Selection for Robust Mink (*Neovison vison)*

*V.H. Nielsen**, S.H. Møller*, B.K. Hansen* and P. Berg*

Introduction

In breeding, it is important to improve growth rate, feed consumption, and feed conversion ratio, but also to ensure a production with animals which are robust with regards to changes in environmental conditions and reproduction performances. From genetic theory provided genotype-environment interaction, selection in an environment which supports the trait under selection, results in the largest improvement. On the other hand, selection in an environment counteracting the trait results in improved robustness with regards to environmental changes (Falconer (1989); de Jong and Bijma (2002)). The present experiment examines whether genotype-environment interaction affects selection for November weight in mink when selection is performed on *ad libitum* feeding supporting November weight and on restricted feeding counteracting November weight.

Material and methods

Animals. Three lines (FF, AL, RF) were established for the experiment by crossing two brown mink lines. The FF-line was a farm fed control line. The AL- and RF-line were selected for high November weight on *ad libitum* and restricted feeding in three generations. Restricted feeding aimed at being 80% of *ad libitum* feeding. Each line was maintained by 100 female and 20 male breeders.

In generation 4, male full-offspring groups in the AL- and RF-line were divided randomly and equally between *ad libitum* and restricted feeding. To obtain an equal distribution of genotypes on the two diets, female offspring received the opposite diet to that of their brothers. In generation 4, there were 442 mink in the FF-line. In the AL-line and RF-line, 96 and 188 mink were tested on *ad libitum* feeding. Hundred and 180 mink from the AL- and RF-line were tested on restricted feeding.

Recordings. Mink were placed in cages in pairs with a male and female at weaning in late June or early July as is normal farm practice. The test feeding was commenced within a week after weaning. The first weighing was performed at 9 weeks of age. Afterwards, individual weight was recorded every third week until 30 weeks of age in November. Feed consumption was recorded from 12-27 weeks of age. Management of feed allowance at cage level was in all lines controlled by a computerized feeding machine regulated by a Palm Pilot (Møller *et al.* 2004). Feed conversion ratio was estimated as the ratio between feed consumption and weight gain. Weight gain was adjusted proportionally to fit the length of the feed recording

* Aarhus University, Faculty of Agricultural Sciences, 8830 Tjele, Denmark

Table 1: Least square means for November weight (g) in male (WM) and female (WF) mink, feed consumption (FC) (kg) and feed conversion ratio (FCR) from July to November in line FF, AL and RF in on test feed AL and RF in generation 4

Traits		FF	AL	RF	SE[1]
WM		2832	3751	3261[a]	44
	Test feeding		3240[a]	3581	42
WF		1269	1900[a]	1669[b]	28
	Test feeding		1738[b]	1850[a]	28
FC.		40.4	48.6	41.0[a]	0.3
	Test feeding		41.3[a]	46.9	0.3
FCR		20.3	15.0[a]	14.8[a]	0.3
	Test feeding		15.1[a]	14.9[a]	0.3

[1]Average standard error. The FF-line is excluded from SE
Means without a common superscript differ (P<0.05)

interval. Total number of kits born was recorded in generation 4. All lines were fed according to normal farm practice in the reproduction period.

Statistical analyses. In generation 4, November weight, feed consumption, and feed conversion ratio were analyzed using a model including line and test feed and the interaction between line and test feed. Age of the mink was included as a covariate in the analyses. Litter size was analyzed using a model including effect of line. PROC GLM (SAS Insitute Inc., 2020-2003) was used for statistical analyses.

Results and discussion

Response to selection. November weight in male and female mink, feed consumption and feed conversion ratio from July to November in the lines in generation 4 are shown in Table 1. Over generations, feed consumption in the RF-line amounted 81-87% of feed consumption in the AL-line. It resulted in a reduced weight gain from July to November in the RF-line, there was 78-88% in males and 84-91% in females of the weight gain in the AL-line. Thus the reduced feeding managed to reduce growth in the RF-line. Males seem to be more affected than females.

The response was estimated as the difference between the mean of the line on its selection feed and the mean of the FF-line corrected for the effect of the different feeding estimated in generation 1. For November weight, it was 642 g and 670 g in males and 514 g and 495 g in females in the AL- and RF-line. The direct responses were large in agreement with large estimated heritabilities for November weight of 0.52±0.10 for males and 0.51±0.07 for females on *ad libitum* feeding and 0.73±0.11 and 0.60±0.09 on restricted feeding (V.H. Nielsen *et al*., unpublished results). The indirect responses were 6.7 kg and 5.3 kg for feed consumption and -3.4 and -6.2 for feed conversion ratio in the AL- and RF-line.

In generation 4, weight and feed consumption were largest in the AL-line (Table 1). Weight and feed consumption in the RF-line were larger than in the FF-line, but feed conversion ratio was smaller in the RF-line than in the FF-line and at the same level as in the AL-line. The results indicate, that feed utilization is improved by selection on restricted feeding as also reported by Hetzel and Nicholas (1986), McPhee and Trappett (1987), Urrutia and Hayes (1988) and Nguyen and McPhee (2005) in mice and pigs.

Number of kits born in generation 4 was 6.6, 4.1 and 5.6 in the FF-, AL- and RF-line. These numbers were significantly different (P<0.0001). Thus selection adversely affected litter size particularly in the AL-line. In generation 4, the number of mink tested in the AL-line was only about half the number of mink in tested the RF-line.

Test on *ad libitum* and restricted feeding. In generation 4, the AL- and RF-line were tested on both *ad libitum* and restricted feeding (Table 1). For both lines, November weight was largest on *ad libitum* feeding. November weight in males and feed consumption on *ad libitum* feeding were largest in the AL-line. Weight and feed consumption were similar in the lines on restricted feeding. Thus, for males a significant line-test feed interaction (genotype-environment interaction) (P=0.03) was obtained indicating that November weight on *ad libitum* and November weight on restricted feeding are different traits. Feed conversion ratio was similar in the AL- and RF-line on both feeding conditions. No significant line-test feed interaction was found for female mink. This may be due to females being less affected by the reduced feeding. Females seem to meet their demand for feed better than males when kept together in a cage.

Average November weight on the two feeding conditions was 3496 g in males in the AL-line and 3421 in males in the RF-line. The environmental sensitivity measured as the difference between November weight on *ad libitum* and restricted feeding was 511 g in the AL-line and 320 g in the RF-line. The best average performance was thus obtained in the AL-line while the RF-line was more robust to changes in feeding conditions.

Conclusion

The results show that November weight in mink on *ad libitum* and restricted feeding are genetically different traits. Selection on *ad libitum* feeding increases appetite while selection on restricted feeding improves feed utilization. The best average performance on *ad libitum* and restricted feeding was obtained by selection on *ad libitum* feeding but environmental sensitivity was smaller in the line selected on restricted feeding. Selection on *ad libitum* severely affected litter size at birth. Thus overall, selection on restricted feeding resulted in more robust mink.

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