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*Original article*

# Obstetric and newborn parameters in the Maine Coon cats

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## Abstract

The aim of this study was to determine several obstetric and neonatal parameters in the Maine Coon breed. The birth data of Maine Coon breeding population were collected of 52 litters from different households using a questionnaire. Significant relationships between various outcomes and the relevant predictors were assessed by multiple linear regression or logistic regression, as appropriate. The overall mean gestation length was  $65.5 \pm 1.32$  days. Larger litter size was associated with shorter gestation lengths ( $p < 0.01$ ). Mean litter size was  $5.3 \pm 2.3$  kittens. The weight of kittens born alive (overall mean  $119.6 \pm 18.4$  g) increased with prolonged gestation lengths ( $p < 0.01$ ) and decreased with larger litter sizes ( $p < 0.01$ ). In the analyzed group of kittens, 12.5% were stillborn. The expulsion intervals varied widely. The duration of the first stage of labour was less than 2h in 82.9% of the cats. The interval between the birth of the first and the last kitten was less than 6h in 99.3% of the cats, and it exceeded 6 h in only 2 cats. The present results can be used to develop reference values and reliable assistance protocol for assessing the parturition in the Maine Coon to protect the queen and reduce perinatal losses.

**Key words:** cat, parturition, delivery, newborn, neonatology

## Introduction

Obstetric and neonatal assistance should be based on the detailed information about the physiological course of parturition and on a basic data regarding newborns (Lawler 2008, Gatel et al. 2011). Neonatal pathologies and loss of purebred kittens can be a major challenge for both breeders and veterinarians (Root Kustritz 2006, Lawler 2008, Keiser et al. 2017). In most species, labor and neonatal parameters have been relatively accurately determined, whereas the relevant information is still

limited in queens (Root et al. 1995, Sparkes et al. 2006, Gatel et al. 2011, Musters et al. 2011). In queens, parameters such as mean birth weight, gender, interkitten time and litter size have already been studied, but they have never been evaluated based on a large population of a specific cat breed (Sparkes et al. 2006, Gatel et al. 2011, Musters et al. 2011). This study aimed to determine several obstetric and neonatal parameters in the population of Maine Coons which are a very popular cat breed. The length of pregnancy, litter size, interkitten time, gender and birth weight of the kittens, and the percentage

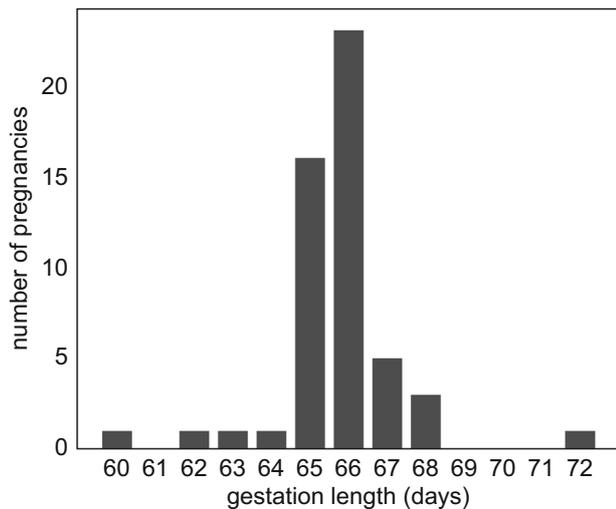


Fig. 1. The median length of gestation in the Maine Coon.

of stillbirths were evaluated with the use of a dedicated questionnaire. The influence of these factors on the course of parturition was also determined.

## Materials and Methods

### Animals

The study analyzed 52 litters from 35 Maine Coon queens mated with 20 different tomcats. The evaluated queens were aged 14-78 months.

### Questionnaire

Data were obtained from several Maine Coon breeders with the use of a questionnaire. All evaluated deliveries were natural, without any veterinary assistance, including C-section. The owners provided the necessary data with the required accuracy.

### Data collection

The following parameters were analyzed: length of gestation (in days), expulsion time (in minutes), interkitten time (in minutes), litter size, number of stillborn kittens, birth weight (in grams), and gender. The length of gestation was calculated as the number of days between the day of successful mating and the day the first kitten was born. Interkitten time was defined as the time between two subsequent expulsions. Litter size was the total number of kittens born alive and stillborn kittens. Stillborn kittens were defined as kittens that were dead upon expulsion. The data relating to stillborn kittens were used in the study when available. Birth weight was measured immediately after expulsion.

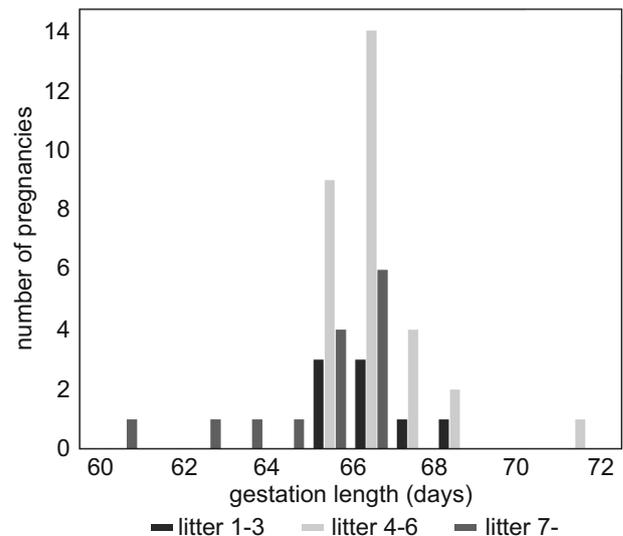


Fig. 2. The length of gestation according to litter size in the Maine Coon.

### Data analysis

The collected data were compared using descriptive statistics. The chi-squared test was used to analyze combined data for the overall differences in the gender ratio and the number of kittens born alive or stillborn. A linear model was used to test whether gender, live births and stillbirths significantly influenced the mean birth weight of kittens. A mixed linear model was also used to check whether gender, live births and stillbirths significantly influenced interkitten time as a measure of parturition progress. Data were expressed as mean  $\pm$  SD, and data that were not normally distributed were presented as median and range. Differences were regarded as statistically significant at  $p < 0.05$ . The analyses were performed in Microsoft 365 Excel and IBM SPSS Statistics 24.

## Results

### Length of gestation

The median length of gestation in 35 queens was 66 days, ranging from 60 to 72 days, and 95% of the deliveries occurred between gestation day 62 and 68 (Fig. 1). The mean length of gestation was  $65.5 \pm 1.32$  days. Gestation length was influenced by litter size ( $p < 0.001$ ). Gestation was shorter ( $p < 0.001$ ) in queens carrying larger litters (seven or more kittens) (Fig. 2).

### Interkitten time

The median interkitten time for 279 expulsions was 43.02 min, ranging from 2 to 295 min (Fig. 3). Fifty percent of the expulsions occurred within 30 min after the previous expulsion, 90% occurred within 93.5 min,

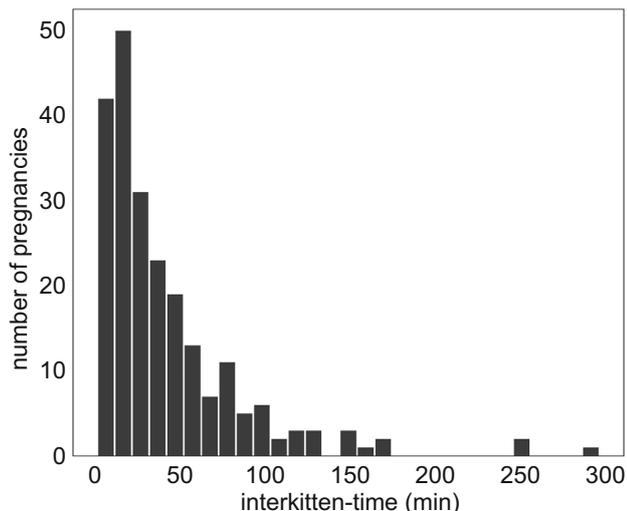


Fig. 3. The interkitten time in Maine Coon deliveries.

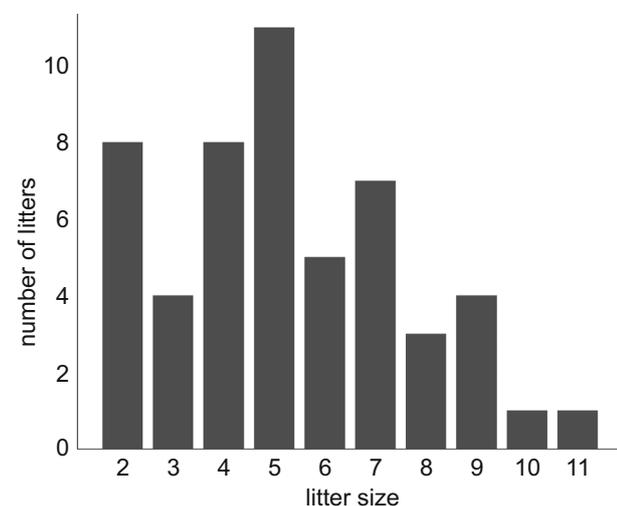


Fig. 4. The litter size in Maine Coon pregnancies.

and 95% – within 128.5 min. Nineteen kittens were born between 100 min and six hours after the previous expulsion, and 4 of these (16%) were stillborn. Two (0.7%) of the 279 expulsions occurred after more than 6 hours (both kittens were stillborn). Interkitten time was not influenced by the kitten's gender ( $p=0.1$ ). The difference in interkitten time between kittens born alive and stillborn kittens was not significant ( $p=0.73$ ).

**Litter size**

The median size of the 52 litters was six kittens (range 2 to 11). Mean litter size was  $5.3 \pm 2.3$  (Fig. 4).

**Gender ratio**

A higher number of male ( $n=158$ ; 59%) than female kittens ( $n=108$ ; 41%) ( $p<0.001$ ) were identified among the sexed kittens. Gender was not recognized in 13 kittens.

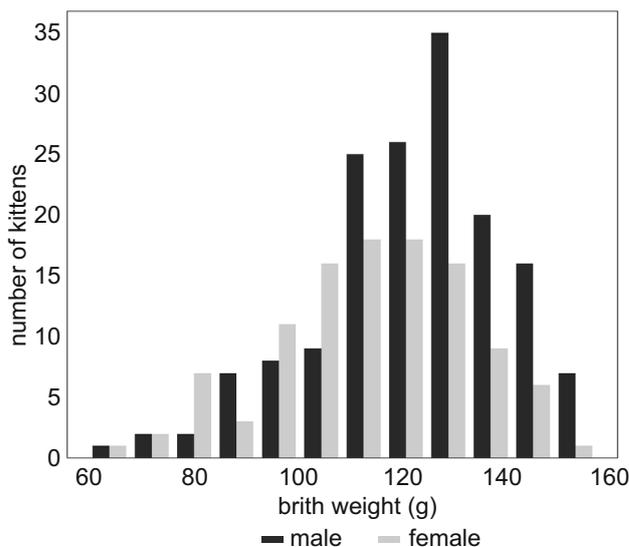


Fig. 5. The birth weight according to the gender ratio in the Maine Coon.

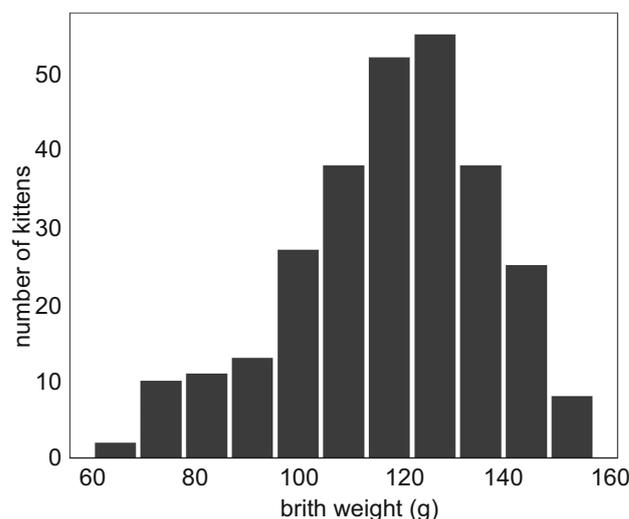


Fig. 6. The weight of newborn Maine Coon kittens.

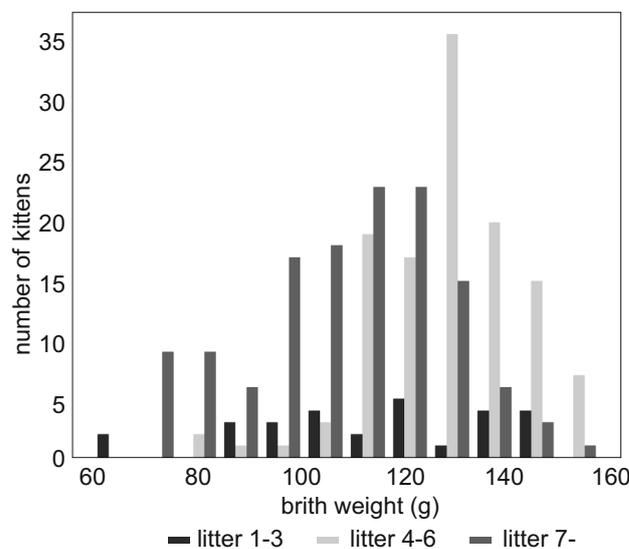


Fig. 7. The correlation between the litter size and the birth weight in the Maine Coon.

### Stillbirths

Thirty-five (12.5%) of the 279 kittens were stillborn. Of the sexed kittens, 12 (55%) were female and 10 (45%) were male. Gender was not recognized in 13 kittens.

### Birth weight

The mean birth weight of 279 kittens was  $117.8 \pm 19.9$  g (range of 60 to 158 g) (Fig. 6). Mean birth weight decreased with an increase in litter size ( $p < 0.01$ ) (Fig. 7) and was higher in males ( $122.6 \pm 18.3$  g) than in females ( $113.9 \pm 18.4$  g) ( $p < 0.01$ ) (Fig. 5). Stillborn kittens weighed less ( $105.5 \pm 25$  g) than those born alive ( $119.6 \pm 18.4$  g) ( $p < 0.01$ ).

### Discussion

The novel aspect of the study was the use of a dedicated questionnaire to elicit information about several obstetric and neonatal parameters in a single cat breed, namely the Maine Coon. This comprehensive study was performed on a large population of this popular cat breed to collect data for accurate predictions of parturition time and decision-making regarding assistance during both physiological and high-risk deliveries. In most queens, gestation length from mating is variable and influenced by many factors (Munday and Davidson 1993, Root et al. 1995, Keiser et al. 2017). The gestation period can be affected by relatively long estrus which can exceed one week in some queens (Malandain et al. 2011). Another important consideration is whether single or multiple mating is required to provoke ovulation and the beginning of pregnancy (Root et al. 1995, Malandain et al. 2011, Beccaglia et al. 2016). In this study, the first day of pregnancy was defined as the day when a queen was mated with a tomcat. Gestation length ranged from 60 to 72 days, with a mean of 65.5 days, and it generally remained within the physiological duration of feline pregnancy (Munday and Davidson 1993, Root et al. 1995). However, it should be noted that general information about the duration of feline pregnancy is based on studies performed on relatively small populations of mixed breed cats or different cat breeds. Musters et al. (2011) did not report a significant influence of breed on gestation length, whereas Sparkes et al. (2006) noted that the duration of pregnancy was significantly correlated with specific breeds. They reported longer gestation (>66 days) in Siamese and Oriental Shorthair cats, and shorter gestation in Korat cats (63 days) (Sparkes et al. 2006). In our study, 95% of the deliveries occurred

65–68 days after mating, which confirms that the length of pregnancy is relatively stable in the Maine Coon. However, it should be noted, that queens presented with obstetric problems require ultrasound fetometry as a helpful tool for predicting the parturition date (Zambelli et al. 2004, Zambelli and Prati 2006, Michel et al. 2011, Garcia Mitacek et al. 2015, Topie et al. 2015, Beccaglia et al. 2016, Keiser et al. 2017, Lopate 2018). Our observation that gestation length decreased with an increase in litter size is consistent with the findings of Musters et al. (Musters et al. 2011). However, the above correlation was not reported by Root et al. (1995), which can probably be attributed to the small number of queens used in their study. A negative correlation between the mean duration of gestation and median litter size was also noted in different dog breeds, which implies that the relationship between gestation length and litter size could be a general biological trend (Okkens et al. 2001, Luvoni and Beccaglia 2006, Socha and Janowski 2014). The noted interkitten times (2 to 295 min) confirm the general observation that expulsion time varies widely in queens, which makes it difficult to distinguish between normal and abnormal parturition. However, the intervals between kittens did not exceed 100 minutes in most cases. In the study by Musters et al. (2011), only 8 of 543 expulsions (1.5%) were longer than 6 hours. Similar results were reported by Sparkes et al. (2006) where 98.1% of 1001 measurements of interkitten time were shorter than 6 hours. According to other authors, parturition lasting longer than 6 hours should not be considered normal (Root Kustritz 2006, Keiser et al. 2017). In our study, the difference in interkitten time between kittens born alive and stillborn kittens was not significant. Despite the above, kitten mortality rate increased when the time between expulsions exceeded 2 hours. In our study, the stillbirth rate was 12.5%, and it was 2–3 times higher than that noted by other authors. In the literature, feline stillbirth rates were reported at 4.7% by Root et al. (1995), 5.0% by Musters et al. (2011) and 7.2% by Sparkes et al. (2006). In the work of Musters et al. (2011), more females than males were stillborn, which could be attributed to the lower mean birth weight of females. No such correlations were observed in our study of Maine Coon cats. The Main Coon is one of the largest domesticated cat breeds; therefore, kittens were expected to have higher birth weight relative to other cats. The mean birth weight of kittens was 117.8 g, and it was higher than that reported by other authors (Sparkes et al. 2006, Gatel et al. 2011, Musters et al. 2011, Keiser et al. 2017). Interestingly, lower birth weights were observed in around 10% of the newborns, which could explain the higher stillbirth rate. In conclusion, the results of this study can be used to develop

reference values for assessing the course of parturition in Maine Coon queens and to ascertain whether parturition is normal or abnormal. The generated data can also be applied to develop a reliable parturition assistance protocol. An evidence-based protocol will facilitate decision-making regarding assisted delivery in pregnancies that are considered to be abnormal, to protect the queen and to reduce perinatal losses.

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