samicami) i kontrolnej II b (krytych samcami z grupy kontrolnej – zestawione standardowo)

Table 3. The values of selected reproductive parameters of females in the experimental group arranged alternately with males and mated with males of the experimental group – arranged alternately with the females and controls (mated with males in the control group – arranged by default)

Tabela 3. Wartości wybranych parametrów rozrodczych samic grupy doświadczalnej zestawionych naprzemiennie z samcami i krytych samcami z grupy doświadczalnej – zestawione naprzemiennie z samicami i kontrolnej (krytych samcami z grupy kontrolnej – zestawione standardowo)

Females Samice	Mean no. of mating encounters Średnia liczba kryć	Mean litter size Średnia liczba urodzonych młodych	Mean no. of live births Średnia liczba żywych młodych	Mean gestation length, days Średnia długość ciąży, dni	Percentage of females giving birth Procent wykoconych samic
Group Ia (treatment) Grupa Ia (doświadczalna)	2.9^{A}	7.3^{B}	6.7^{C}	51.9^{D}	85
Group Ib (control) Grupa Ib (kontrolna)	2.3^{A}	6.2^{B}	5.8^{C}	50.3^{D}	88

Numbers marked with the same upper case letters differ significantly at $P \leq 0.01$.
Liczby oznaczone tymi samymi dużymi literami różnią się istotnie przy $P \leq 0{,}01$.

Analysis of the number of kits in nests of group III a, compared with III b, showed that also in this case a higher percentage of nests with a higher number of kits was observed in the experimental group, III a. In this group, nests which contained seven, eight, or kits were most frequent (Fig. 5).

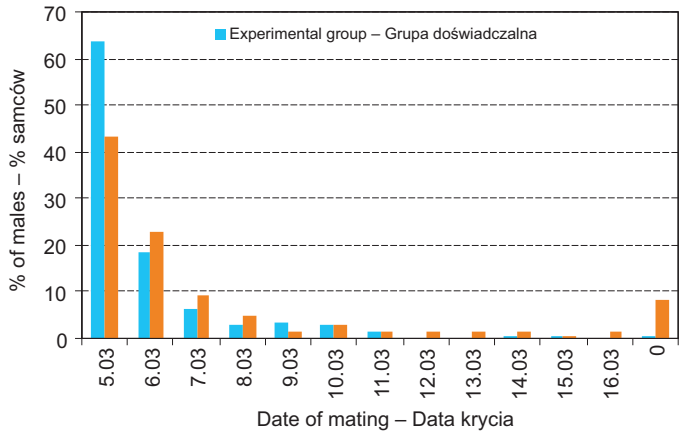

Fig. 5. Percentage distribution of nests by number of kits for females of the experimental group III a (arranged alternately with males and mated with males from the experimental group – also arranged alternately with females) and the control III b (mated with males in the control group – default arrangement)

Rys. 5. Procentowy udział gniazd z różną liczbą młodych dla samic z grupy doświadczalnej III a (ustawionych naprzemiennie z samcami i krytych samcami z grupy doświadczalnej – również zestawionych naprzemiennie z samicami) i kontrolnej III b (krytych samcami z grupy kontrolnej – zestawione standardowo)

The results on the reproductive performance of mink in the studied herd remained at a high level compared with the data presented by other authors from other farms. Święcicka [2004] in her study on the mahogany color variety reported an average 6.75 live births per female. This result is very high considering that Polish farms, according to Socha and Markiewicz [2002], achieve the average litter size at a quite low level, which ranges from 2.2 to 5.9 individuals. According Amstislavsky and Ternovskaya [2000] and Persson [2007], the average litter size of mink remains at a level of 5 individuals. Or data indicate that the analysed farm achieves outstanding results in both breeding and reproduction management.

CONCLUSION

The results clearly demonstrate beneficial effects of the modified arrangement of the breeding set, with males alternating with females on the reproductive performance of mink.

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ANALIZA ZALEŻNOŚCI POMIĘDZY SPOSOBEM ROZMIESZCZENIA SAMCÓW NORKI AMERYKAŃSKIEJ (*NEOVISON VISON*) W ZESTAWACH ROZRODCZYCH A POZIOMEM WYBRANYCH PARAMETRÓW ROZRODCZYCH

Streszczenie. Celem doświadczenia było określenie, jaki wpływ na poziom wybranych parametrów rozrodczych miał sposób rozmieszczenia samców w zestawach rozrodczych. Doświadczenie polegało na zastosowaniu zmian w standardowym rozmieszczeniu zwierząt w przygotowywanych przed okresem kryć zestawach rozrodczych. Modyfikacja standardowego usytuowania zwierząt polegała na takim rozmieszczeniu samców w klatkach, aby każdy znajdował się w bezpośrednim sąsiedztwie dwóch samic. Analizie poddano: płodność, plenność, liczebność młodych w miocie, wskaźnik odchowu oraz średnią liczbę kryć. Stwierdzono, iż średnia liczba kryć przypadająca na jednego samca z grupy doświadczalnej, w której samce usytuowane były naprzemiennie z samicami wynosiła więcej niż w grupie kontrolnej (samce w zestawieniu standardowym). Zaobserwowano wyższy procentowy udział kryjących samców grupy doświadczalnej w porównaniu z samcami grupy kontrolnej. Statystycznie istotne różnice na korzyść grupy doświadczalnej zaobserwowano w obrębie takich parametrów, jak: średnia liczba urodzonych i żywo urodzonych młodych, a także średniej liczby kryć i długości ciąży. Uzyskane wyniki jednoznacznie dowodzą korzystnego wpływu zmodyfikowanego, naprzemiennego z samicami ustawienia samców w zestawach rozrodczych, na uzyskiwane wartości parametrów rozrodczych.

Słowa kluczowe: norka amerykańska, rozród, zestawy rozrodcze

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