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Effects of Age and Nutritional Status at Mating on the Reproductive and Productive Traits in Suffolk Sheep Kept under Permanent Outdoor Management System

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ABSTRACT

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This study examined the variability of reproductive and productive traits in Suffolk sheep (a commercial flock, n = 316 ewes) with regard to the dams' age or the nutritional status of sheep at mating under a year-round outdoor management. Data were collected across a 3-year monitoring period (totally 655 observations). The fixed effects of dam's age (dams grouped as: 2, 3, 4, 5, 6 years and older), ewe's live weight (LW; ewes grouped as: < 72 kg; 72–83 kg; > 83 kg), and backfat thickness at mating (BT; ewes grouped as: < 7.9 mm; 7.9–10.5 mm; > 10.5 mm) were evaluated. The dam's age influenced reproductive and productive traits such that 2- and 6-year and older ewes reached the lowest values. Ewes with LW > 83 kg had significantly higher lambing rate (11.8%) compared to those with LW < 72 kg. The group of ewes with LW < 72 kg gave birth to a significantly lower number of live lambs in litter (–8.9%) in comparison with LW < 83 kg group. An increase (9.9%; $P < 0.01$) of total litter weight at birth or an increase (12.5%; $P < 0.05$) of total litter weight at 100 days of age were detected in LW > 83 kg group compared to LW < 72 kg group. BT > 10.5 mm ewes had by 8.9% lower lambing rate ($P < 0.05$), by 6.8% lower litter size ($P < 0.05$), by 14.5% lower number of live lambs in litter ($P < 0.01$), and by 8.6% lower total litter weight at birth compared to BT < 7.9 mm ewes. A significantly lower total litter weight at 100 days of age (–10.8%) and a significantly lower total litter gain from birth to 100 days of age (–11.5%) were detected in BT > 10.5 mm ewes in comparison to BT 7.9–10.5 mm ewes.

Keywords: live weight; backfat thickness; body condition score; lamb

The Czech sheep production sector had been oriented at wool production for decades, however from the early 90s its orientation changed towards meat production (Milerski et al. 2006). Suffolk sheep played a dominant role in this process (Maxa et al. 2007), because of their adaptability, maternal characteristics, and lambs' growth parameters (Dwyer and Lawrence 2005). Therefore, it seems to be an optimal genotype for a permanent outdoor management system using natural shelters (windbreaks and groves) only. Lambing occurs on pastures in late spring, when favourable climatic conditions and adequate grazing pasture arrive. Minimal inputs in the form of constructions of buildings, feed costs, and manpower are likewise appreciated. However, there are only

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several flocks taking advantage of this system in the Czech Republic. Effects of the flock or the management system and season of lambing are important factors influencing reproductive and productive traits in ewes (Notter 2000; Safari et al. 2007; Ptacek et al. 2014a).

Mature ewes are crucial in every management system just because ewes primarily influence flock profitability due to their reproductive and productive traits. In this connection factors such as the dam's age or nutritional status (Aliyari et al. 2012; Corner-Thomas et al. 2014; Kenyon et al. 2014) are very important and frequently discussed. Sheep nutritional status is expressed by live weight (LW), body condition score (BCS), backfat thickness, and muscle depth (Kenyon et al. 2014; Ptacek et al. 2014b). Kenyon et al. (2004) and Gaskins et al. (2005) determined the positive influence of higher mature ewe's LW at mating on both lamb birth and weaning LW at 90 days of age. Yilmaz et al. (2011), Aliyari et al. (2012), and Vatankhah et al. (2012) found a negative effect of excessively emaciated and overfat ewes at mating on both reproductive and productive traits, while using the BCS assessment. In relation to ewes' nutritional status determination, Abdel-Mageed and Abo El-Maaty (2012) suggested measurements of backfat thickness as a more suitable method than the subjective BCS evaluation. Most of the above-mentioned studies were performed shortly prior to mating. Generally, there are very sporadic occurrences of selective nutritional status management in a breeding system of keeping sheep outside year-round. The mating period also seems the most appropriate time for evaluating the nutritional status. All the sheep are carefully inspected and culled if necessary at this time. Therefore, general guidelines which farmers can use to determine the optimum nutritional status that ewes should achieve at this time could be useful as e.g. potential selection criteria for subsequent reproduction. Particularly this situation has been described in Suffolk sheep and their crossbreeds in conditions of the Czech Republic (Ptacek et al. 2014a, c, 2015). The results, however published only as preliminary results, indicated that the highest reproductive and productive traits were detected in the heaviest and overfat ewes at mating. The present study differs from these studies by long-term observation in a specific management system. Also, more detailed information about lambs' survivability during rearing has not been published yet. Other available information in this area is not up-to-date (Gunn et al. 1969; Gibb and Treache 1980), or it specializes mainly in local rustic African or Asian sheep breeds as mentioned above.

Therefore, the objective of this study was to evaluate the variability of reproductive and productive traits in Suffolk sheep with regard to the dam's age or nutritional status of sheep at mating in specified breeding conditions of a permanent outdoor management system.

MATERIAL AND METHODS

Animals and flock management. The monitoring was performed in a semi-extensive Suffolk sheep flock located in the Central Bohemian Region (Příbram district). The flock was located at an altitude of 310 m a.s.l., with an average annual rainfall of 900 mm per year and average annual temperature of 8°C. The feed ration during the grazing season (from mid-April to mid-October) consisted of grassland pasture and hay (*ad libitum*) as a potential food supply. The stocking rate was 2–5 ewes (0.4 to 0.8 of livestock unit) per ha in specific years and grazing pasture areas. The dominant forages of grazing pasture were *Festuca rubra*, *Poa pratensis, Lolium perenne,* and *Trifolium repens.* The average production of herbage mass was 2.0 t dry matter (DM)/ha; estimated in 1 m × 1 m plots of ca. 5 cm herbage height. The meadow hay and clover grass haylage were produced in a standard manner with 85% and 50% DM content. There was no flushing applied before the mating season. The sheep had free access to mineral lick and to drinking water during the whole year. In the non-grazing period (from mid-October to mid-April), the ewes' feed ration consisted of haylage (3–5 kg/head/day) and hay (*ad libitum*). The feed ration of lambs consisted of ewe's milk, pasture, meadow hay in unlimited volume, and a concentrated supplement (alfalfa granules for lambs; Mikrop Čebín, a.s., Czech Republic, 2 × 200 g/head/day). During the 2^{nd} half of August the ewes were sheared and hooves trimmed. Ram lambs were separated from their mothers, and ewe lambs were kept together with the rest of the flock until mating. Four weeks before mating all ewes in the flock were inspected. Ewes with teeth, udder, foot, and blowfly strike

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problems were culled from the basic flock. Their hooves were also trimmed repeatedly at this time. Approximately 7 days before mating all ewes were routinely inspected once more, their nutritional status was evaluated, and they were divided into particular groups. Individual groups of ewes – each mated by one sire – were balanced according to the ages of the ewes and breeding values. The mating period started from the 14–17th November during all the observed years. Each sire had to service a group of 40 ± 5 ewes. Sires selected into reproduction were classified among top 5% according to breeding values. The inbreeding in the flock was eliminated by rotation of sires and their regular replacement. Ca. 1.5 month before lambing all ewes began to be vaccinated against clostridial diseases and dewormed according to a vaccination scheme. Lambing occurred from April 14 to June 23, and more than 92% of all mature ewes lambed during a period of 30 days. Only 6 ewes lambed in June.

Data collection. The data were collected from 316 ewes and 14 sires of one commercial flock during a three-year monitoring period (2011/2012–2013/2014; totally 665 observations). The age of the dams was grouped as follows: 2 years, n = 168; 3 years, n = 137; 4 years, n = 131; 5 years, n = 77; 6 years and older, n = 142. The group of 6 years and older ewes had to be created due to the low numbers of ewes aged from 6 to 11 years. The LW at mating was divided to create groups: LW < 72 kg, n = 202; LW = 72–83 kg, n = 241; LW > 83 kg, n = 212. The LW (kg) was obtained using a tensometric scale VHD (MyWeigh, Germany) ± 0.1 kg designated for the weighing of small ruminants. Backfat thickness at mating (BT, mm) was grouped BT < 7.9 mm, n = 184; BT = 7.9–10.5 mm, n = 298; BT > 10.5 mm, n = 173. The evaluation of BT was performed in the area of the last thoracic vertebra using the ultrasound Aloka 500 (Hitachi Aloka Medical, Ltd., Japan) and a 5 MHz linear probe (UST-5011U) according to Milerski (2001). The same process was used to obtain *musculus longissimus lumborum et thoracis* depth (MLLT; range from 23 mm to 48 mm). The groups of LW and BT were created according to their arithmetic means (AM) and standard deviations (s) (AM < –0.5 s; AM = –0.5 to 0.5 s; AM > 0.5 s). Ewes' BCS at mating was determined by an evaluator (scale 1–5; 1 = emaciated, 5 = obese) with an accuracy of 0.5 point (Russel et al. 1969). However, it was not used for further analysis as explained in the statistical analysis chapter.

Immediately after birth, the lambs were identified to their dam, weighed, and tagged. They were weighed repeatedly at 100 days of age during official monitoring of growth performance recording (the lambs were weighed at 70–130 days of age and the age was recalculated on the average of 100 days). This information was provided by officially published data of the Sheep and Goat Breeders Association of the Czech Republic. Finally, average daily gain from birth till 100 days of age was computed.

Evaluated traits. The following reproductive traits were assessed: lambing rate (LR; percentual proportion of ewes lambed vs ewes mated), litter size (included all born lambs – live and dead), number of live-born lambs (NL0), number of lambs reared during 48 hours (NL48), and number of lambs reared at 100 days of age (NL100). Productive traits of total litter weight at birth (LW0, including birth weight of all lambs born – live and dead, kg), total litter weight at 100 days of age (LW100, kg), and total daily gains in a litter at 100 days of age (LG100 = (LW100 – LW0)/100 (g)) were evaluated.

Statistical analysis. All statistical analyses were conducted using the SAS software (Statistical Analysis System, Version 9.3., 2011). The REG procedure under the STEPWISE method was used for appropriate model selection. The influence of evaluated factors on reproductive and productive traits was tested by the analysis of variance (ANOVA), the Generalized Linear Model method (GLM). The reproductive and productive traits (dependent variables) in ewes were corrected by fixed effects of year, dam's age, LW, BT, and MLLT as covariate. The fixed effect of BT and MLLT as covariate was more appropriate in the model than the BCS estimation during the ongoing analysis. Therefore, BCS was removed from the final model, moreover, to eliminate the duplication of the factor representing backfat reserves (Ptacek et al. 2015). The results were explained in relation to fixed effects of dam's age, LW, and BT. Also, the influence of two- and three-way interactions (dam's age × LW, dam's age × BT, LW × BT, and dam's age × LW × BT) was tested during the ongoing analysis; however, it was non-significant in all the models. Therefore, the model equation adapted to explain the variability in reproductive and productive traits was as follows:

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$y_{ijklm} = YEAR_i + AGE_j + LW_k + BT_l + b^*mllt + e_{ijklm}$

where:

y_{ijklmn} = dependent variable (LR, NL0, NL48, NL100, LW0, LW100, LG100)

YEAR = fixed effect of the i^{th} year (i = 1st year, n = 226; i = 2nd year, n = 185; i = 3rd year, n = 244)

AGE = fixed effect of the j^{th} dam's age (j = 2 years, n = 168; j = 3 years, n = 137; j = 4 years, n = 131; j = 5 years, n = 77; j = 6 years and older, n = 142)

LW = fixed effect of the k^{th} dam's live weight at mating (k = LW < 72 kg, n = 202; k = LW 72–83 kg, n = 241; k = LW > 83 kg, n = 212)

BT = fixed effect of the l^{th} dam's backfat thickness at mating (l = BT < 7.9 mm, n = 184; l = BT 7.9–10.5 mm, n = 298; l = BT > 10.5 mm, n = 173)

b*mllt = *musculus longissimus lumborum et thoracis* depth as covariate (23–48 mm)

e_{ijklmn} = residual error

The differences between the variables estimated were tested by the Tukey-Kramer method at the levels of significance $P < 0.05$ and $P < 0.01$.

RESULTS AND DISCUSSION

Basic statistics of dataset structure are presented in Table 1 for a better view. The effect of two- and three-way interactions was non-significant in all the models. Therefore, the LSM results were published only as the influence of fixed effects of dam's age, LW, and BT on reproductive and productive traits.

Age of dam. The results of the effect of dam's age on their reproductive and productive traits are presented in Table 2. Differences among particular groups were non-significant. Generally, the significantly lowest values of LR, LS, NL48, LW0, LW100, and LG100 were detected in the groups of ewes aged either 2 years or 6 years and older. It is crucial to select animals with adequate reproductive and productive traits, especially in breeding systems demanding maximal sheep self-sufficiency. Well-timed culling of sheep with regard to their age (above 6 years of age) could potentially reduce losses during rearing lambs. The boundary of 6 years was published by Yilmaz et al. (2011), Aliyari et al. (2012), Vostry and Milerski (2013), Yavarifard et al. (2015) concerning sheep of different production systems and various genotypes. All the results indicated that Suffolk sheep, as an intensive sheep breed, maintained their reproductive and productive performance until physiologically normal age, and thus could be easily and successfully used in this breeding system.

Live weight at mating. The ewe's LW at mating positively influenced subsequent reproductive traits, as presented in Table 2. Ewes with the highest LW (group LW > 83 kg) had about 11.8% higher LR ($P < 0.01$) compared to those with the lowest

Table 1. Data on the sheep flock structure

Variable	n	AM	SD	Min.	Max.	CV
Age of dam (years)	655	3.8	1.5	2	6	38.7
Ewes live weight at mating (kg)	654	77.6	10.2	46	107.5	13.1
Ewes backfat thickness at mating (mm)	655	9.2	2.6	3	20	28.1
Ewes MLLT depth at mating (mm)	655	35.3	4.0	23	48	11.3
Lambing rate (%)	655	86.1	34.6	0	100	40.2
Litter size (lambs)	563	1.8	0.5	1	3	27.1
Number of live born lambs (lambs)	564	1.7	0.6	0	3	37.0
Number of lambs reared during 48 h after birth	564	1.5	0.7	0	3	47.2
Number of lambs reared at the age of 100 days	561	1.1	0.7	0	3	65.0
Total litter weight at birth (kg)	560	8.7	2.3	2	17.7	26.4
Total litter weight at 100 days of age (kg)	439	56.6	19.3	21.3	104.8	34.1
Total litter gain from birth to 100 days of age (g/day)	439	477.7	186.7	103	938	39.1

n = number of observations, AM = arithmetic mean, SD = standard deviation, Min. = minimal value, Max. = maximal value, CV = coefficient of variation (%), MLLT = *musculus longissimus lumborum et thoracis*

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LW (LW < 72 kg). The group of ewes with LW > 83 kg produced more lambs in a litter (+8.9%; $P < 0.05$) in comparison with ewes of LW < 72 kg. The significantly lowest NL0 was detected in the group LW < 72 kg, which gave birth to 14.3% less live lambs ($P < 0.01$) in comparison with group LW > 83 kg. Similarly, the significantly lowest NL48 parameter was detected in the group LW < 72 kg. Also NL100 traits tended to be the highest in ewes' LW > 83 kg. Overall, ewes with lower LW had negatively affected subsequent productive results of LW0, LW100, and LG100 (see Table 3). This situation was documented by 9.9% ($P < 0.01$) difference in LW0, by 12.5% ($P < 0.05$) difference in LW100, and by 13.2% ($P < 0.05$) difference in LG100 between groups of LW > 83 kg and LW < 72 kg. Ewes' productive traits are influenced by their reproductive traits as well as by the growth performance traits of their lambs. Therefore, it is possible to assume that lambs of the heaviest ewes at mating grew faster than the lambs born to the lightest mothers. This hypothesis is supported by findings of Kenyon et al. (2004) and Aliyari et al. (2012). As a result, the highest total meat production was achieved from the heaviest mothers (group LW > 83 kg). The positive effect of LW on selected reproductive traits or lambs' growth abilities was also obvious in Suffolk sheep and their crossbreds (Ptacek et al. 2014a, c, 2015), however, kept in smaller flocks with more intensive breeding conditions. Assumptions for achieving adequate LW were provided in the study presented by no limited grazing pasture intake with a combination of hay as a potential food supply in the grazing period. The lack of nutrition was compensated by haylage during the non-grazing period. The animals were grazed naturally without any flushing, ram effect (Cumming et al. 1977) or selective nutrition (Zhang et al. 2015). The defined feeding ration enabled to achieve the breeding standard of Suffolk LW,

Table 2. Effect of age, mature live weight, and backfat thickness at mating on subsequent reproductive traits

	LR (%)	LS	NL0	NL48	NL100
		(lambs)			
AGE (years)					
2	86.9 ± 2.96	1.74 ± 0.045^{a}	1.60 ± 0.057	1.39 ± 0.063	1.08 ± 0.068
3	83.7 ± 3.00	1.88 ± 0.047^{b}	1.71 ± 0.059	1.54 ± 0.065^{a}	1.20 ± 0.071
4	90.4 ± 3.08^{a}	1.89 ± 0.047^{b}	1.75 ± 0.058	1.47 ± 0.064	1.20 ± 0.070
5	82.8 ± 3.96	1.86 ± 0.062	1.76 ± 0.078	1.58 ± 0.086^{a}	1.12 ± 0.093
6 and older	81.9 ± 3.12^{b}	1.80 ± 0.049	1.62 ± 0.061	1.33 ± 0.068^{b}	1.07 ± 0.073
LW (kg)					
LW < 72	77.5 ± 2.86^{A}	1.75 ± 0.046^{a}	1.56 ± 0.057^{A}	1.35 ± 0.063^{A}	1.05 ± 0.069
LW 72–83	88.6 ± 2.35^{B}	1.83 ± 0.036	1.68 ± 0.045^{a}	1.42 ± 0.050^{a}	1.15 ± 0.054
LW > 83	89.3 ± 2.79^{B}	1.92 ± 0.042^{b}	1.82 ± 0.052^{Bb}	1.62 ± 0.058^{Bb}	1.20 ± 0.065
BT (mm)					
BT < 7.9	89.2 ± 2.45^{a}	1.91 ± 0.038^{a}	1.86 ± 0.047^{A}	1.59 ± 0.052^{a}	1.18 ± 0.057
BT 7.9–10.5	85.9 ± 2.41	1.82 ± 0.037	1.62 ± 0.047^{B}	1.41 ± 0.051^{b}	1.12 ± 0.056
BT > 10.5	80.3 ± 2.93^{b}	1.78 ± 0.047^{b}	1.59 ± 0.058^{B}	1.38 ± 0.064^{b}	1.10 ± 0.070
Significance					
YEAR	0.476	0.138	0.234	0.295	0.239
AGE	0.289	0.113	0.169	0.070	0.467
LW	0.003	0.053	0.010	0.014	0.323
BT	0.095	0.116	0.001	0.025	0.683
b*mllt	0.194	0.297	0.710	0.900	0.383

LR = lambing rate (%), LS = litter size, NL0 = number of live-born lambs, NL48 = number of lambs reared during 48 h after birth, NL100 = number of lambs reared at the age of 100 days, YEAR = year of observing, AGE = age of dam, LW = ewe's live weight at mating, BT = ewe's backfat thickness at mating, b*mllt = ewe's *musculus longissimus lumborum et thoracis* depth at mating as covariate

means within rows with different letters differ significantly ($^{a,b}P < 0.05$; $^{A,B}P < 0.01$)

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which represents 70–100 kg in the Czech Republic. Therefore it is fully acceptable for keeping the sheep under a permanent outdoor management system. LW monitoring at mating can in practice help with culling the sheep just before subsequent reproduction. Suffolk sheep with mature LW at mating below 70 kg should be eliminated, especially in breeding systems demanding maximal sheep self-sufficiency. Previous studies also found heritability of mature live weight 0.30 (Safari et al. 2005) to 0.49 (Janssens and Vandepitte 2004) in Suffolk sheep and other meat breeds. Therefore, positive selection of Suffolk ewe lambs with regard to LW of their mothers could thus improve the reproductive and productive traits in the flock.

Table 3. Effect of age, mature live weight, and backfat thickness at mating on subsequent productive traits

	LW0 (kg)	LW100 (kg)	LG100 (g/day)
AGE (years)			
2	8.04 ± 0.206^{A}	55.1 ± 2.00	468.0 ± 19.36
3	9.02 ± 0.212^{B}	59.0 ± 2.02^{a}	497.5 ± 19.50^{a}
4	9.09 ± 0.211^{Ba}	59.1 ± 1.99^{a}	500.9 ± 19.20^{a}
5	8.66 ± 0.281	55.1 ± 2.73	465.1 ± 26.37
6 and older	8.47 ± 0.223^{b}	42.3 ± 2.14^{b}	435.5 ± 20.74^{b}
LW (kg)			
LW < 72	8.19 ± 0.208^{aA}	52.3 ± 2.05^{a}	439.5 ± 19.84^{a}
LW 72–83	8.69 ± 0.163^{b}	56.3 ± 1.56	474.5 ± 15.05
LW > 83	9.09 ± 0.192^{B}	59.8 ± 1.83^{b}	506.1 ± 17.68^{b}
BT (mm)			
BT < 7.9	9.06 ± 0.170^{A}	57.4 ± 1.63	483.5 ± 15.76
BT 7.9–10.5	8.63 ± 0.170	58.5 ± 1.65^{a}	497.4 ± 15.99^{a}
BT > 10.5	8.28 ± 0.210^{B}	52.5 ± 2.00^{b}	439.2 ± 19.34^{b}
Significance			
YEAR	0.003	0.049	0.016
AGE	0.002	0.073	0.110
LW	0.015	0.051	0.079
BT	0.030	0.050	0.053
b*mllt	0.047	0.238	0.309

LW0 = total litter weight at birth, LW100 = total litter weight at 100 days of age, LG100 = total litter gain from birth to 100 days of age, YEAR = year of observing, AGE = age of dam, LW = ewe's live weight at mating, BT = ewe's backfat thickness at mating, b*mllt = ewe's *musculus longissimus lumborum et thoracis* depth at mating as covariate

means within rows with different letters differ significantly ($^{a,b}P < 0.05$; $^{A,B}P < 0.01$)

Backfat thickness and musculus longissimus lumborum et thoracis depth. In evaluation of reproductive traits, the fixed effect of BT and MLLT as covariate was more appropriate in the model than the BCS estimation. The influence of BT on reproductive and productive traits is presented in Tables 2 and 3. The ewes in the group of BT < 7.9 mm had the highest LR, which significantly differed (8.9%; $P < 0.05$) from that of the overfat (group BT > 10.5 mm). Also, the significantly lowest values of LS (–6.8%; $P < 0.05$), NL0 (–14.5%; $P < 0.01$), and NL48 (–13.2%; $P < 0.01$) were detected in the group of ewes BT > 10.5 mm in comparison to ewes in the group BT < 7.9 mm. These results are in contrast with those of Abdel Mageed and Abo El-Maaty (2012) and Vatankhah et al. (2012), who reported practically the opposite findings to ours in Rahmani, Barki, Ossimi, and Lori-Bakhtiari sheep. Differences in their results could be explained by genotype or different groups of BT, suggesting that fat cover of particular sheep breeds in various breeding conditions should be assessed individually. Significantly higher LW0 (+8.6%; $P < 0.01$) was detected in the group of BT < 7.9 mm compared to overfat ewes (group BT > 10.5 mm). Ewes in the group of BT 7.9–10.5 mm had about 10.8% higher LW100 ($P < 0.05$) and about 11.5% higher LG100 ($P < 0.05$) in comparison to BT >10.5 mm ewes. Our results indicate that the worst results of reproductive and productive traits examined in our study were observed in overfat ewes (group BT > 10.5 mm). On the contrary, sheep with BT 7.9–10.5 mm, which corresponded to BCS 3.5–4 (Ptacek et al. 2014b), were considered the most appropriate, because of their significantly highest LW100 and LG100 traits. Similarly to our results Kenyon et al. (2004) and Vatankhah et al. (2012) pointed out the negative effect of overfat ewes on their productive traits or lambs' growth abilities. Oppositely, some of the previously published studies in Suffolk sheep indicated a positive effect of overfat ewes rather than a negative one (Ptacek et al. 2014a, c, 2015), mainly in selected productive traits. These results could be connected with more intensive rearing of lambs that could not survive in breeding systems with only minimal additional help. Higher milk production of overfat ewes (Abdel-Mageed and Abo El-Maaty 2012) was not fully reflected in our results. Back body tissue development in meat Suffolk sheep at mating should help cull extremely overfat animals,

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because of very sporadic occurrences of selective nutritional status management in a breeding system of keeping sheep outside year-round. Sheep breeders who decide to use the advantages of keeping sheep outside year-round should be aware of specific features which are associated with this. The results of the present study could help them resolve the partial issue of well-timed culling of sheep for subsequent reproduction with the aim of improving reproductive and productive traits in the flock.

CONCLUSION

The results of the present study confirmed the positive influence of ewe's LW at mating on subsequent reproductive and productive traits. The mating period is an appropriate time for monitoring the LW in a permanent outdoor management system. Culling Suffolk ewes with mature LW at mating below 70 kg with a combination of selecting ewe lambs of high-weight mothers could improve both reproductive and productive traits. Similarly, overfat ewes should be eliminated just before next reproduction, because of their decreased subsequent reproductive and productive traits. The results of the present study provide important and practical implications for improved management and performance of commercial sheep farms in the Czech Republic.

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