

# Effect of feeding level during autumn and winter on breeding weight and result in single and pair-housed minks

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The effect of feeding intensity (standard vs. restricted ration) and housing system (males and females kept singly vs. animals kept in male-female pairs) on breeding body condition and whelping was studied in farm standard mink (*Mustela vison*). Dietary interventions lasted from 20 September to 31 January. The maximum body weights of minks fed the standard ration were higher than those fed the restricted ration, and, the weights of animals housed in pairs were higher than those of animals housed singly. Daily feed intake was only slightly lower for singly-housed minks. Singly-housed females came on heat slightly later than females housed with a male. No statistically significant differences were found in whelping success due to feeding intensity or housing system. Whelping results tended, however, to be best for the females on restricted feeding and housed with a male (4.1 kits/mated female), and poorest for the females fed the standard ration but housed singly (3.4 kits/mated female). The conventional housing set-up, in which males and females are housed in pairs, is therefore recommended, but feeding from autumn onwards should be restricted.

*Key words:* breeding performance, farm mink, feeding regulation, grouping, obesity

## Introduction

After weaning, farm-raised mink kits (*Mustela vison*) are fed an energy-rich diet because high feeding intensity is usually considered necessary if they are to produce large furs of good pelt quality (Berg 1986). This practice often leads to obese animals in autumn and early winter. The reproductive success of fat minks, however, tends to be poor. High pre-mating live weights would

particularly increase the frequency of barren females and kit losses, thereby leading to smaller litters (Sanne and Åhman 1966, Jorgensen and Glem-Hansen 1972, Tauson 1985). Animals intended for breeding are therefore usually slimmed before the breeding season to what is considered good individual breeding condition. This can, however, result in impaired reproductive capacity, as observed in yearling mink females (Tauson and Alden 1984). Furthermore, it is not necessarily easy to achieve the intended

body condition as some animals respond poorly to rapid conditioning or flushing.

The mink exhibits pronounced sexual dimorphism, males being significantly larger than females (Iversen 1972, Moors 1980, Korhonen et al. 1983). Consequently, males consume more feed than females (Korhonen and Niemelä 1993). Minks are conventionally housed in male-female pairs until pelting, a housing arrangement that has been thought to guarantee normal growth and fur development. On the other hand, animals housed singly do not have to compete against their cage partners for feed. One would also expect it to be easier to regulate body condition by individual feeding of singly-housed animals (Korhonen and Harri 1990, Korhonen et al. 1990). Thus, irrespective of feeding intensity, the body condition of farmed minks would be affected by the housing arrangement within a cage.

The aim of our study was to establish, first, whether the need for intensive slimming before breeding could be eliminated by decreasing the feeding intensity of farmed minks from September onwards and, second, whether this practice would improve the breeding result. The comparisons were made between animals housed in pairs, that is, a male with a female, and animals kept singly.

## Material and methods

### General management

The experiments were carried out at the Fur Farming Research Station of Kannus, western Finland. Juvenile dark minks (standard genotype), all found to be plasmacytosis-negative according to the counter-immuno-electrophoresis test (Hansen 1974), served as experimental animals. The minks were housed in standard rearing cages, measuring 40 cm wide x 60 cm long x 40 cm high, in two-row sheds. A wooden nest-box (22 cm wide x 30 cm long x 40 cm high) provided with sufficient bedding was connected to each cage.

Water was freely available from an automatic dispenser system. The minks were weighed at monthly intervals.

### Experimental groups and feeding

Two feeding intensity levels were used: (1) a standard ration (S), with the amount of feed adjusted to conventional daily consumption (slightly lower than *ad libitum*), and (2) a restricted ration (R), amounting to 90% of the standard ration (see Fig. 1). The experimental feeding lasted from 20 September to 30 January. Thereafter, the experimental groups were fed at the same level (males 230 g/animal/day; females 150 g/animal/day). The freshly mixed mink feed was manufactured at a local feed kitchen (Kannus Minkinrehu Ltd.). The animals were fed 6 days a week at about 1 pm. Feeding was omitted on Sundays. Leftovers were collected and weighed on a group basis in order to calculate daily feed intake. The feed mainly consisted of slaughterhouse offal, fish and cereals, and its composition (Table 1) therefore met the conventional Scandinavian Standard Recommendations (Berg 1986).

Three sub-groups were formed within above feeding intensity levels: (1) females (N=72) housed singly throughout the study period (coded S1, R1), (2) males (N=42) housed singly throughout (coded S2, R2), and (3) males and females housed in pairs (N=72 couples) until 10 December, but thereafter singly (coded S3, R3). S in codes means standard feeding and R restricted feeding.

### Mating routines

The animals were mated between 7 and 23 March. Before the breeding season, the testicles of all males were palpated. Those with hypoplasia, that is, with very small or otherwise abnormal testicles, were excluded. All experimental females were left for breeding, but most of the males were pelted (only the number of males

Table 1. Dietary and chemical composition of feed in different months of the year (from September to March). DM=dry matter, ME=metabolizable energy.

	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Ingredient, %							
Baltic herring	25	30	30	10	15	10	10
Cod offal	5	5	5	25	20	35	35
Beef offal	21	10	10	10	22	10	10
Broiler offal	12	10	10	6	—	—	—
Cooked wheat/barley	19	25	25	15	10	10	10
Soybean oil	1	1.5	1.5	—	—	—	—
Dried protein mixture	4.7	—	—	6	5	5	5
Meat meal	—	4	4	—	—	—	—
Vitamins <sup>a)</sup>	1	1	1	1.5	1.5	1.5	1.5
Chemical composition							
DM, %	37.5	36.2	37.5	35.3	31.0	31.6	31.6
In DM, %							
Ash	7.5	8.5	7.7	8.6	9.1	11.0	10.9
Protein	31.4	31.4	28.7	32.1	37.0	37.7	41.1
Fat	18.0	17.5	17.9	15.0	14.1	16.7	16.8
Carbohydrates	43.1	42.6	45.7	44.3	39.8	34.6	31.2
ME, MJ/kg DM	17.2	16.9	17.2	16.3	16.1	16.4	16.8
Calculated % of ME from							
Protein	31.7	32.8	30.4	34.4	39.3	38.1	42.2
Fat	40.8	40.4	42.4	36.0	33.1	37.7	38.6
Carbohydrates	27.5	26.8	27.2	29.6	27.6	24.2	19.0

<sup>a)</sup>1 kg mixture contains: vitamin A, 500 000 IU; vitamin D3, 50 000 IU; vitamin C, 6000 mg; vitamin E, 4000 mg; vitamin K, 10 mg; vitamin B1, 1500 mg; vitamin B2, 600 mg; vitamin B12, 1 mg; choline, 2500 mg; pantothenic acid, 500 mg; nicotinic acid, 1000 mg; pyridoxin, 400 mg; folic acid, 50 mg; and biotin, 3 mg.

needed for breeding were left, i.e. 23 per group). Singly-housed animals were mated with each other, and, animals housed in pairs were mated only within the group. During the first weeks, females were mated according to the 1 + 8 system, but later they were remated the day after the first mating (Tauson 1985). For females that rejected mating, the date of exposure was recorded and another attempt was made within a few days. At whelping, the date of parturition and the numbers of live born and stillborn kits were recorded. The whelping result was calculated at birth and at 4 weeks.

### Statistics

Statistical analyses were made using procedures (GLM procedure, NPARIWAY procedure) described by SAS Institute Inc. (1990). Animal live weights were analysed for effect of treatment group. The effects of feeding level and housing system on whelping results were tested by two-way analysis of variance. The whelping results of two groups were compared using the Mann-Whitney U-test. The results are presented as means and standard deviation (SD).

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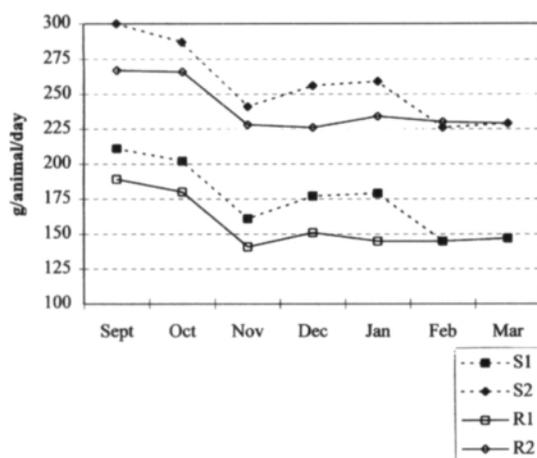


Fig. 1. Food intake of singly-housed minks. S = standard ration, R = restricted ration. 1 = ♀, 2 = ♂.

## Results

### Feed consumption

The feed intake of the animals housed in couples (from 20 September to 10 December) tended to be slightly higher (S3: +1.8%, R3: +3.5%; not significant) than the calculated value of two separate individuals housed singly. The feed consumption of the treatment groups declined during a 2-week-long cold spell in November, but increased during a period of high ambient air temperatures from December to mid-January (Fig. 1). After mid-December when all experimental animals were kept singly in their cages,

no marked differences in feed consumption were detected between the groups. During the entire winter period, the feed consumption rates in the female groups, S1, S3, R1 and R3, were 806, 803, 752 and 763 kJ ME/animal daily, respectively, and in the male groups, S2, S3, R2 and R3, 1227, 1243, 1192 and 1203 kJ ME/animal daily, respectively.

### Body weight development

Animal live weights are shown in Figs. 2 and 3. Males fed the standard ration reached their maximum body weights in October (8 Oct). The body weights of singly-housed males (S2) were then lower ( $2096 \pm 151$  g; mean  $\pm$  SD) than those of males housed with females ( $2233 \pm 164$  g). Breeding body weights (March 3rd) were about equal in S2 males ( $2060 \pm 139$  g) and S3 males ( $2107 \pm 187$  g). Males on restricted feeding were heaviest in November, when R2 males were somewhat lighter ( $2027 \pm 112$  g) than R3 males ( $2152 \pm 201$  g). At the beginning of March, the animals of both groups had similar live weights (R2:  $1993 \pm 141$  g, R3  $1982 \pm 167$  g).

The body weights of all the female groups were at a maximum in October (S1:  $1096 \pm 143$  g and S3;  $1150 \pm 128$  g, R1:  $1025 \pm 92$  g and R3:  $1062 \pm 122$  g). Singly-housed females were slightly lighter than females housed with males. The breeding body weights (3 March) of females fed the standard ration were equal (S1:  $1025 \pm 136$  g vs. S3:  $1036 \pm 130$  g). A similar result was found between females in restricted feeding groups (R1:  $896 \pm 136$  g vs. R3:  $909 \pm 146$  g).

Table 2. Mating results of treatment groups. S = standard ration, R = restricted ration. 1 = singly-housed, 3 = housed in pairs. N = number of animals. Animals were mated between 7 and 23 March.

Group	Mean mating date	Breeding ♀		Mated ♀	
		N		N	%
S1	15 March	69		65	94.2
S3	13 March	71		70	98.6
R1	15 March	70		69	98.6
R3	13 March	69		68	98.6

### Reproductive performance

Mating routines proceeded normally, and females whelped at the end of April or in the first half of May. Singly-housed females (S1, R1) came into oestrus slightly later than females housed with males (Table 2). The percentage of females mated was lowest in the S1 group (Table 2).

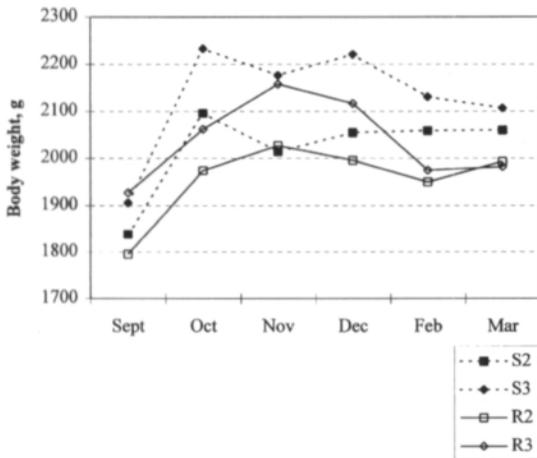


Fig. 2. Weight trend of male minks. S = standard ration, R = restricted ration. 2 = singly-housed, 3 = housed in pairs. Note that January is omitted from Figures 2 and 3 because there were no weighings.

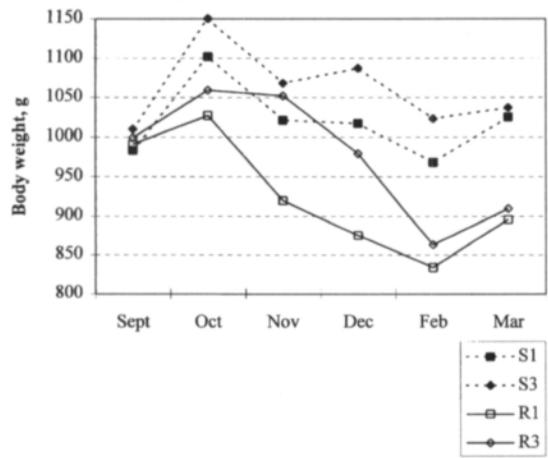


Fig. 3. Weight trend of female minks. S = standard ration. R = restricted ration. 1 = singly-housed, 3 = housed in pairs.

The reproductive performance of the animals was rather poor in general. There were no statistically significant differences in whelping results (kits/mated female) between dietary groups (S: 3.5 kits vs. R: 3.9 kits) or housing system (singly: 3.5 kits vs. couples 3.9 kits). The best whelping result was for females housed with a male and fed restrictively (R3: 4.1 kits); the poorest whelping result was for singly-housed females fed standard rations (S1: 3.4 kits) (Table 3).

## Discussion

Regulation of the farm mink's breeding body condition by feeding interventions may not be easy in practice. One crucial problem is the great variation in temperatures between months and between years under out door conditions. Cold winters are known (Korhonen et al. 1989) to cause eating problems from time to time. The

Table 3. Number of females and reproductive results. S = standard ration, R = restricted ration, 1 = singly-housed, 3 = housed in pairs.

	S1	S3	Total	R1	R3	Total
Breeding ♀	65	70	135	69	68	137
Whelped ♀	46	48	94	51	57	108
Kits lost	3	—	3	1	2	3
Barren ♀	17	22	39	16	10	26
Kits: at 4 wks	223	255	478	249	282	531
per mated ♀	3.4	3.6	3.5	3.6	4.1	3.9
per whelped ♀	5.2	5.3	5.3	5.0	5.1	5.1

stomach volume of the male mink is about 50–70 ml, and can hold no more than 75 g of fresh feed at once. In fact, the mink eats on average 13 times in a 24-hour period during the winter (Korhonen and Niemelä 1993). Thus, feed offered at temperatures below  $-10\text{...}-15^{\circ}\text{C}$  quickly becomes so firmly frozen that the mink cannot consume it all (Korhonen 1990) and inevitably loses weight before breeding. Moreover, when the ambient air temperature falls to  $-10^{\circ}\text{C}$ , the mink has to double its metabolic rate, which further increases the mobilization of body fat (Korhonen et al. 1983). If, however, the winter is mild, minks often become too fat despite efforts to restrict their daily feed intake. In the present study, the marked changes in ambient air temperatures (cold period in November vs. warm period in December–mid-January) clearly affected the feed intake of the animals. The cold period in November was also the main reason why maximum body weights were already reached in October. During mild winters, maximum body weights are usually achieved later (Korhonen et al. 1989, Korhonen 1990). Thus, the outcome of conditioning farm mink varies because of yearly and short-term changes in climatic conditions.

The energy expenditure of the mink has been shown to increase by about 40% when the ambient air temperature falls from  $+20$  to  $0^{\circ}\text{C}$  (Chwalibog et al. 1980). A nest is therefore necessary for the mink, particularly during the winter. It can decrease the lower critical temperature of the mink by about  $10\text{--}15^{\circ}\text{C}$  (Korhonen and Harri 1984), and so provides marked energy savings. The insulation provided by the nest depends on (1) the bedding material, and (2) the number of animals in the nest. The expected energy costs for singly-housed minks are thus higher than those for mink couples. The same assumption can be made on the basis of the results of Alden and Tauson (1979), for instance, who found that animals housed alone used more energy for thermoregulation and therefore less energy for growth than those housed in pairs. This conclusion was also confirmed by our present finding that minks housed in male-female pairs had

markedly higher body weights than singly-housed animals during October–December.

Weight loss, from maximum body weight to breeding weight, in female farm minks has been shown to vary from 9% to 25% (Charlet-Lery et al. 1984, Korhonen 1990). Excessively high weight loss before breeding can impair the whelping result (Backus 1982, Tauson and Alden 1984). Moreover, females that are still obese at the onset of the breeding season, often tend to have poorer whelping results than normal size females. Wenzel and Schicketanz (1980) found that females fed restrictively from October onwards had better whelping success than those fed intensively, a finding that was also supported by the results of Tauson and Alden (1984). In our study, no significant whelping difference was noted between animals on restricted and standard feeding, although there was an observable tendency for a better whelping result on the restricted treatment. However, the weight loss of females on restricted feeding was higher (13.4%) than that of animals on the standard ration (8.2%). The most probable reason why the difference in whelping results between our experimental groups was not significant was that feed was not restricted sufficiently from February onwards and/or the restriction was not total individually. Thus, the planned goal for body condition was not fully achieved.

According to normal farming practice, minks are raised in male-female pairs until pelting. Our results showed that minks grow best in this conventional housing arrangement. This conclusion is consistent with the findings of Shackelton et al. (1977) and Alden and Tauson (1979) that animals reared singly do not grow as well as those kept in pairs. Furthermore, Möller (1991) found that separation of pastel kits from September onwards resulted in a lower weight at pelting and a shorter skin length than in animals raised in pairs. In our study the best whelping result was achieved with pair-housed females. A parallel conclusion was drawn in the study of Heller and Jeppesen (1980), namely, that the level of sexual performance was higher in group-housed than in singly housed females. It can therefore be

concluded that the conventional housing set-up, in which males and females are housed in the same cage, can continue to be recommended for use on farms.

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## SELOSTUS

### Syys- ja talviruokinnan vaikutus yksin ja pareittain kasvatettujen minkkien lisääntymistulokseen

Hannu Korhonen ja Paavo Niemelä

*Maalouden tutkimuskeskus*

Tutkimuksen tarkoituksena oli selvittää miten kaksi erilaista ruokintatasoa (normaali vs. 10 % rajoitettu) vaikuttaa yksin ja pareittain (uros ja naaras) kasvatettujen minkkien siitoskuntoon ja pentutulokseen. Ruokintajärjestelyt kestivät syyskuun 20 päivästä tammikuun loppuun. Pareittain olleet eläimet siirrettiin erilleen joulukuun 10 päivä. Tulosten mukaan normaalisti ruokittujen minkkien maksimipainot olivat suuremmat kuin rajoitetulla ruokinnalla olleiden. Vastaavasti pareittain kasvatettujen minkkien painot olivat suuremmat kuin yksin kasvatettujen. Yksinkasvatettujen minkkien rehunkulutus oli hieman alhai-

sempi kuin pareittain kasvatettujen. Yksinkasvatetut naaraat tulivat kiimaan hieman pareittain kasvatettuja myöhemmin. Ruokintataso ja kasvatustapa eivät vaikuttaneet lisääntymistulokseen, mutta tiettyä suuntausta kyllä ilmeni. Pentutulos oli paras rajoitetusti ruokituilla pareittain kasvatetuilla naarailla (4,1 pentua/paritettu naaras) ja huonoin normaaliruokituilla yksinolleilla naarailla (3,4 pentua/paritettu naaras). Tämän tutkimuksen perusteella paras lisääntymistulos saadaan perinteisellä tarhaustavalla missä uros ja naaras kasvatetaan yhdessä nahkontaan saakka.