

Seasonality in the reproductive activity of male chinchillas on a breeding farm in the climatic conditions of southern Poland

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Farmed chinchillas continue to have very low fertility and prolificacy, although the reproductive potential of females is much higher and can be exploited. An increasing number of studies deal with the specific nature of reproduction in this species, with particular focus on female fertility. However, there is a lack of analyses and studies of males. Therefore, this study has attempted to determine the impact of the season of the year on the reproductive activity of male chinchillas and on the results of their use for breeding in the period from January 1991 to December 1996. The analysis was conducted on farmed animals on one of the largest farms in Poland. The farm was established in 1991 with an initial foundation stock of about 150 females and 25 males. Breeding was based on animals imported from a reputable farm in Germany, from which modern breeding technologies were adopted as well. Polygamous breeding with 6 females per male is used. Sexual activity was varied between years. Taking into account the entire foundation stock, an average of 8.15 litters and 14.77 pups were obtained per male per year. Analysis of five selected males revealed higher values: the mean number of litters ranged from 7.13 to 11.8 and the litter size ranged from 1.9 to 2.59. Thus, better utilization of males for breeding is possible on chinchilla farms. The system of keeping a male with many females at the same time enables strict selection of males.

KEYWORDS: chinchillas / males / seasonality / reproduction

Intensive growth of battery farming of chinchillas has been observed in Poland for many years. The increased interest in these animals is due to the high prices obtained for their skins. The most important functional features of chinchillas, determining the profitability of farming, include fertility and prolificacy [10]. The goal of every breeder is to obtain the best reproduction results. On farms in Poland, however, the number of chinchillas born and reared in a year is still not very high; an average of 1.6-2.5 kits are obtained per female, which cannot be considered fully satisfactory [15]. Research by Szeleszczuk et al. [22]

and Seremak and Sulik [15] has shown that reproduction in female chinchillas depends on climatic conditions, and above all on the light and temperature in the breeding facilities.

Prolificacy and seasonality in the reproduction of these animals have been the subject of numerous analyses and studies. Factors influencing the prolificacy of various colour varieties [18, 19], breeding use [20] and intensity of use [12] have been analysed, but the research has always covered females alone. Apart from a few exceptions [16], there have been no studies analysing the influence of the male on the breeding results of farmed female chinchillas.

Therefore, a study was undertaken to determine the effect of the season of the year on the breeding activity of male chinchillas on a breeding farm. The study took into account only the first years after the establishment of the farm.

Material and methods

Located in the Małopolska Voivodeship, the farm was established in 1991 and is one of the largest in Poland. Breeding was begun from a foundation herd of 150 females and 25 males, imported from a renowned farm in Germany, from which modern breeding technologies were adopted as well. From the beginning of the farm's operation, the animals were subject to assessment and supervision by the National Animal Breeding Centre in Warsaw. In 1996, the farm attained the status of a breeding farm. The total number of animals in the period analysed, including young, ranged from 200 to 2,300. Polygamous breeding is used on the farm, with 6 females per male. The animals are kept in closed, ventilated rooms with a constant temperature of 18-20°C and access to natural light. Additional 12-hour artificial light is used as well. Double cages joined by a corridor for males are equipped with a feeder, drinkers and a dust bath. The animals have permanent access to complete pelleted feed, water and hay. There are also chew blocks in the cage.

The subject of the research was the breeding performance of farmed male chinchillas (*Chinchilla lanigera*). Breeding documentation including whelping dates from 1 January, 1991 to 30 April, 1997 was analysed. On the basis of the whelping date, the most likely dates of mating were estimated. Then, after preparing tables and graphs in Microsoft Excel, the seasonality of the sexual activity of male chinchillas and their breeding performance were analysed, i.e. the number and size of litters and the number of reared young obtained from the male per year. The data for 20 genetically homogeneous males of the foundation herd, derived from one German breeding line and of a similar age, were analysed in detail.

The influence of the year and the calendar month on the reproductive activity of male chinchillas was examined by two-way analysis of variance using the GLM procedure in the SAS/STAT package [14]. The feature tested was the number of successful matings by the male during the month. The value of the feature in each year and calendar month was illustrated by least-squares means (LSM) [14]. The standard errors (SE), defining the reliability of the estimates, were given as well. Significance of differences between means was tested by the Tukey-Kramer test.

Results and discussion

Data from the breeding documentation were used to analyse the reproduction results of all females on the farm from January 1991 to April 1997. During this period, a total of 3,183 litters were obtained from 1,050 females. Probable dates of mating were calculated based on the whelping dates given in the breeding documentation, assuming that gestation lasts an average of 112 days. A harem mating system is used in breeding of farmed chinchillas, and copulation occurs most often at night or in the early morning. The distribution of the total number of successful matings on the farm in each month is presented in Table 1.

Table 1

Number of females mated in each calendar month in successive years of breeding exploitation of males in the breeding herd

Year	Number of matings												Total
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1991	15	26	23	12	14	19	7	3	4	12	24	16	175
1992	38	45	41	34	39	32	21	16	6	14	75	67	428
1993	42	40	74	65	83	45	54	52	44	32	63	83	662
1994	67	72	58	61	73	93	49	39	29	55	67	47	710
1995	70	47	35	24	18	72	56	42	36	45	74	80	599
1996	61	58	56	86	59	33	34	22	16	19	38	112	594
Total	293	288	287	282	286	294	221	174	135	177	341	405	3183

Analysis of the data in Table 1 shows that the number of mated females increased each year, due to the gradual increase in the size of the foundation herd, primarily with animals bred on the farm itself. The most successful matings occurred between November and June. A particularly pronounced increase in matings occurred in December – a total of 405 females. The number of matings was significantly lower from August to October (135-177 females), which indicates low sexual activity of male chinchillas on the farm during this period.

As mentioned above, chinchilla breeding on the farm was initiated with the purchase of animals from a renowned large German farm. Table 2 presents the breeding performance results of 20 genetically homogeneous males imported from Germany, which were the basis for chinchilla breeding on the farm. Detailed statistical analysis was performed for the influence of the year and the calendar month on the number of successful matings by males of the German line.

The statistical analysis showed that the year of the male's exploitation on the farm did not significantly affect this feature (Table 3). In a study by Socha et al. [19], no statistically significant effect of the year of whelping on reproductive results was demonstrated.

Table 2

Number of females mated in each calendar month in successive years of breeding exploitation of males of the German line

Year	Number of matings												Total
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1991	15	26	19	12	14	19	7	3	5	11	24	16	171
1992	20	26	30	18	13	15	10	7	3	7	31	26	206
1993	15	17	29	15	24	12	21	15	11	7	18	36	220
1994	23	32	28	23	18	14	8	11	5	4	23	16	205
1995	19	10	10	5	3	22	19	7	2	1	14	23	135
1996	7	10	11	11	6	9	4	2	2	4	11	30	107
Total	99	121	127	84	78	91	69	45	28	34	121	147	1044

Table 3

Least square means with standard errors (SE) for the number of matings in each year of use of males of the German line

Year	Number of matings per month	
	LSM	SE
1991	1.51	0.08
1992	1.48	0.07
1993	1.59	0.07
1994	1.56	0.08
1995	1.44	0.09
1996	1.45	0.10

In the period analysed, the calendar month had a statistically significant effect on the reproductive activity of males on the farm (Table 4). The fewest matings occurred in September and October and the most in February and March and again in November and December (Table 5).

Table 4

Frequency distribution of matings of males of the German line in each month of 1991-1996

Calendar month											
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
% matings											
9.48	11.59	12.16	8.05	7.47	8.72	6.61	4.31	2.68	3.26	11.59	14.08

The number of matings in September differed statistically significantly from the number of matings in February and March and in November and December. The number of matings in October was significantly different from the number of matings in February and December (Table 5).

Table 5

Least square means with standard errors (SE) for the number of matings of males of the German line in each calendar month

Calendar month	Number of matings per month	
	LSM	SE
I	1.55 ^{ab}	0.10
II	1.88 ^a	0.10
III	1.66 ^{ac}	0.10
IV	1.49 ^{ab}	0.11
V	1.42 ^{ab}	0.11
VI	1.52 ^{ab}	0.11
VII	1.46 ^{ab}	0.12
VIII	1.31 ^{ab}	0.14
IX	1.01 ^b	0.16
X	1.20 ^{bc}	0.16
XI	1.72 ^{ac}	0.10
XII	1.86 ^a	0.09

a, b, c – means with different letters differ significantly at $p \leq 0.05$

Jarosz and Rzewska [9] report similar intensity of mating, but they consider January and February to be the main months of sexual activity in male chinchillas. In a study by Gromadzka-Ostrowska [7], the breeding season lasted from November to April, with increased mating in March, and therefore the most kits were born in July. According to Barabasz [1], the breeding season on Polish farms extends from November to June, while Szeleszczuk et al. [22] found that it lasted from November to January and then from April to October, as evidenced by two peaks in births. Felska-Błaszczuk [5] considered November, December and January to be the most important months of the breeding season. According to the author, sexual activity was lower in the summer, as evidenced by the small number of whelpings in autumn. In the mountainous Andes, which are chinchillas' natural environment, increased sexual activity is observed between April and September. Seasonality of breeding cycles serves to ensure the young the best possible climatic and dietary conditions after birth. In the northern hemisphere, this period is reversed by 6 months [21].

The spermatogenesis process in males of all species is affected by seasonal changes in ambient temperature, as well as day length [9], as the lengthening photoperiod affects the hypothalamic–pituitary–gonadal axis, suppressing the secretion of melatonin, and then stimulating neurons involved in GnRH secretion. Spermatogenesis should last all year,

and until recently it was believed to occur at the same rate every month. Histological examination of viscacha testes by Morales and Cavicchia [13] contradict this theory. They observed differences in the histological image of the testes from the period of completed spermatogenesis (June) and during testicular regression (August). These results indicate seasonality in the reproduction of males of the suborder *Hystricomorpha*, to which the chinchilla is related. A study by Szeleszczuk et al. [23] also showed marked seasonality in the concentration of spermatozoa in the gonads of sexually mature male chinchillas, both in the testes and the epididymis. Seasonal changes in the reproductive system are also confirmed in a study by Surmacki et al. [21] analysing the Leydig cells of male chinchillas. These cells actively influence the seasonality of reproduction by regulating the production and secretion of testosterone. During the period of the highest male reproductive activity (from June to October), Leydig cells were found to be larger and to have a polygonal shape and small vacuoles, which may indicate increased testosterone secretion in this period. In contrast, in the period when the males are less active, the cells and their testes become smaller and more oval. In a study by Cepeda et al. [3], testosterone in the blood of male chinchillas reached its maximum level in April, May, June and August, and was lowest in January, February and July.

In battery farm breeding of chinchillas, breeding exploitation of males determines the quantity and quality of skins as the final product. During the breeding period males seek out females in oestrus, deciding in this way, without the intervention of the breeder, on the time of mating. Thus the selection of fertile breeding males is particularly important, as infertile individuals may cause breeders to incur significant financial losses, especially in the case of the harem system and the degree of polygamy used on battery farms (1:4-8).

Strict selection is used on the farm analysed when choosing a male for a breeding group. The size and build, colour type, and the colour purity and quality of the coat are assessed. The most important aspect of this assessment, however, is the results of their breeding performance. Only those males that produce a large number of litters and kits in a year remain in the breeding herd. Males with low reproductive rates are replaced by new ones.

The next stage of the analysis of the breeding documentation in the research was the assessment of the reproductive performance of the foundation herd on the farm, calculated per male of the foundation herd. The results are shown in Table 6.

Theoretically, 10 to 15 litters per year should be obtained from one breeding male kept in a polygamous system together with 6 females, assuming that 2 to 2.5 litters per year are obtained per female. Only some individuals achieved this result. On average, 8.15 litters per year were obtained per male, which in practice can be considered a satisfactory result, indicative of their good breeding condition (Table 6). The number of successful matings by a male varies from 1 to 18 per year, most often ranging from 6 to 12 per year. Individuals from which a dozen litters per year are obtained are considered extremely valuable in breeding.

In a study by Seremak and Sulik [16], 4.65 litters were obtained per male per year in a 1:4 polygamous system. The average period of male exploitation in the study was 2.75 years. Calculated per female per year, only 1.16 litters per male were obtained. In our stu-

Table 6

Breeding exploitation of male chinchillas in the first years of breeding 1991-1996

Year	Number of males	Mean number of litters	Mean number of pups per male per year	
			born	reared
1991	21	7.95	17.52	17.10
1992	46	9.11	18.61	17.85
1993	66	10.11	20.82	19.55
1994	83	8.46	16.69	16.07
1995	81	7.32	13.19	12.20
1996	100	5.94	8.03	7.55
Total/Average	397	8.15	15.81	15.05

dy, about 1.36 litters were obtained per male per year on the farm, which is a much better result and may indicate that having more females in the group enables better breeding utilization of males in the breeding herd. From the farm's establishment in 1991, the number of litters increased until 1993, when as many as 10.11 litters per male were obtained during the year. This was probably due to the adaptation of animals imported from Germany to the new conditions, as well as to the breeder having become familiar with the specificity of reproduction in these animals.

The average litter size in the years 1991-1996 on the farm was 1.97 kits, with fluctuations from 1 to 6. This is a result comparable to that obtained in research by Barabasz et al. [2], in which the average litter size was 1.94. At the Grywałd farm, the oldest in Poland, litters numbered on average 1.85 kits [22], while litter size in Denmark was 2.29 [16]. A study by Socha and Kasjaniuk [17] showed that litter size is also influenced by the colour variety of chinchillas. The largest litters have been obtained in the case of beige (2.15) and standard (3.02) coats, while the litters of black velvet chinchilla females were the smallest. The inferior reproduction results obtained from coloured varieties indicate, according to Socha et al. [19], a negative correlation between these traits.

The average number of offspring born from one male in the period analysed was 15.81 (Table 6), which calculated per female comes to 2.63 kits per year. From some males on the farm as many as 30-39 young were obtained. According to Barabasz [1], from 2 to 2.5 kits should be obtained from a female per year, so the results obtained in our study can be considered fully satisfactory and are indicative of the good breeding condition of the males on the farm.

The average number of reared kits per male was only slightly lower, at 15.05, so deaths on the farm were only about 5%. According to Jarosz and Rżewska [8], mortality can reach up to 20% in the first two weeks after birth and is lowest in litters with two kits. Szeleszczuk et al. [22] divided the losses of kits into three periods. In the first period, i.e.

immediately after birth and in the first days of life, deaths can account for up to 66% of all losses of young. The main cause of losses in this period is failure of the kits to adjust to new conditions, developmental defects, milk deficiency in the mother, inactive teats or two few active teats. In the second period, i.e. during rearing, 23% of all losses occurred, while only 11% took place in the third period, i.e. after weaning. Other causes of deaths during rearing include hypothermia when the temperature drops below 10°C, excessive litter size, diseases, and stress associated with separation from the mother during weaning. Cannibalism by the mother is also a common phenomenon when litters are too large and the females are not able to feed all the young. The rearing rate is also affected by the size of the farm [2]. The largest numbers of young are reared on medium-sized farms, with 50-100 females in the foundation herd, while the most deaths are noted on large farms, due to insufficient monitoring of the animals by breeders. Seasonality is also evident in deaths among kits, with the most losses occurring from March to May and from September to November [19].

The results presented describe the specificity of chinchilla reproduction on the farm analysed and cover the entire breeding herd. However, although the averages given pertain to the majority of cases, there are also deviations resulting from individual variability and preferences. For this reason, we randomly selected five individuals (no. I, III, VIII, X, and XX) from among the males from the German line and analysed their reproductive performance in 1991-1996 (Table 7). The selection criterion was the approximate date of birth and the size of the litter they came from. The data presented in Table 7 clearly show that the sexual activity of these males varied in different years of use.

According to Seremak and Sulik [16], a good male can be exploited for up to 9 years, but on average this period is 2.75 years. On the farm analysed in the present study, the males were left much longer due to their good reproductive results.

Taking into account the entire foundation herd, an average of 8.15 litters and 14.77 kits were obtained per male per year. The analysis of selected males revealed higher values: the mean number of litters ranged from 7.13 to 11.8, and the number of kits per litter from 1.9 to 2.59. Hence, even more intensive breeding of males on the farm is possible. The system of keeping a male with many females enables strict selection of males. However, farmed chinchillas include individuals that do not accept polygamy and mate with only one female of their choosing from the entire group, becoming aggressive towards others [1]. This adversely affects breeding results and causes significant losses. Dzierżanowska-Góryń and Janik [4] also observed males that wanted to remain with their chosen partners outside the breeding and rearing period.

It must be remembered, however, that reproduction results on chinchilla farms do not depend only on males or climatic conditions, but also, and perhaps primarily, on females. Their sexual cycle is subject to cyclical changes, and its length and course may change depending on the season. According to Jarosz and Rżewska [8], these cycles are shorter (40 days) and more regular from mid-December to the end of May, and longer (over 50 days) and less regular from June to November. Gromadzka-Ostrowska [7] observed the most short cycles (24.6 days on average) from March to June, and the fewest long ones

Table 7

Results of breeding exploitation of selected males in 1991-1996 expressed as the number of litters and weaned pups

Year	Number of litters (litters) and number of reared chinchillas (reared)									
	litters	reared	litters	reared	litters	reared	litters	reared	litters	reared
	Male chinchilla's number									
	I		III		VIII		X		XX	
1991	8	16	5	9	5	14	17	36	15	28
1992	12	23	5	11	9	17	15	32	16	33
1993	8	17	16	35	6	10	8	17	4	8
1994	10	21	11	13	10	20	14	39	5	12
1995	5	13	3	8	12	24	5	12	0	0
1996	13	24	5	12	6	13	0	0	0	0
Total	44	114	45	88	48	98	59	136	40	86

(up to 70 days) from October to February. Felska-Błaszczuk [5] claims that increased light intensity can shorten the whelping interval by approximately 30 days. In that study, the percentage of litters with two and five kits increased with increased light intensity. However, this did not eliminate seasonality in the reproduction of these individuals. This was confirmed in further research by this author [6], in which the highest numbers of litters and chinchillas born to one female per year were obtained using higher light intensity, from 151 to 240 lx.

Seasonality in chinchilla reproduction is currently the subject of disputes among many researchers. Some say that although they are polyoestrous animals, their sexual activity changes throughout the year [7, 12]. According to others, when microclimatic conditions are similar, seasonality in reproduction has been shown to vanish [16]. Some express the opinion that changes due to the domestication of the chinchilla have gone so far that they cannot return to their natural environment [22], or that seasonality in reproduction disappears in an environment other than the natural one [11]. A similar view is held by Barabasz [1], according to whom it is slowly becoming eliminated. The author states that while seasonality in chinchilla reproduction occurs, over the course of years, during which selection is conducted, the breeding of these animals slowly becomes independent of cyclical changes. This is the result of continuous improvement of housing conditions and better knowledge of the biological characteristics of the species.

To sum up, it can be concluded from the research that seasonality in chinchilla reproduction has not disappeared, as evidenced by the increased sexual activity of male chinchillas during the period with longer daylight. Male chinchillas in farm breeding are still inadequately exploited for breeding.

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