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Mean body weight gains in standard mink depending on the number of kits in a litter

NATASZA ŚWIĘCICKA, HENRYKA BERNACKA, JACEK ZAWIŚLAK
Department of Sheep, Goat and Fur Animal Breeding
University of Technology and Life Sciences in Bydgoszcz

Abstract: *Mean body weight gains in standard mink depending on the number of kits in a litter.* The objective of the study is to determine the effect of litter size from which animals came on their weight at weaning and pre-slaughter, and as a consequence also on their mean daily gains. The study was conducted on a population of 330 minks, divided into groups depending on the size of litter from which they came: I (2–4 kits) – 74 animals (44 ♂, 30 ♀), II (5–7 kits) – 170 animals (92 ♂, 78 ♀), III (8–10 kits) – 86 animals (44 ♂, 42 ♀). We established a significant effect of litter size on body weight at weaning and mean daily gains. Animals from smaller litters were found to have a higher body weight at weaning; whereas higher gains were observed in animals coming from bigger litters. Pre-slaughter body weight was similar in all assessed groups.

Key words: mink, daily gains, litter size, body weight

INTRODUCTION

Female fertility, meaning the number of offspring in a single litter, is a decisive factor in successful and profitable mink breeding. It varies from 2 to 15 animals, with the mean value at 6–7 animals. Fertility is shaped by a number of genetic and environmental factors. It is largely influenced by polyspermy, which results from a female mating with more than one male (Sulik and Felska 2000). Multiple authors have reported that in two- or three-year-old females, the number of animals born in a litter is much higher compared to one- or four-year-old females. Maintaining females for longer than four years is not cost-effective or efficient (Socha and Markiewicz 2001, Socha et al. 2003, Święcicka 2004, Felska-Błaszczyk et al. 2008). The higher the fertility in females, the higher the number of pelts obtained from them. Often, when a litter is too big, females struggle to feed the entire offspring, or kits reared in such litters are weaker and smaller. According to Lohi and Hansen (1990), body weight is positively correlated with pelt length; while Rozempolska-Rucińska et al. (2001) showed a negative correlation between body weight and pelt quality. Kubacki et al. (2010) observed that mink body weight has a positive effect on the final conformation score. High pelt prices at international auctions are largely influenced by both fur quality and pelt size.

The hypothesis adopted for this study is that the size of litter from which animals come affects their weight at weaning and prior to slaughter, and as a consequence also their daily gains. If this is confirmed, breeders will be able to take action earlier in order to obtain bigger pelts from minks.

MATERIAL AND METHODS

The study was conducted in the years 2014–15 on a mink farm in Poland, on the total of 330 standard mink, including 180 males (98 animals in 2014, and 82 animals in 2015) and 150 females (86 animals in 2014, 64 animals in 2015). The kits evaluated over two years came from the same dams (two-year-olds in 2014, and three-year-olds in 2015). The fathers are difficult to establish, as female minks mated two or three times with different males. The animals were all fed the same food, depending on maintenance requirements in respective breeding periods determined according to feeding standards (Gugołek et al. 2011). In each of the analysed years, animals were divided into three groups depending on the sizes of litters from which they came, and then they were divided further within these groups depending on their sex: I (2–4 kits) – 74 animals (44 ♂, 30 ♀), II (5–7 kits) – 170 animals (92 ♂, 78 ♀), III (8–10 kits) – 86 animals (44 ♂, 42 ♀). Animals were weighed twice: after weaning (at the age of seven weeks) and prior to slaughter (at the age of approx. seven months), using electronic scales. After seventh week of their lives, mink were kept at the same density, two animals of either sex in each cage (♂, ♀). Based on body weight data, we calculated daily body weight gains in mink using the following formula:

$$P = \frac{Mc_2 - Mc_1}{D}$$

where:
P – daily body weight gains;
Mc_1 – body weight at weaning;
Mc_2 – pre-slaughter body weight;
D – number of days from weaning to slaughter.

We characterised analysed traits statistically, calculating the arithmetic mean and standard deviations. Then we used the fixed effects model (GLM) and calculated the analysis of variance, applying the fixed model with an interaction. We incorporated the following effects into the model: year, sex, litter size:

$$y_{ijk} = \mu + R_i + S_j + P_k + (R{\cdot}S)_{ij} + (R{\cdot}P)_{ik} + (S{\cdot}P)_{jk} + e_{ijkl}$$

where:
y_{ijk} – body weight at weaning, pre-slaughter body weight, daily gains;
μ – general mean;
R_i – the i year effect;
S_j – the j sex effect;
P_k – the k effect of litter size;
$(R{\cdot}S)_{ij}$ + $(R{\cdot}P)_{ik}$ + $(S{\cdot}P)_{jk}$ – the effect of interactions between factors;
e_{ijk} – random error.

Additionally, to enable estimation of the relations between the assessed traits, we calculated the Pearson correlation coefficient (Kot et al. 2011). The correlation was calculated on the basis of primary data. In order to verify the significance of differences between the group, we applied the Scheffé's test. All calculations were made using the Statistica PL. 9.0 data analysis software (StatSoft Inc. Statistica).

RESULTS AND DISCUSSION

Data from Table 1 show that the biggest population was constituted by group II animals (5–7 in a litter) – 92 ♂ and 78 ♀.

TABLE 1. Statistical characteristic of body weight at weaning in standard mink

Year	Statistical measures	Number of animals in a litter						Significant differences between groups	
		Group I (2–4)		Group II (5–7)		Group III (8–10)			
		♂	♀	♂	♀	♂	♀	♂	♀
2014	*n*	24	15	52	48	22	22	I, II, III*	III–I, II*
	$\bar{x}$	928.5^{A}	636.6^{A}	792.1^{D}	634.6^{D}	727.6^{G}	571.3^{G}		
	SD	231.3	33.9	47.3	41.8	142.2	114.4		
2015	*n*	20	15	40	30	22	20	I, II, III*	III–I, II*
	$\bar{x}$	956.4^{B}	640.1^{B}	796.6^{E}	630.5^{E}	777.6^{H}	586.2^{H}		
	SD	281.6	167.2	68.10	74.22	37.7	28.0		
Total	*n*	44	30	92	78	44	42	I, II, III*	III–I, II*
	$\bar{x}$	940.8^{C}	632.3^{C}	797.2^{F}	635.9^{F}	745.3^{I}	569.1^{I}		
	SD	265.4	109.4	57.7	61.4	107.7	92.1		

A, B, C – significant differences ($P \leq 0.01$) between sexes within a given group; * significant differences ($P \leq 0.01$) between a groups.

Mink coming from litters of 2–4 animals had higher body weight at weaning compared to other groups ($P \leq 0.01$). The lowest body weight, both in females as well as males, was found in group III (745.3 g ♂, 569.1 g ♀). No statistically significant differences were observed between the assessed years within the analysed groups. However, we established that in 2015 female and male body weights at weaning were slightly higher. Malmkvist and Palme (2008) proved that offspring of females with two births or older were on average heavier by 11–13%. The authors attribute it to bigger experience of dams which results in better care and rearing of kits. In our study, however, body weight varied depending on sex (Table 1). This is caused by the strongly developed sexual dimorphism in mink. Male body weight at weaning was higher during the two examined years compared to female body weight by approximately 200 g. Sławoń (1987) stated that animals of both sexes gain weight at the same rate until day 10, and afterwards males begin developing quicker than females. The earliest differences may be observed in 30-day-old minks, when the body weight in males is higher by 9% compared to females. According to Lagerkvist et al. (1994), kit body weight at weaning largely depend on the size of litters from which they come as well as their mothers' lactation. The smaller the number of kits in a litter, the less intense the competition for food among siblings, resulting in a better physical development. Heavier and stronger animals are more capable of making sounds calling their mother and drawing attention. In mice and rats, sounds made by the young are important in taking them back to the nest because the mother gets a signal directing her to the stimulus (Ehret 2005). Similar dependencies were noted in mink by Clausen et al. (2008), who established that prior to being taken to the nest, kits first intensively call their mother. So, if an animal comes from a smaller litter, this is the optimum situation for their development. This has been confirmed in studies by Lohi and Hansen (1990). They proved that mink from litters of 3–7 animals develop the best. Piórkowska et al. (2014), analysing the body weight in mink depending on the number of animals in a cage, concluded that body weight at weaning was at the same level in all of the examined groups; differences were noted in subsequent months when animals ate only solid food. In our study, we found that there was an effect of sex ($P \leq 0.01$) and litter size ($P = 0.02$) on the above trait; but the examined years had no effect on body weight at weaning. We did find interactions between the examined factors (year, litter size, sex) which influence body weight at weaning ($P = 0.004$).

Analysing the final pre-slaughter body weight, we established that in animals weighed at that time there were no significant differences between the examined groups. Similarly as with body weight prior to weaning, differences between the sexes were also found at pre-slaughter weaning ($P \leq 0.01$). Body weight in females was at 1,600 g, and in males at 3,000 g (Tables 2 and 3). According to other authors, pre-slaughter body weight in mink, both in males as well as females, was approximately 2,000 g ♂ and 1,200 g ♀ (Piórkowska et al. 2004, Bielański et al. 2005, Piórkowska et al. 2014); whereas in a study by Pölönen et al. (1999) it equalled 1,800 g. Nurominen and Sepponen (1996) are of the opinion that mink stop to grow in mid-September, and any intensive feeding after that has a minimum effect on the final length of pelt. Lagerkvist (1997) established that pelts of mink born in big litters of approximately 10 animals were smaller. They also had a lower pre-slaughter body weight. Apart from feeding, the mean pre-slaughter body weight is significantly influenced by the placement of animals inside cages. Piórkowska et al. (2014) proved that adding another animal causes smaller body weights. However, it is difficult to deter-

TABLE 2. Statistical characteristic of pre-slaughter body weight in standard mink

<table>
<tr><th rowspan="3">Year</th><th rowspan="3">Statistical measures</th><th colspan="6">Number of animals in a litter</th><th colspan="2" rowspan="2">Significant differences between groups</th></tr>
<tr><th colspan="2">Group I (2–4)</th><th colspan="2">Group II (5–7)</th><th colspan="2">Group III (8–10)</th></tr>
<tr><th>♂</th><th>♀</th><th>♂</th><th>♀</th><th>♂</th><th>♀</th><th>♂</th><th>♀</th></tr>
<tr><td rowspan="3">2014</td><td>n</td><td>24</td><td>15</td><td>52</td><td>48</td><td>22</td><td>22</td><td colspan="2" rowspan="9">no significant differences between groups</td></tr>
<tr><td>$\bar{x}$</td><td>3 070.8^{A}</td><td>1 553.3^{A}</td><td>3 027.5^{D}</td><td>1 598.5^{D}</td><td>3 067^{G}</td><td>1 539.6^{G}</td></tr>
<tr><td>SD</td><td>214.6</td><td>147.6</td><td>187.5</td><td>134.9</td><td>157.7</td><td>138.25</td></tr>
<tr><td rowspan="3">2015</td><td>n</td><td>20</td><td>15</td><td>40</td><td>30</td><td>22</td><td>20</td></tr>
<tr><td>$\bar{x}$</td><td>3 195.0^{B}</td><td>1 670.0^{B}</td><td>3 185.6^{E}</td><td>1 669.5^{E}</td><td>3 144.0^{H}</td><td>1 659.0^{H}</td></tr>
<tr><td>SD</td><td>408.78</td><td>161.0</td><td>199.0</td><td>343.6</td><td>186.0</td><td>129.9</td></tr>
<tr><td rowspan="3">Total</td><td>n</td><td>44</td><td>30</td><td>92</td><td>78</td><td>44</td><td>42</td></tr>
<tr><td>$\bar{x}$</td><td>3 124.1^{C}</td><td>1 610.0^{C}</td><td>3 061.4^{F}</td><td>1 641.1^{F}</td><td>3 086^{I}</td><td>1 612.6^{I}</td></tr>
<tr><td>SD</td><td>337.8</td><td>150.9</td><td>208.7</td><td>268.8</td><td>162</td><td>135.2</td></tr>
</table>

A, B, C – significant differences ($P \leq 0.01$) between sexes within a given group.

TABLE 3. The F_{emp} value and the significance of the effect of examination year, sex and litter size on body weight at weaning, prior to slaughter, and daily gains in brown mink

Factor	*a* F_{emp}/P	*b* F_{emp}/P	*c* F_{emp}/P
Examination year	3.22/0.07	1.24/0.267	2.90/0.08
Sex	149.89/0.001	1 806.46/0.001	1 275.54/0.001
Number of animals in a litter	3.89/0.02	3.01/0.05	5.043/0.007
Examination year × sex	14.25/0.002	1.00/0.95	2.041/0.153
Examination year × number of animals in a litter	13.16/0.003	1.85/0.15	6.224/0.002
Sex × number of animals in a litter	0.17/0.843	6.12/0.003	5.737/0.004
Year × sex × number of animals in a litter	10.40/0.004	3.64/0.03	6.272/0.02

a – body weight at weaning, *b* – pre-slaughter body weight, c – daily body weight gains.

mine the importance of litter size on the final pre-slaughter body weight. It can be assumed that kits from bigger litters with lower body weight at weaning, when moved to separate cages with the same number of animals and with constant access to food, recover body weight losses and grow faster than those which have a higher initial body weight at weaning; but the final body weight is similar in all animals. In our study, we also established mean body weight gains, which in males were 16.8 to 18.0 g. Much smaller gains were registered for females (7.5 to 8.0 g). Furthermore, we found that sex (P = 0.001) and litter size (P = 0.007) had an effect on mean body weight gain in mink as well as interactions between the above factors (P = 0.004) which affect this trait (Tables 3 and 4). We ob-

TABLE 4. Statistical characteristic of daily body weight gains in standard mink

Year	Statistical measures	Number of animals in a litter						Significant differences between groups	
		Group I (2–4)		Group II (2–4)		Group III (2–4)			
		♂	♀	♂	♀	♂	♀	♂	♀
2014	*n*	24	15	52	48	22	22	I, II, III*	III–I, II*
	$\bar{x}$	16.5^{A}	7.1^{A}	17.2^{D}	7.4^{D}	18.0^{G}	8.2^{G}		
	SD	1.9	1.0	1.8	1.0	1.4	1.0		
2015	*n*	20	15	40	30	22	20	I–II, III*	I, II–III*
	$\bar{x}$	17.2^{B}	7.8^{B}	18.0^{E}	7.9^{E}	18.2^{H}	8.3^{H}		
	SD	2.9	2.0	3.2	2.7	1.4	0.9		
Total	*n*	44	30	92	78	44	42	I, II, III*	I, II–III*
	$\bar{x}$	16.8^{C}	7.5^{C}	17.4^{F}	7.7^{F}	18.0^{I}	8.0^{I}		
	SD	2.6	1.5	2.7	2.1	1.4	1.1		

A, B, C – significant differences (P ≤0.01) between sexes within a given group; *significant differences (P ≤0.01) between a groups

TABLE 5. Correlation coefficient (r_{xy}) for the number of animals in a litter and body weight at weaning, prior to slaughter, and daily gains, taking into account the sex of an animal

r_{xy}	Body weight at weaning		Pre-slaughter body weight		Daily body weight gains	
	♂	♀	♂	♀	♂	♀
Number of animals in a litter	–0.18**	–0.12	–0.01	-0.02	0.07	0.02

*Corelation high statistical significant ($P \leq 0.01$).

served statistically significant differences between the examined groups. Bigger gains were registered in mink from litters of 8–10 animals ($P \leq 0.01$) – Table 4. Based on correlation coefficients, we estimated relations within sexes between litter size and body weight at weaning, prior to slaughter, and mean daily gains. In males, there was a significant negative correlation between litter size and body weight at weaning: r_{xy} = –0.18 ♂ ($P \leq 0.001$), in females this value was r_{xy} = –0.12 ♀. Equally negative correlation in both males as well as females was found between litter size and pre-slaughter body weight of kits (r_{xy} = = –0.01 ♂; –0.02 ♀). This proves that animals from smaller litters have a higher kit body weight after seven weeks of life, the same as when weighed prior to slaughter. Based on correlation results, it can be assumed that pelts obtained from these animals should be bigger. In our study, however, the values of correlation coefficients are very low in all cases; hence it is hard to presume that there is any strong dependency of these traits especially for pre-slaughter body weight. Similar results were obtained by Kubacki et al. (2010), who concluded that as the number of animals born in a litter grows, their body weight decreases (r_{xy} = 0.034). In our study, the correlation coefficient for litter size and mean gains equalled respectively: r_{xy} = 0.07 ♂; –0.02 ♀). In this case, however, a positive correlation coefficient was found for both sexes (Table 5).

CONCLUSIONS

1. The adopted hypothesis has been partly confirmed. We established that litter size has a significant effect on body weight at weaning, and this in turn indirectly influences mink gains.
2. The highest body weight at weaning in both male and female animals was found in the group of mink coming from litters of 2–4 animals.
3. It was shown that the biggest body weight gains occur in animals from the largest litters of 8–10 animals.
4. Pre-slaughter body weight was similar in mink from all of the study groups.
5. Differences in terms of the examined traits were seen in both sexes. We established that males had higher daily gains as compared to females.

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Streszczenie: *Średnie przyrosty masy ciała norek odmiany brązowej w zależności od liczebności szczeniąt w miocie.* Celem badań jest określenie wpływu wielkości miotu, z którego pochodziły zwierzęta, na ich masę przy odsadzeniu przed ubojem a w konsekwencji na średnie dobowe przyrosty. W badaniach wykorzystano populację 330 norek, którą podzielono na grupy w zależności od wielkości miotu, z którego pochodziły zwierzęta: I (2–4 szczeniąt) – 74 szt. (44 ♂, 30 ♀), II (5–7 szczeniąt) – 170 szt. (92 ♂, 78 ♀), III (8–10 szczeniąt) – 86 szt. (44 ♂, 42 ♀). Stwierdzono istotny wpływ liczebności w miocie na masę ciała przy odsadzeniu i średnie przyrosty dobowe norek. Wykazano, iż zwierzęta pochodzące z mniejszych miotów charakteryzują się większą masą ciała przy odsadzeniu. Większe przyrosty natomiast zaobserwowano u osobników z bardziej licznych miotów. Masa ciała przed ubojem była zbliżona we wszystkich badanych grupach.

Słowa kluczowe: norka, przyrosty dobowe, liczebność w miocie, masa ciała

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Authors' address:
Natasza Święcicka
Katedra Hodowli Owiec, Kóz i Zwierząt Futerkowych
Wydział Hodowli i Biologii Zwierząt
Uniwersytet Technologiczno-Przyrodniczy
ul. Kordeckiego 20, 85-225 Bydgoszcz
Poland
e-mail: swiecicka@utp.edu.pl