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Research Note

Comparison of two breeding systems for timing of whelpings in farmed silver foxes

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Two principally different mating systems are practised for farmed silver foxes. In the traditional system the breeding females are kept all the time in cages well separated from each other. In the Nordic system, on the other hand, the breeding females are transferred prior to mating time into a separate shed where they are placed close to each other and sometimes males are put among them. After artificial insemination (AI) or natural matings, the females are transferred in the mating order to new cages. The condensed premating grouping is assumed to enhance the effect of air-borne male and female pheromones leading to a more intense and synchronised heat development. In this study these two systems were compared for timing and synchrony of parturitions. In contrast to the working hypothesis, date of whelpings were positively skewed with a great kurtosis in the traditional system, an indication that the majority of deliveries occurred during a short period and at the beginning of the season. On the other hand, in the Nordic system the whelpings were more uniformly distributed over the whole season and the peak was later. The results show that the most recent system, although widely used, is not necessarily the only possible alternative but other alternatives should also be considered.

Key words: fur farming, housing, mating system, vixens

Introduction

At the earliest stage of fox farming it was a common practice to keep silver foxes in a large communal enclosure. It soon became evident that individual apartments were needed for each fox family. Recognising that foxes are monogamous by nature, pair mating became standard practice and the breeders were left together throughout most of the year (Forester and Forester 1973). The next stage was a double mating system in which a male pen was placed between two female breeding pens (Smith 1928). After weaning the pups were transferred into separate pelting sheds. The development soon led to a polyg-

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amous mating system in which males were housed apart from females and they were taken to the females' pens for mating purpose only (Smith 1935).

The basic structure of the housing design has stagnated to this level in many fur producing countries, e.g. in Canada and Eastern-Europe. However, mainly in the Nordic countries, the development has progressed further, stimulated by the adoption of artificial insemination (AI) during the 1980s (Jalkanen and Joutsenlahti 1988). In the most recent system females are placed at least one month before the mating time as closely as possible to each other in neighbouring cages with some breeding males among them. The condensed grouping is assumed to enhance the effect of air-borne male and female pheromones leading to a more intense and synchronised heat development. After AI or natural matings, the females are transferred in the mating order to new cages. This is both practical and, in addition, the parturitions of neighbouring vixens are expected to take place synchronously and they may disturb each other less than if giving birth at a very different time.

It has also been suggested that the most recent housing environment deviates too far from the basic biology of the species. In nature red foxes establish their territory already in autumn and defend it fiercely against conspecifics. Within a group of several females most commonly only the dominant female rears cubs (Macdonald 1979, 1980; von Schantz 1981, 1984). There is evidence that dominance relationships function on farms between individuals of neighbouring cages as well, with vixens with higher competition capacity than their neighbour having a better reproductive performance (Bakken 1993). Thus a new cage and a new neighbour after mating means that the foxes have to establish a new territory and a new social hierarchy, all of which are already established for wild foxes well before this time.

The aim of the present study was to compare traditional housing of breeding females yearround in one and the same breeding cage separated from each other with the Nordic system in which all breeding females are placed close to each other before the breeding time followed by transfer to the new cage after mating. Since comparison of reproductive parameters between different farms is difficult due to different mating systems, natural vs. AI, number of matings, skill of farmer, time when the cubs are counted post partum etc., the main focus in this study was on the distribution of the mating time. We hypothesise that if pheromones play a role in heat development, the heats of vixens are expected to be more synchronised and more condensed at the beginning of the season in the Nordic mating system.

Material and methods

The present data were extracted from the database of the Fur Unit of the Nova Scotia Agricultural College, Truro, Canada and the Fur Animal Research Station of the University of Kuopio, Finland. Both these farms are experimental farms of about the same size (about 50 breeding females each) with computerised databases for reproduction data. Instead of mating time we report here the date of parturition, because gestation time is constant at 52–53 days in silver foxes and because a successful delivery implies that the timing of mating or AI, whether once or several times, has been correct and that feed, despite possible differences between countries, has been adequate to support pregnancy.

In Truro the breeding females are housed singly in outdoor wire-mesh cages, 160 x 107 x 74 cm, primiparous vixens after pelting season in December and multiparous vixens since their previous season(s). The cages are outdoors in 5 rows, with about 120 cm apart from each other and about 270 cm from the next row. The cages have wire mesh roof, and wire mesh walls, but the vixens have access through a 50 cm long tunnel to the anteroom of their nest boxes yearround and to the main room about 2 weeks before their expected day of parturition. Double-

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walled nest boxes are situated outside the cages. Breeding males are kept singly in wire mesh cages, equipped with wooden platforms but no nest boxes and covered with an opaque roof. The male cages are situated at least 5 m apart from the closest female cages and several tens of meters from the farthest. Natural mating is used preferably for all vixens, AI is being practised as an exception. For mating the vixens are usually transferred to the cage of the selected male, but they are returned to their home cage after the mating has been taken place.

In Kuopio all breeding females are transferred into two cage-row sheds in adjacent wire-mesh cages (105 x 115 x 70 cm) during the last week of December. One breeding male is placed into a wire-mesh tunnel on the back-wall of the female cages of the whole row. The sheds are covered with a roof but they do not have walls. Vixens are mainly mated using AI. After insemination, the females are transferred in the insemination order into two-cage row breeding sheds placing them in every other cage. Nest boxes are placed into the neighbouring cage of each female cage about three weeks before the expected day of parturition.

In Truro the cubs born are counted as soon as parturition has been noticed. In Kuopio the first inspection of nest boxes takes place more irregularly during the first week post partum. To allow comparison of the distribution of the dates of parturition, the data for each parity, farm and year medians for each group were adjusted to 100. Frequency distributions between the groups were tested using chi-square test. Multiparous vixens include several age classes older than 2 years.

Results and discussion

During all three years of study primiparous vixens delivered their cubs later than multiparous ones and for both age groups deliveries took place several weeks earlier in Truro than in Kuopio (Table 1). There were also some random variation between the years. The earlier breeding season in Truro compared with Kuopio is independent of the different mating systems used on these farms. It is known that in nature the timing of breeding season in red foxes depends on the total number of daylight and twilight hours from the 16-h isohel to the date of onset of breeding (Lloyd and Englund, 1973). Most probably the same mechanism operates in farmed silver foxes as well. As Truro is located at a much more southern latitude (45°N) than Kuopio (63°N), this difference is expected.

Table 1. Date of whelping in primiparous and multiparous silver fox vixens during three consecutive years on Truro and Kuopio experimental farms.

Year & location	Date of whelping, days from January 1			
	Primiparous	N*	Multiparous	N*
1995				
Truro	99.9±10.3	10	96.8±5.8	16
Kuopio	139.7±8.4	13	130.7±9.6	16
1996				
Truro	105.5±11.4	10	98.3±7.1	22
Kuopio	137.3±6.6	19	128.6±8.2	29
1997				
Truro	110.3±9.9	15	102.8±10.6	18
Kuopio	135.5±8.9	23	117.0±7.6	26

* Number of vixens that gave birth to a litter

Table 2. Timing and duration of whelping season in primiparous and multiparous silver fox vixens on Truro and Kuopio experimental farms.

	% of vixens whelped, date*					5–95 %	25–75 %	Kurtosis	Skewness
	5	25	50	75	95	days	days		
Primiparous vixens									
Truro	82.5	91.5	100	110.5	117.5	35	19	-0.77	0.12
Kuopio	85	93	100	106	113	28	13	-0.62	-0.19
Multiparous vixens									
Truro	91	94.5	100	107	115	24	12.5	1.52	1.01
Kuopio	86	94	100	103	117	31	12.0	0.07	-0.12

* 50 % of whelpings adjusted at 100

The Truro data for multiparous vixens was positively skewed with a great kurtosis, an indication that the majority of deliveries occurred during a short period and at the beginning of the season (Table 2, Fig. 1). On the other hand, the Kuopio data for multiparous vixen was more uniformly distributed over the whole season and the peak was later ($P<0.001$ vs. Truro data, chi-square). The dates of parturition for primiparous vixens were distributed more widely than for multiparous vixens (low kurtosis) but the majority of deliveries in Truro occurred at the beginning of the season while in Kuopio the peak tended to be later ($P>0.05$, chi-square). The somewhat wider distribution of the dates of parturitions in Truro as compared with Kuopio is due to the fact that in Kuopio those primiparous vixens having late heat were not mated or inseminated at all.

In Kuopio data the litter size (y) tended to decrease towards the end of the season (x, days from January 1): $y = 10.2–0.059x$ ($R^2=0.072$, $P=0.047$) for primiparous vixens. The trend was not significant for multiparous vixens ($y=6.9–0.024x$, $R^2=0.025$, $P=0.184$). In Truro data no such trend was observed: $y=6.5–0.012x$ ($R^2=0.006$, $P>0.05$) and $y=0.08x+4.7$ ($R^2=0.001$, $P>0.05$) for primiparous and multiparous vixens, respectively.

Mean litter size (±SD) tended to be higher in Truro than in Kuopio both among primiparous vixens (5.2±1.6 vs. 3.8±1.8) and among multiparous ones (5.5±1.9 vs. 4.6±1.5, respectively). However, these figures should be interpreted

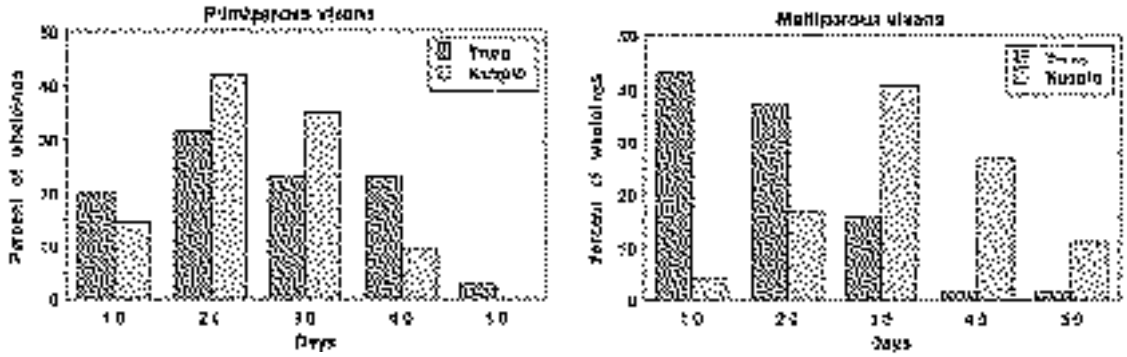

Fig. 1. Timing of whelpings in primiparous (left) and multiparous (right) vixens in decades from the date of first whelping in Truro (Canada) and in Kuopio (Finland).

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with caution as the inspection of cubs born took place at an earlier stage post partum in Truro than in Kuopio, and thus more cubs could have been lost in Kuopio before the counting.

The present results do not support the hypothesis that grouping the breeding females close to each other before the breeding season results in a more intense and synchronised heat development than placing them more apart. Rather the opposite conclusion can be drawn. In Truro the parturitions of multiparous vixens (and accordingly matings 52 days before that) took place during a shorter period than in Kuopio and with a peak at the beginning of the season. In primiparous vixens the peak was also earlier in Truro than in Kuopio. The results of Smeds and Ojala (1991) with a larger number of vixens than in the present study confirm that on the average silver foxes giving birth at the beginning of the season have larger litters than ones giving birth later. Thus regarding reproductive performance, an early peak of whelpings has an advantage over the later peak.

In the 1930s it was regarded absolutely necessary that the breeding males were separated from any female at least one month before the breeding season (Smith 1935). Furthermore, it was not advisable to attempt to mate foxes housed in adjacent pens if they had not been running together. It was thought that antagonism developed between these foxes whether they were males or females. This practice still holds true in Canada and some East-European countries. In the Nordic countries today, it is regarded absolutely as necessary to place breeding males among the breeding females to stimulate their heat. Neither of these practices is based on scientific evidence. To our knowledge, no systematic research work has been carried out to map advantages and disadvantages of either system but all experiments are generally carried out within a given system. This work is the first comparative study between these two practices. The results show that more such studies are warranted.

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References

Bakken, M. 1993. The relationship between competition capacity and reproduction in farmed silver-fox vixens, Vulpes vulpes. Journal of Animal Breeding & Genetics 110: 147–155.

Forester, J.E. & Forester, A.D. 1973. Silver fox odyssey. History of the Canadian silver fox industry. The Canadian Silver Fox Breeders Association and the Prince Edward Island Department of Agriculture and Forestry, Irwin Printing, Charlottetown, P.E.I. 45 p.

Jalkanen, L. & Joutsenlahti, U. 1988. Present and future use of artificial insemination in fox breeding in Finland. In: Murphy, B.D. & Hunter, D.B. (eds.) Biology, Pathology and Genetics of Fur Bearing Animals. University of Saskatchewan Press, Saskatoon. p. 64–68

Lloyd, H.G. & Englund, J. 1973. The reproductive cycle of the red fox in Europe. Journal of Reproduction and Fertility, Supplement 19: 119–130.

Macdonald, D.W. 1979. Helpers in the fox society. Nature 282: 69–71.

– 1980. Social factors affecting reproduction amongst red foxes, (Vulpes vulpes L., 1758). Biogeographica 18: 123–175.

Smeds, K. & Ojala, M. 1991. Rävens fruktsamhetsegenskapers arvbarhet. NJF-Utredning/rapport nr. 70: 15–20.

Smith, G.E. 1928. Experimental fox ranch, Summerside, P.E.I. Report of the superintendent for the years 1926 and 1927. Dominion of Canada, Department of Agriculture, Dominion Experimental Farms, Ottawa. 59 p.

– 1935. Experimental fox ranch, Summerside, P.E.I. Progress report of the superintendent for the years 1931, 1932, 1933 and 1934. Dominion of Canada, Department of Agriculture, Dominion Experimental Farms, Ottawa. 57 p.

Von Schantz, T. 1981. Female cooperation, male competition, and dispersal in red fox, Vulpes vulpes. Oikos 37: 63–68.

– 1984. Carnivore social behaviour – Does it need patches? Nature 307: 388–390.

SELOSTUS

Vertaileva tutkimus kahden paritusjärjestelmän vaikutuksista tarhattujen hopeakettujen penikoimisten ajoittumiseen

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Tarhatuilla hopeaketuilla on käytössä kaksi erilaista paritusjärjestelmää. Perinteinen tapa on pitää siitosnaaraat koko ajan omissa yksikköhäkeissään, jotka sijaitsevat selvästi erillään toisistaan. Pohjoismaisen käytännön mukaan siitosnaaraat siirretään ennen parituskautta lähelle toisiaan ja usein niiden joukkoon sijoitetaan koiraita. Parituksen jälkeen naaraat siirretään paritusjärjestyksessä penikoimishäkkeihin. Pohjoismaisen käytännön otaksutaan stimuloivan ja aikaistavan naaraiden kiimaantuloa. Tässä tutkimuksessa verrattiin penikoimisen ajoittumista perinteistä paritusjärjestelmää käyttävällä Nova Scotia Agricultural Collegen (NSAC, Truro, Kanada) tarhalla ja pohjoismaista järjestelmää käyttävällä Kuopion yliopiston koetarhalla. Penikoimistiedot kerättiin molemmilta tarhoilta vuosien 1995–1997 ATK-rekistereistä. Vertailu osoitti, että hopeaketun penikoimiset ruuhkautuivat lyhyelle aikavälille ja lisääntymiskauden alkuun perinteistä järjestelmää käyttävällä NSAC:n tarhalla, kun taas pohjoismaista järjestelmää käyttävällä Kuopion yliopiston tarhalla penikoimiset ajoittuivat pitemmälle aikavälille ja niiden painopiste oli kauden lopussa. Ero oli merkitsevä vuotta vanhemmilla naarailla. Vaikka eri tarhojen vertailu onkin vaikeaa, tulokset osoittavat, ettei pitkään harrastettu käytäntö ole ainoa mahdollinen ja rohkaisevat kokeilemaan muunlaisia käytäntöjä.