Benefit of high number of active mammary nipples in mink

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Abstract

From 2009 till 2011 Edelveen has looked into the effect of the number of active mammary nipples on kit survival, kit growth and the heritability of mammary nipples. The projects showed the significant negative correlation in kit mortality between birth and 3 weeks of age. There is a clear variation in number of active mammary nipples in the total population. The repeatability of nipples is high. The correlation between mammary nipples and litter size is not strong. Females with 8 or 9 active mammary nipples had kits with a higher weight at 7 weeks of age and those females lost less weight between 3 and 7 weeks in lactation. The variation in number of nipple dots at kits of 2 weeks of age is high (6 to 11). The dots are strongly correlated with the number of mammary nipples of the mother and father. Nipple dots develop into active mammary nipples when the female has kits. The number of active mammary nipples is genetic correlated and showed a high heritability. Selection on number of active nipples is effective and helps the female mink in nursing their kits and results in a better welfare in mink.

Keywords: mammary nipples, nipple dots, kit losses, growth

Introduction

The relation between the number of active mammary nipples and various parameters has been studied previously. Pedersen (1978) reported in scientifur the works of Mohr and of Hoogenbrugge and a variation in the number of active nipples from 1 to 10, and they assessed a poor positive correlation between the number of nipples and litter size. Fiedler and Siler (1978) reported that the heritability for the number of nipples is high (h2 = 0.53). Møller and Brzozowski (1996) described how mammary glands develop with high intensity during the last weeks of gestation. Individual mammary glands can be activated up to 12 days post partum, and kits activate glands such that the nipples become available for the kits (Møller, 2008).

These results strongly suggest that it is worthwhile use the mammary nipple number as a selection criteria, as is done in pig and rabbit breeding. Still, on Dutch mink farms little attention is paid to mammary nipple numbers. The aim of this study was to collect recent Dutch data on active mammary nipple numbers, heritability and the impact of the number of nipples on litter size and kit development. We will argue that selection in favour of larger number of active mammary nipples is profitable for the farmers, and improves mink welfare.

Material and methods

Animals

Edelveen consisted of 1,500 brown/glow females which were introduced as young females short before 2009's mating season. The size of the stock was the same in 2010 and 2011, but the amount of old females raised.

Housing and food

The animals were housed in standard mink cages (30×85×45cm) provided with a nest box. They were fed with the food produced by food-kitchen Flevo, using an automatic feeding system (Farm Pilot).

Recorded data

These usual breeding data were recorded: date of birth, litter size one day after birth and at 3 and 6 weeks. Weight of mother and kits at 3 and 5 and 7 weeks. For this study we also recorded the numbers of nipple dots and active mammary nipples (MN). At the age of ±18 days, nipple dots were counted. Nipple dot can develop into mammary nipples during adulthood. Active nipples were counted also at ±18 days after whelping. Table 1 lists how many animals contributed to the various topics during the three years. Data were analysed with Anova.

Table 1. Materials and methods projects active mammary nipples.

Topic	Year(s)	Actions / selected mink[1]	n Litters	days in Lactation
Kit losses	2009/2010/2011	counting kits	± 1,450	d 1 and d 21
		counting active MN		± day 18
MN next lactation	2009/2010/2011	counting active MN	± 700	± day 18
Litter size	2009/2010/2011	counting kits	± 700	d 1 and d 21
		counting active MN		± day 18
Nipple dots kits	2010	OF with 6-7-8 or 9 active MN	100	± day 18
		and sons /daughters of OF	140	
Nipple dots kits	2011	OF with 6-7-8 or 9 active MN	100	± day 18
		sons /daughters 6-7-8 or 9 nipple dots	140	
Nipple dot -> MN	2010/2011	counting dots 2010 and MN 2011	100	± day 18
Kit growth	2011	whelping date: 28/4, 03/05, 09/05	±60/date	
		n kits 21 days: 5or6, 7or8, 9or10	±60/n kits	
		N active MN: 6, 7, 8 or 9	±45/n MN	
		weighting kits and OF	175	d 21, 35 and 49

[1] MN = mammary nipples; OF = old female mink.

Results

Active MN and kit losses during the first 21 days

The relation between number of active MN, litter size and kit survival was consistent over the years so that all data are lumped. Generally spoken, more kits survived the more active MN's were available, but Table 2 with lumped data from 2009-2011 shows that the exact relations between MN, litter size and survival rate are difficult to unravel. Reading the rows from left to right makes clear that the number of active MN is negatively correlated with mortality, in litters of all sizes from 10 to 6. Reading the columns from top to bottom reveals that mortality also depends on litter size. The smaller the litter in the range 6-10, the lower the mortality. The number of active MN seems to have more impact than litter size.

Table 2 does not show whether litter size and number of active MN depend on each other. Table 3 is composed to show their relation: the more active MN, the more live born kits per litter.

Active MN and kit growth from 3 to 7 weeks

De Rond (2007) already reported that kits gained more weight and mothers lost less, the more MN were active. In later studies (De Rond, 2011a,b), 175 mothers and kits were weighed 3 and 5 and 7 weeks after birth. The weight gain was not only influenced by the number of active MN, but more so by litter size. Kits from litter size 5/6 were the heaviest (615 g), litter size 7/8 weighed 585 g and litter size 9/10 only 515 g. Females lost most weight with litter size 5/6 (140 g). With litter size 9/10 they only lost 100 g. The birth date was less important, but not neglectable. Kits from 9/10 May weighed after 7 weeks 595 g and kits from 28/29 April 565 g.

Table 2. Litter size, number of mammary nipples, and mortality between 1 and 21 days after birth during 2009-2011.

Litter size	Number of mammary nipples				
	9	**8**	**7**	**6**	**5**
10 kits	3%[a]	4%[a]	6%[a]	10%[b]	
9 kits	2%[a]	3%[a]	7%[a]	9%[b]	17%[b]
8 kits	3%[a]	5%[a]	5%[a]	8%[ab]	11%[b]
7 kits	1%[a]	4%[a]	6%[a]	9%[a]	11%[b]
6 kits	2%[a]	3%[a]	3%[a]	8%[ab]	10%[b]
Females (n)	155	1,028	1,401	1,066	255
Liveborn kits (avg.)	8.4	8	7.7	7.1	6.4
Kit losses/litter	2%[a]	4%[a]	5%[a]	7%[ab]	11%[b]

[a,b] Groups with different letters are significantly different at $P<0.05$.

Table 3. Mammary nipples (MN) and litter size.

Mammary nipples at first lactation	Reproduction 2nd lactation	
	litters (n)	liveborn kits (n)
9 MN	25	7.5[a]
8 MN	193	7[a]
7 MN	231	6.7[b]
6 MN	162	6.5[b]

[a,b] Groups with different letters are significantly differents at $P<0.05$.

The relation between active MN and kit weight and Female weight loss is shown in table 4. Apparently, the relation between weight gain/loss and number of active MN during the second part of the lactation period is not strong. Females with 8/9 active MN scored the best.

Heritability and selection

Selection in favour of a large number of active MN only makes sense if the numbers vary. As a matter of fact they do. The number of active MN varied from 1 tot 10 and the number of dots varied from 6 to 11 per kit. Even within litters the numbers varied, in fact only in 25% of the litters (5 or more kits) the kits of the same sexe (male or female) had the same number of nipple dots.

If heritability plays an important role, then it is to be expected that the number of active MN of one female is more or less the same every year. Indeed, the numbers of active MN in subsequent years were strongly correlated with each other (Table 5).

Table 4. Active mammary nipples (MN), kit weight and female weight loss.

Active MN (n)	Litters (n)	kits/ litter at 21 days (n)	Kit (m/f) weight at 7 wks	Female weight loss 3-7 wks lact
6 MN	45	7.1	570[ab]	135
7 MN	45	7.2	560[a]	150
8 MN	45	7.3	585[ab]	105
9 MN	40	7.7	600[b]	105
Standard variation			55	115

[a,b] Groups with different letters are significantly differents at $P<0.05$.

Table 5. Number of active mammary nipples (MN) in the next lactation period.

Females (n)	MN 2009 (1st)	MN 2010 (2nd)	higher MN in 2nd (%)
20	9	8.9	0%
103	8	7.8	4%
143	7	6.9	9%
102	6	6.2	23%
25	5	5.8	60%

Table 5 also shows that the number of active MN tended to increase rather than decrease in the second year. Litter size dictated these numbers far less as shown earlier. Thus, an environmental factor like litter size, influenced the number of active nipples less than did the female itself.

The crucial test in assessment of heritability is looking for correlations between parents and offspring. Various correlations are worth to investigate: correlations between the mother's active MN en the kits' dots. And correlations between the mothers dots and the kit's dots. Only lactating females have active MN during part of their life, whereas kits and males of any age only have nipple dots. From the females introduced in 2009 we did not count the old female's dots, but only their active MN. Hence, the results of 2010 and 2011 are not lumped. Table 6 shows the average numbers of kit's dots and the numbers of their parents. In 2010 the only information of the females and males was the number of active MN of the old female. In 2011 the information of the parents was complete (n MN or n dots). Both in 2010 and 2011, the numbers in the kits were larger, the more dots the parents had. So, selection in favour of increased numbers of nipples must be effective.

Table 6. Nipple dots in kits and mammary nipples (MN) in parents in 2010 and 2011.

Year	Number	number of MN parents or nipple dots kits			
2010	150 (old) females	9	8	6	4.5
	1000 kits	8^{a}	7.6^{b}	7.3^{c}	7.3^{c}
2011	200 females	8.7	8	7.3	6.3
	1,130 kits	8.4^{a}	8^{b}	7.6^{c}	7.3^{d}

$^{a\text{-}d}$ Groups with different letters are significantly differents at $P<0.05$.

Discussion

The results confirm earlier reports on the number of active mammary nipples. The variation in the numbers of nipples is about the same as reported by Pedersen (1978). Our correlations

between the numbers of parental nipple dots and those of their kits fits in the h2=0.53 reported by Fiedler and Siler (1977) and the development from dots to active nipples as described by Møller (1996, 2008) was seen as well.

The number of active nipples was positively correlated with some of the characteristics which determine the breeding results. Litter size and number of active nipples were positively correlated. The causal relationship is not fully clear, since suckling induces the transformation from nipple dots into nipples. Mortality was clearly less, the more nipples were available and active. If all females at Edelveen had a minimum of 7 active mammary nipples, 200 kits would have been saved per year. The weight of the kits slightly increased with the number of active nipples. Hence, it seems worthwhile to increase of the number of nipples.

Various information justify the conclusion that hereditary factors influence the number of nipples. Most convincing is of course the positive correlation of the mean number of the parental nipple dots with the number of the kits nipple dots. These correlations were already assessed by Fiedler and Siler (1977) and confirmed in this study. The fact that the number of active nipples of one female is rather consistent over the years supports the conclusion that the number of nipples is certainly not only determined by environmental factors.

All in all we conclude that it is worthwhile to select for more mammary nipples. In spite of the fact that some of our results are already known for decades, selection for nipples is hardly or not practised. Apparently, some practical problems have to be solved such as the variation in the number of dots of littermates. The next step at Edelveen is to solve the practical problems and to develop an effective way of working.

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