

Correlation between birth season and litter size in Maine Coon cats

Magdalena Świątek-Cukier¹, Wojciech Wójcik^{2*}

¹ Faculty of Animal Breeding, Bioengineering and Conservation, Warsaw University of Life Sciences - SGGW, Ciszewskiego 8, 02786 Warsaw, Poland

² Department of Animal Breeding, Institute of Animal Science, Warsaw University of Life Sciences - SGGW, Ciszewskiego 8, 02786 Warsaw, Poland

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The domestic cat is classified as a seasonally polyestrous species whose reproductive cycles are influenced by increasing daylight duration. However, in many pedigree cat catteries, where cats coexist closely with humans, exposure to artificial light sources can substantially diminish their dependence on photoperiod cues, making them continuously polyestrous animals.

The present study aimed to evaluate the presence of natural reproductive seasonality in domesticated purebred cats in contemporary breeding systems. This analysis utilized data extracted from litter records (born between 2010 and 2023) registered with the Polish Feline Association, originating from Maine Coon queens.

The obtained data were divided into four periods: (1) queens mated during the short-day period (November to January) and gave birth in January to March; (2) queens mated during the period of increasing day length (February to April) and gave birth in April to June; (3) queens mated during the long-day period (May to July) and gave birth in July to September; and (4) queens mated during the period of decreasing day length (August to October) and gave birth in October to December.

The results showed that Maine Coon queens give birth to and rear an average of five kittens per litter. The conception period had no effect on reproductive success ($p = 0.40$). No correlation was observed between season of the year and litter size ($r = -0.017$; $p = 0.869$), between the season in which the queen gave birth for the first time and mean lifetime litter size ($r = -0.103$; $p = 0.311$), and between litter size in the first litter and mean lifetime litter size ($r = 0.185$; $p = 0.0684$). In summary, there is no association between the breeding season and reproductive success in MCO cats.

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*Corresponding author: wojciech_wojcik@sggw.edu.pl

The domestic cat (*Felis catus*) is considered a seasonally polyestrous species and exhibits a reproductive pattern characterized by photoperiod-dependent, induced ovulation and the capability to undergo multiple reproductive cycles throughout the year [Hurni, 1981, Faya *et al.* 2011]. Under natural conditions, increasing day length (12 h or more) reduces melatonin secretion, thereby activating the reproductive axis and initiating the estrous cycle [Faya *et al.* 2011]. In natural environments, feline sexual activity predominantly occurs from spring to early autumn [Nutter *et al.* 2004, Jennett 2015].

Light serves as the primary factor influencing sexual activity in domestic cats, while circulating melatonin functions as its main antagonist [Lantermo *et al.* 2026]. Additional factors that contribute to this activity include the feeding regime and the nutritional status of the female [Olavson 1989]. Hurni [1981] demonstrated a strong association between the occurrence of the reproductive period in queens and successive periods of short and long light exposure, which enabled females to enter reproductive readiness more than four times within a given year. Similar results were reported by Leyva *et al.* [1989]. Furthermore, studies have also shown differences in the duration of the natural breeding season across different latitudes [Hurni 1981, Eaton 2023].

An important aspect of feline reproduction is the breeding of pedigree cats under controlled environments. Pedigree cat breeding is primarily conducted in domestic conditions, which reduces reproductive seasonality in most females. This phenomenon can be attributed to the high quality of commercial diets provided to these animals and the use of artificial light sources in households, which are essential for human living conditions. Artificial lighting exerts a stimulatory effect on the physiology of female cats, leading to an extension of reproductive activity among purebred cats. Additionally, many studies have indicated that spontaneous ovulation occurs in approximately one-third of queens maintained in pedigree breeding systems [Faya *et al.* 2011, Johnson 2022, Pereira *et al.* 2024]. Studies focusing on unmanipulated reproductive seasonality have shown that, although estrous cycles may occur throughout the year, a clear increasing trend is observed in the number of days in estrus during the period of increasing day length [Faya *et al.* 2011].

In cats, the onset of sexual maturation generally occurs between 8 and 11 months of age [Tsutsui *et al.* 2004, Romagnoli *et al.* 2019], although some differences are observed between queens born in different months as well as between short- and long-haired breeds. Specifically, queens born in early spring (during the increasing day length period) reach puberty at an older age than those born in late summer. This characteristic is attributed to the onset of a new period of increasing day length, which stimulates all females to initiate sexual maturation [Little 2011]. The reproductive cycle of female domestic cats consists of five main phases:

- proestrus, designated as the preliminary phase, is a brief period that may go unnoticed by breeders. During this phase, ovarian follicles mature and become ready for ovulation. It lasts typically for 1-2 days and is characterized by sexual arousal, rubbing behavior, and the absence of receptivity to the male.

- estrus, commonly referred as the true heat phase, lasts for an average duration of 5-7 days (in some cases, it may extend up to 19 days). The queen shows full receptivity to the male, performs treading movements with her hind limbs, and adopts a lordosis posture that aligns her body toward the male. This period is marked by peak fertility, increased need for attention, a potential reduction in appetite, and characteristic vocalization. The acceptance of copulation (often multiple times at short intervals) induces ovulation, thereby facilitating the possibility of fertilization.
- interestrus is the interval between successive estrous cycles. This phase occurs in the absence of male contact or following an unsuccessful mating attempt (characterized by lack of fertilization). It may last from 2 to 19 days (average duration: 7 days), during which the queen shows no interest in the male or in reproductive behavior. If appropriate photic conditions are met (continuous light stimulation), the queen re-enters the proestrus and estrus phases.
- diestrus (luteal phase) occurs following ovulation and the concurrent formation of corpora lutea. It has two distinct forms: (1) pseudopregnancy, which arises following early embryonic loss or absence of fertilization and persists for 40-50 days, and (2) pregnancy, which lasts for approximately 65 days. Re-entry of the queen into estrus may occur as early as approximately 10 days after the luteal phase, although lactational anestrus in nursing queens may persist for up to 8 weeks.
- anestrus is the non-reproductive period, which begins during decreasing day length in the winter season and ends with the onset of spring and the transition of the queen into proestrus [Root Kustritz 2005, Little 2011, Johnson 2022].

The Maine Coon (MCO) breed originates from North America, where it developed under harsh climatic conditions, and is now a popular breed of cat kept in homes and catteries. They are known for having large litters (larger than those of other cat breeds). However, as a member of the *Felis catus* species, it may exhibit reproductive photoperiodism. The present study aimed to determine whether MCO queens under breeding conditions exhibit seasonal reproductive activity and whether the length of daylight at the time of mating influences reproductive success, expressed as litter size of weaned kittens.

Material and methods

Breeding data (litter records for the 2010-2023 period) of 98 MCO queens aged 10 months to 8 years and housed in domestic breeding catteries in Poland were obtained from catteries registered with the Polish Feline Association operating under the guidelines of the World Cat Federation. Each litter record included information provided by the owner (breeder) regarding the queen's age, number of weaned kittens per litter, date of parturition, date of mating, and sex and coat color of born kittens. The obtained data were divided into four periods:

- queens that mated during the short-day period (November to January) and gave birth between January and March;
- queens that mated during the increasing day length period (February to April) and gave birth between April and June;
- queens that mated during the long-day period (May to July) and delivered between July and September;
- queens that mated during the decreasing day length period (August to October) and gave birth between October and December.

To determine the correlation between litter size in the first litter and the mean litter size in subsequent litters, only queens that had given birth at least twice were included. Queens producing litters at a significantly later age than the typical physiological age (over 3 years of age) were excluded, as their litters had previously been registered in other feline federations, which could have resulted in bias. Of the 454 recorded litters, 400 litters from the 2010-2023 period were included in the analysis, corresponding to 1,906 documented kittens.

Statistical analysis

The obtained data were subjected to descriptive statistical analysis. The Shapiro-Wilk test was used to determine the normality of the data. The effect of the investigated factors was assessed using analysis of variance (ANOVA). For multiple comparisons between treatment periods, one-way ANOVA was applied based on the following equation:

$$Y_{ij} = \mu + A_j + e_{ij} \text{ or } Y_{jk}$$

where Y is a dependent variable; μ is the general mean; and A_j is the effect of period. The results of one-way ANOVA are expressed as p-values. Pearson's correlation coefficients were calculated to evaluate the relationships between selected variables. Statistical analyses were conducted using Statistica 13 [TIBCO, 2017] software, and the significance level for all analyses was set at 0.05.

Results and discussion

Table 1 shows the results for descriptive statistics of the analyzed litters (sum, minimum, maximum, median, mode, standard deviation, number of litters, and mean) for each year (2010-2023). The maximum litter size gradually increased (from 10 kittens during 2010-2016 to 13 kittens during 2017-2023), along with a slight increase in the annual mean litter size ($\bar{x} = 4.42$ and 4.84 for 2010-2016 and 2017-2023, respectively).

The obtained results for the mean litter size in the MCO breed are consistent with previous findings [Socha *et al.* 2019, Mugnier *et al.* 2022, Wójcik and Piechowska 2025]. However, the mean value was higher than that reported for other breeds, which may be attributed to the larger body size of MCO queens. Their greater body size

is associated with an increased abdominal capacity, which provides more space for the uterus during pregnancy [Socha *et al.* 2019, Mugnier *et al.* 2022, Wójcik and Piechowska 2025].

The conception season had no effect on the number of weaned kittens (Tab. 2); $p = 0.40$. This may be due to the loss of reproductive seasonality in MCO cats, probably resulting from indirect stimulation by artificial light sources present in household environments, provision of high-quality nutrition, and disruption of the mechanism regulating the natural photoperiodic reproductive process in pedigree cats.

To date, several authors have examined the influence of photoperiod on hormonal changes in felids and analyzed the relationship between fluctuations in hormonal levels and cat behavior [Lantermينو *et al.* 2026]. Breeding systems impose restrictions on litter frequency, limiting queens to a maximum of four litters within a 2-year period. Although this condition significantly constrains the assessment of the full reproductive

Table 1. Descriptive statistics for the litters analyzed (sum, minimum, maximum, median, mode, variance, number of litters, and mean) for each year (2009-2023).

Year	Sum	Minimum	Maximum	Median	Mode	Standard deviation	Number of litters	Average
2010	18	3	7	5.00	4	1.73	4	4.50
2011	4	2	6	5.00	2	1.89	4	3.25
2012	12	2	8	5.00	4	1.56	12	4.67
2013	10	2	10	5.00	6	2.71	10	4.70
2014	19	1	7	5.00	5	1.83	19	3.84
2015	24	1	8	5.00	1	2.44	24	4.17
2016	34	1	9	5.00	5	1.85	34	5.26
2017	41	1	13	5.00	4	2.45	41	4.78
2018	37	1	13	5.00	4	2.69	37	4.97
2019	41	2	11	5.00	3	2.02	41	5.15
2020	44	1	10	5.00	5	2.08	44	5.00
2021	48	1	11	5.00	5	2.16	48	4.85
2022	45	1	11	5.00	5	2.19	45	4.76
2023	36	1	12	5.00	6	2.27	36	4.36

Table 2. the effect of gestation period on litter size in female MCO cats

Groups	Count	Sum	Average	Variance	Deviation
1	87	439	5.05	5.65	2.38
2	85	411	4.84	4.33	2.08
3	89	425	4.78	5.70	2.39
4	139	631	4.54	4.19	2.05
<i>P-value</i> = 0.40					

1 – female cats mated during the short-day period (November through January) and giving birth between January and March; 2 – female cats mated during the long-day period (February through April) and giving birth between April and June; 3 – female cats mated during the long-day period (May-July) and giving birth during the period: July-September; 4 – female cats mated during the shortening-day period (August-October) and giving birth during the period: October-December.

potential of MCO queens, it provides real-world data on reproductive outcomes in pedigree cat breeding systems.

Nutter *et al.* [2004] reported that free-ranging cats most frequently nursed their young ones during the spring-summer period; this behavior is consistent with the natural photoperiod in domestic cats. The results of the present study confirm the loss of reproductive seasonality in MCO queens. Moreover, the results revealed a tendency toward smaller litters in queens that conceived during the long-day period (4.78 kittens) and during the decreasing day length period (4.54 kittens) compared to those conceiving during the short-day period (5.05 kittens) and the increasing day length period (4.84 kittens).

Smaller litters conceived during the summer period may result from high ambient temperatures, which can induce heat stress and significantly impair sperm quality, thereby reducing reproductive success in domestic cats. Heat stress has been recorded in many animal species, including cats [Ross *et al.* 2017, Boni 2019, Wolfenson and Roth 2019, Favre *et al.* 2022, Arero and Ozmen 2025].

In the present study, a decreasing trend in litter size was observed (Fig. 1) in the correlation between litter size in the first litter and season of the year ($r = -0.017$; $p = 0.869$) as well as between the overall mean litter size and the season in which the queen gave birth for the first time (Fig. 2); $r = -0.103$; $p = 0.311$. In both cases, this trend was nonsignificant ($p > 0.05$).

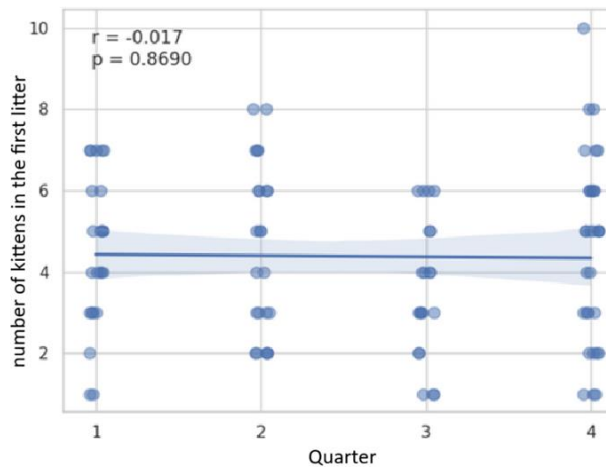


Fig. 1. Correlation between the quarter of birth and the number of kittens in the first litter. 1 – female cats mated during the short-day period (November through January) and giving birth between January and March; 2 – female cats mated during the long-day period (February through April) and giving birth between April and June; 3 – female cats mated during the long-day period (May-July) and giving birth during the period: July-September; 4 – female cats mated during the shortening-day period (August-October) and giving birth during the period: October-December.

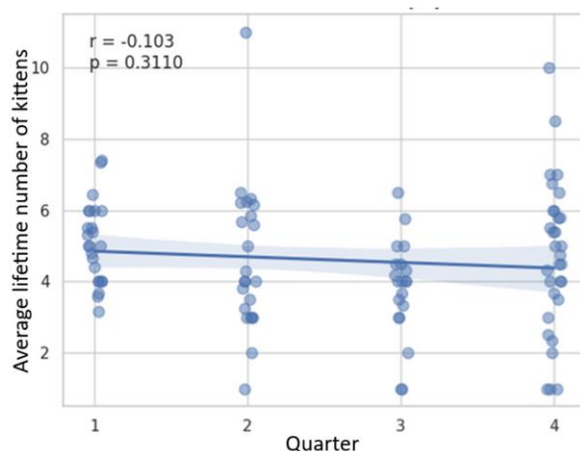


Fig. 2. Relationship between the season in which the first kittens were born and the lifetime average number of kittens in following litters. 1 – female cats mated during the short-day period (November through January) and giving birth between January and March; 2 – female cats mated during the long-day period (February through April) and giving birth between April and June; 3 – female cats mated during the long-day period (May-July) and giving birth during the period: July-September; 4 – female cats mated during the shortening-day period (August-October) and giving birth during the period: October-December.

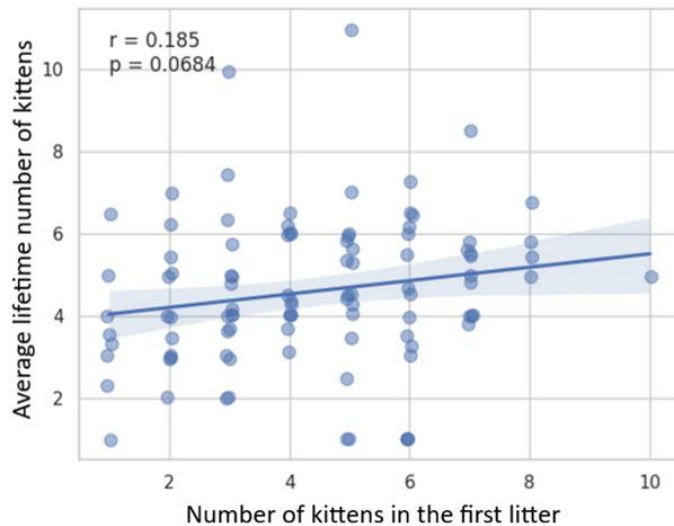


Figure 3. Correlation between the number of kittens in the first litter and the average number of kittens in subsequent litters.

The lack of reproductive seasonality in MCO queens also did not affect litter size across different seasons of the year. Figure 3 shows the trend of increasing litter size in subsequent litters with an increasing litter size in the first litter ($r = 0.185$; $p = 0.0684$).

Studies on rabbit reproduction also confirmed no relationship between reproductive parameters [Ezzaroug *et al.* 2019]. Future studies should employ larger datasets to validate the trends observed in this study. This would enable the assessment of a female cat's reproductive potential after her first parturition or could support decisions related to her potential exclusion from a breeding program.

Disclosures

The authors declare no conflicts of interest.

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