LIVEWEIGHT CHANGE OF RED DEER (*CERVUS ELAPHUS* L.) CALVES AFTER WEANING

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Abstract
The article analyses the data obtained while evaluating red deer calves on the red deer breeding farm 'Dumpji' during the herd's annual prophylactic check-up in December and April of the years 2013 and 2014. Farm is a private enterprise owned by a company located in Northern Latvia. The study comprises data for calves born in 2013 (n = 36) that were born from the same hinds, but from different stags in consecutive years. It was discovered that the calves' liveweight gain in 24 hours significantly decreases during wintering period. After the wintering smaller body mass was observed in calves of both sexes born in 2014; however, the body mass of bull calves born in both years of reference considerably exceeded that of the hind calves. In the group of hind calves born in both years of the study period the liveweight loss was observed during the wintering. Nevertheless, at the age of 1.5 years the lowest liveweight among hind calves was 82.4 kg (year 2013), and the highest 129.6 kg (year 2014). In the group of spikers, during the winter period liveweight loss was not observed. Analysis of the results revealed a close positive correlation between the liveweight in December and the liveweight in the spring among spikers and heifers alike. The conducted analysis of influencing factors attests to the fact that the liveweight at the age of six months has material impact on the animals' liveweight both in the spring and at the age of 1.5 years.
Key words: Red deer, cross breed calves, liveweight gain.

Introduction

Considering deer-breeding a profitable farming industry in Latvia there has been developed the Red deer breeding program. Its first stage commenced in 2005. After completion of the second stage in 2015, 17 farms were acknowledged as red deer breeding farms. Implementation of red deer breeding program in Latvia ensures production of quality breed, thus improving the existing animal population. The second stage of the program expired in 2015. Deer-breeding in Latvia is being coordinated by the society Organic Farmers and Wild Animal Breeders Association (OF&WABA) (Proškina, 2013; Staltbriežu ciltsdarba programma, 2010).

In Europe there are no red deer breeding programs similar to that developed in Latvia. There have been developed some guidelines for red deer breeders based on the demand in global markets and the newest scientific studies have been published in a handbook, such as Deer industry manual etc. (Beatson, Campbell, & Judson, 2000; Deer industry news, 2015).

Under the Red deer breeding program that was developed in Latvia in 2005 (Staltbriežu ciltsdarba programma, 2010), as a primary breeding feature was considered the precocity of calves. The precocity of calves is being assessed by measuring their liveweight prior or after their weaning from mothers and at the age of 100 days. When reaching the age of 1.5 years young animals are subjected to reassessment. Best animals are earmarked for the reproduction of breed, while others are realised for the meet production (Staltbriežu ciltsdarba programma, 2010). In Europe and New Zealand the calves' liveweight is taken upon their separation from mothers or fattening during the winter period (Bokor & Bokor, 2014; Beatson, Campbell, & Judson, 2000; Dan DeBaedemaecker, 2014). The weaning of farmed calves from their mothers takes place at the age of three to five months depending on the farming strategy, while wild animals suck for 5 to 8 months (Guinness, Hall, & Cockerill, 1979; Clutton-Brock, Guinness, & Albon, 1982; Pollard, Littlejohn, & Suttie, 1992). The body mass by the end of feeding period has a close correlation with the livestock output, and it is economically justified (Dusalijeva, 2006).

Elsewhere around the world for the needs of studies on red deer calves of various ages the calculations are based on the data about their time of birth, circumstances and liveweight upon birthing. In Latvia as of 2016 there is no appropriate methodology of acquiring such data. In literature sources as the calves' birth period is mentioned the turn of May and June (Clutton-Brock *et al*., 1987; Drabinska, 2006). In turn, the results acquired in New Zealand imply that, statistically, the frequency of parturition is concentrated within the 10-day period at the turn of November and December, which corresponds to May-June in Europe (Audige *et al*., 1999).

The objective of this study is to compare changes in liveweight of red deer calves born in 2013 and 2014 and the pace of growth from the age of 6 months to 1.5 years as well as the compliance of liveweight with the requirements specified in the breeding program for calves of both sexes. Similar studies have been performed in New Zealand, Australia, United Kingdom and Poland. Taking into account the climatic

differences of the current place of study, we believe that locally conducted researches will facilitate the goal set by WABA- breed both trophy and meat animals of local bloodline, which are suitable for the Latvian climatic conditions.

Materials and Methods

The research was conducted in red deer breeding farm 'Dumpji' which is located in Northern Latvia, Vidzeme region - Lat: 57.4552889, Lon: 26.6339798. According to the administrative division it is situated in Trapene rural parish of Ape region. In terms of geographic location - in Tālava lowland, Trapene plains, on the right bank of the Melnupe river, which is the tributary to the Mustjõgi river in Estonia. Total space of the farm comprises 164 ha, out of which the woods take some 70 ha and farming land - some 89 ha. Red deer breeding takes place in a fenced territory of 72 ha.

The conception date for more than 100 red deer hinds cannot be determined with absolute precision. As such is assumed the period from 1st through 20th October based on observations of similar studies (Beatson, Campbell, & Judson, 2000; Clutton-Brock, Guinness, & Albon, 1982). The length of gestation period that depends also on the calf's sex for red deer hinds comprises 234 ± 3 days (Clutton-Brock, Guinness, & Albon, 1982), or 34-35 weeks (Siliņš, 1984). Respectively, the parturition takes place from 25th May through 15th June.

During the prophylactic herd handling, the calves and young animals were weighted in a pen with installed scales 'Tru-Test Multipurpose MP800'. Scale producer specified an error of no more than ± 0.5 kg, readings taken by the electronic 'EziWeigh6' indicator were entered into Windows Excel software and prepared for processing. By several reasons the study was commenced on 8th December 2013 when the calves were separated from their mothers and weighted for the first time. Late separation is beneficial for calves, in particular for late borne animals, yet such practice may impair the next-year reproduction ratios and affect the herd's numerical growth (Beatson, Campbell, & Judson, 2000). Therefore, the farm's strategy discontinues such practice. Out of 36 separated calves in December 2013, 18 were female and 19 male. Initially, after taking the liveweight during the wintering period from the group of study were excluded three bull calves and two hind calves. After initial data processing for further research purposes, the number of young animals was n = 15 female and n = 16 male calves. Calves were 25% Polish and 75% UK blood born from two years old Polish/UK crossbreed hinds. Stags were 100% UK born. In the mating season of the year 2013 the same hinds were mated with pure Polish blood stag. As a result, calves born in the year 2014 were 75% Polish and 25% UK blood born from three years old Polish/UK crossbreed hinds. The number of new-born calves was 20 female and 22 male. Calves born in 2014 for the first time were weighted and separated from mothers as soon as by the end of October and weighted again in early December prior to the wintering period, in the spring and at the age of 1.5 years. As no comparison with liveweight of calves born in 2013 was possible in October, information for October was not taken in

Table 1

Supplementary feed quality indicators

Feed products	Detectable indicator, unit	Result
Oat grain	Crude protein, %	11.18
	NDF, %	32.75
	ADF, % NEI, MJ kg^{-1} of dry matter	16.08 7.33
	Digestibility	76.40
Silage	Crude protein, %	14.25
	NDF, %	53.81
	ADF, % NEI, MJ kg^{-1} of dry matter	38.64 5.53
	Digestibility	58.80
Hay	Crude protein, %	6.91
	NDF, %	64.30
	ADF, % NEI, MJ kg^{-1} of dry matter	38.04 5.57
	Digestibility	59.3

consideration regarding calves born in 2014. Within both years of study calves were weighted three times:

- calves born in 2013 – December 7 same year, April 13 and December 8 in the year 2014
- calves born in 2014 – December 7 same year, May 4 and November 26 in the year 2015.

At the beginning of wintering period the calves born in 2013 and 2014 were kept in a small enclosure that was connected to the shed. For supplementary feeding were used the oat grain, silage from sown grassland (mixture G1) and hay from natural pastures. Water as well as silage and hay were freely accessible to the animals - *Ad libitum.*

The forage ration was defined and fed according to the age and weather when calculating 1.0 – 1.5 kg per calf. For feed, chemical analysis were carried out and quality indicators identified in year 2014 (see Table 1). What should be taken in consideration is the fact that the mothers of calves born in 2013 were just 2 years old; however, as pointed out in the literature sources, red deer hinds at the age of two reach their rutting time by 17 days later and in the third year by some 5 days later than those of the age of 5 (Beatson, Campbell, & Judson, 2000).

The analysis was conducted by applying the statistical methods subject to calculating the minimum, maximum and mean values, standard error of mean, deviation and variance. Comparison of liveweight and liveweight gain is based on t-test, while the analysis of impact exerted by influencing factors - on One-way ANOVA. To determine the relationship between liveweight in different periods, the correlation analysis was used. Data analysis was performed on IBM SPSS Statistics 21 software.

To mark the importance of differences in results acquired over the years of study, lower-case letters are used, while those among sexes – with upper-case letters.

Results and Discussion

Analysis of the study results was commenced with the calves' liveweight in December. According to Table 2, the average liveweight of bull calves born in 2013 amounted to 64.9 kg, varying from 46 (worst result) to 79 kg (top result). At the same time, the weight of hind calves was lower by 4.6 kg on average, which corresponds to the data specified in the deer producers' handbook published in New Zealand. This manual states that the liveweight of red deer bull calf subject to weaning at the age of 3 months exceeds that of the hind calf by 4.8 ± 0.8 kg on average (Beatson, Campbell, & Judson, 2000). The highest liveweight for hind calves in 'Dumpji' farm amounted to 70 kg, while the lowest – to 45 kg.

Weighting of calves born in December of 2014 revealed similar differences in the average liveweight between bull and hind calves, i.e. some 4.9 kg ($p<0.05$). Dispersion of liveweight among bull calves was close to the mean, the coefficient pf variation being 10%, which was by 3.6% less than that among the bull calves born in 2013. The maximum liveweight among bull calves was by 1 kg less, yet the minimum - by 7 kg more than in 2013. As to the hind calves, their maximum liveweight remained the same, while the

Table 2

Liveweight of calves at the beginning of study in 2013 and 2014

Variable	Year	Sex	x±Sx	Min	Max	V, %
Liveweight in December, kg	2013	male (n = 16)	64.9 ± 2.20^{A}	46.0	79.5	13.6
		female (n = 15)	60.3 ± 1.40^{A}	45.0	70.0	9.10
	2014	male (n = 16)	66.4 ± 1.38^{A}	52.0	78.5	10.0
		female (n = 15)	61.5 ± 1.70^{B}	48.0	70.0	11.0

$^{A, B}$ – significant differences have been observed between sexes, $p<0.05$.

Table 3

Calves' liveweight by the end of wintering period, kg

Variable	Year	Sex	x±Sx	Min	Max	V, %
Liveweight in April/ May, kg	2013	male (n = 16)	72.4 ± 2.30^{A}	51.0	94.5	13.0
		female (n = 15)	64.3 ± 0.90^{B}	58.5	71.5	5.2
	2014	male (n = 22)	70.8 ± 1.70^{A}	53.0	84.5	11.0
		female (n = 17)	62.7 ± 1.50^{B}	49.0	73.5	11.0

$^{A, B}$ – signifficant differences have been observed between sexes, $p<0.05$.

Table 4

Liveweight of young animals at the age of 1.5 years, kg

Variable	Year	Sex	x±Sx	Min	Max	V, %
Liveweight at age 1.5 years, kg	2013	male (n = 16)	110.5 ± 3.00^{aA}	82.5	140.0	10.8
		female (n = 15)	92.4 ± 1.20^{aB}	82.5	103.5	4.8
	2014	male (n = 22)	97.8 ± 2.13^{bA}	77.0	114.0	10.0
		female (n = 10)	$96.3 \pm 2.20a^{A}$	87.5	110.0	7.0

$^{A, B}$ – significant differences have been observed between sexes, $p<0.05$.
^{a,b} – significant differences have been observed by years of observation, $p<0.05$.

minimum liveweight grew by 3.0 kg. The variation range has decreased, while the coefficient of variation - increased. The study reveals that in both years the sex has been a significant factor to affect the calves' liveweight in December.

By the end of wintering period, which in both years occurred to be late April - early May, red deer calves were weighted once again. The mean liveweight of young red deer spiker born in 2013 was 72.4 kg (Table 3).The heaviest spiker at the time weighted 94.5 kg, while the lightest - 51 kg.

The coefficient of variation for liveweight in the group remained within the borders of 13%. Among spikers born in 2014, the heaviest weighted 84.5 kg, which is by 10 kg less than the maximum liveweight among spikers born one year before, while the lightest - 53 kg, which, in turn, is by 2 kg more than one year before. The coefficient of variation as compared to the precedent year has decreased by 2%. The mean liveweight among bull calves in both years of study reveal no significant differences, $p>0.05$.

The average liveweight among hind calves born in 2014 as compared to those born in 2013 was by 1.6 kg less, i.e. 64.3 kg and 62.7 kg, respectively. Considerably lower was the weight of the lightest hind calf: mere 49 kg, which was by 9.5 kg less than that of the lightest hind calf in 2013. Moreover, for the liveweight of hind calves born in 2014 the coefficient of variation had grown by 5.8%, reaching that of spikers – 11%, thus pointing out to bigger dispersion of liveweight.

The mean liveweight of hind calves at the age of 1.5 years, i.e. 96.3 kg implies improved quality of animals. The weight of the heaviest hind calf born in 2014 amounted to110 kg, which was by 6.5 kg more than that of the one born in 2013 (see Table 4). Similar situation is with the minimum observed liveweight. The weight of the lightest hind calve born in 2014 by 5 kg exceeded that of the one born in 2013.

According to observations, the coefficient of variation regarding liveweight grew by 2.2%, while the mean value - by 3.9 kg, which may be explained by alternations within the group: in the summer/autumn period seven hinds with the lowest weight were sold to a farm abroad.

It should be noted that in breakdown by years negative liveweight variation trends were observed in the group of spikers, where the mean liveweight of those born in 2014 was by 12.7 kg less ($p<0.05$) as compared to those born in 2013, which only by 1.5 kg exceeded the calves' liveweight.

Analysis of the results revealed a close positive correlation for calves of both sexes between their liveweight in December and in spring: for males=0.9 and females r = 0.8, as well as between liveweight in December and at the age of 1.5 years r = 0.7. The critical value of the correlation coefficient has been taken into account and indicates that correlation is considered to be statistically significant.

By using the attained liveweight of calves and young animals, the liveweight gain per day over various rearing periods was computed (see Table 5). Bull calves born in 2013 produced the liveweight gain per day during the winter period by 72.2 g on average. Those males that were born one year later over the same period gained 35.88 g per day on average, which is by 49.7% less than one year before ($p<0.05$). The minimum liveweight gain per day for males born in 2013 amounted to 14.6 g, while for those born in 2014 - 6.76 g. In turn, the maximum liveweight gain per day for males of the above groups amounted to 145.6 g and 121.6 g, respectively. Liveweight gain for female calves per day during the winter period on average amounted to 25.0 g for those born in 2013 and to 1.79 g for those born in 2014 ($p<0.05$). It was observed that part of female calves that were born in 2013 and 2014 lost some liveweight during the winter period. The biggest liveweight loss for female calves of both groups was similar, 55.1 g and 50.7 g per day on average, thus resulting in material dispersion ratio of this feature. Material differences on liveweight gain from December through April/May were observed both between years and sexes.

From December till the age of 1.5 years the biggest liveweight gain per day was observed among hind calves born in 2014, i.e. 106.3 g, while among those

Table 5

Calves' liveweight gain per day over the observation periods, g day^{-1}

Variable	Year	Sex	x±Sx	Min	Max	V, %
Liveweight from December to spring April/ May, g day-1	2013	male (n = 16)	72.2 ± 8.10^{aA}	14.6	145.6	45.0
		female (n = 15)	25 ± 8.76^{aB}	-55.1	106.3	144.4
	2014	male (n = 21)	35.88 ± 6.62^{bB}	6.8	121.6	84.8
		female (n = 17)	1.79 ± 4.33^{bB}	-50.7	33.8	997.8
Liveweight from December to age 1.5 years, g day-1	2013	male (n = 16)	134.0 ± 5.80^{aA}	94.1	177.9	17.3
		female (n = 15)	94.4 ± 3.10^{B}	82.4	129.4	12.5
	2014	male (n = 21)	88.7 ± 7.74^{bA}	15.5	165.3	40.9
		female (n = 8)	106.2 ± 4.05^{B}	96.0	129.6	10.8

$^{A, B}$ – signifficant differences have been observed between sexes, $p<0.05$.
^{a,b} – significant differences have been observed by years of observation, $p<0.05$.

born in 2013 it amounted to 94.4 g. Liveweight loss among hind calves was observed during the wintering period only, while over the entire observation period the liveweight gain per day was positive. The fast growth of calves might be explained by the so-called compensatory growth during the spring period, when the vegetation recommences in pastures and animals stop receiving the fodder (Fletcher, 2006). One of the explanations why liveweight loss among hind calves was observed during wintering period could be the fact that male and female calves are kept together in one enclosure and female calves have limited access to forage due to their size and weight. Of particular importance is the liveweight gain for hind calves in summer-autumn period, taking into account their sooner maturity for breeding and liveweight at the age of 16 months when they reach the economic maturity for breeding and are ready for mating (Moore, Littlejohn, & Cowie, 1988).

In the group of bull calves the highest liveweight gain from December till the age of 1.5 years displayed those born in 2013 (134.0 g), which by 45.3 g ($p<0.05$) exceeded the daily liveweight gain among bull calves born in 2014 over the same period. During this time the growth of hind calves was faster, exceeding the daily liveweight gain of bull calves by 17.5 g ($p<0.05$).

Spikers born in 2014 at the age of 1.5 years reached the liveweight of 97.8 kg, which according to the Red deer breeding program gives them 4 points and is considered very poor.

Taking into consideration the accessible data from other studies (Beatson, Campbell, & Judson, 2000; Asher *et al*., 2011) one can conclude that the ratios in both groups are behind the optimum ones. There was a rather small share of animals which met and even surpassed the expectations. According to the Red deer breeding program, the optimum weight of hind calves at this age should be 70 – 90 kg and more, while that of spikers – 110 – 125 kg and more (Staltbriežu ciltsdarba programma, 2010).

After separation, the daily liveweight gain till the age of 5 months may be up to 236 g, while at the age of 5 to 6 months the liveweight gain decreases and may shrink below 138 g per day. In order to ensure such liveweight gain prior and after separation, the nursing hinds and their calves must be provided with quality feed, maintaining the energetic concentration of 11 MJ kg of dry contents, green weight of some 60% out of the total feed ration, limiting the content of proteins to 400 g per day (Beatson, Campbell, & Judson, 2000; Asher *et al*., 2011).

One may make a supposition that different climatic conditions in the southern hemisphere pose an important factor both in terms of the feed quality and the weather conditions.

The conducted analysis of influencing factors indicate that the liveweight at the age of six months has material impact both on the liveweight attained during the spring period and that at the age of 1.5 years. Similar evidence was already obtained in New Zealand where the researchers ascertained that the liveweight upon separation influences the liveweight at the age of six months and that at the age of 12 months (Beatson, Campbell, & Judson, 2000). It indicates that in order to breed a quality animal one should pay particular attention to receiving the utmost ratios during their first months of life. Material impact on liveweight at the age of 1.5 years had both the sex and the year of birth ($p<0.05$).

Under the Red deer breeding program (Staltbriežu ciltsdarba programma, 2010) that was effective until 2015, calves of both sexes at the age of 1.5 years passed evaluation (see Table 6). The obtained results confirmed that 11 of spikers out of 16 born in 2013 scored 7 points and more. In turn, all hind calves both in 2013 scored 9 and 10 points.

Table 6

Evaluated spikers and score according to the Breeding program, points

Score points	Number of spikers
10	1
9	2
8	2
7	6
6	3
5	1
4	-
3	1

The liveweight of spikers born in 2014 should be regarded critically at the age of 1.5 years. Only two out of 22 animals, according to the Red deer breeding program received the score of 7 points; other animals received 6 points and less. However, 9 out of 10 hinds that still were at the farm by the end of research received 10 points. To be ready for mating in the second year of life, the hind calves must have at least 60% of an adult hind's liveweight, i.e. some 85 kg (Kelly & Moore, 1977; Beatson, Campbell, & Judson, 2000). Such liveweight, according to the breeding program requirements should score 8 points (Staltbriežu ciltsdarba programma, 2010).

The low score of spikers' liveweight hypothetically could be explained by the fact that two-year old hinds last year were in heat on average by some 14 days later than those of three years (Beatson, Campbell, & Judson, 2000). It entails later parturition and lactation, which might affect the hind's bodily condition and the new generation. Observers in Rama Island concluded that every 10 liveweight kilos of the hind increase the calf's liveweight upon birth by 0.33 - 0.53 kg (Moore, Littlejohn, & Cowie, 1988). In turn, the liveweight upon birth has impact on further growth of the calves. It should be noted that during the entire research period the calves of both sexes were held, separated and fed under similar conditions.

Conclusions

1. Liveweight of calves of both sexes at the age of six months upon commencement of the research in December exceeded 60 kg, being considerably higher for bull calves born in 2014, i.e. 66.4 kg on average, which is by 4.9 kg more than that of hind calves born in the same year ($p<0.05$). The obtained results are similar to those acquired elsewhere around the world.
2. After wintering, calves of both sexes that were born in 2014 had a lower liveweight; however, in both years of observation the liveweight of bull calves considerably exceeded that of the hind calves, i.e. by 8.1 kg on average ($p<0.05$).
3. In the group of hind calves born in both years of research the liveweight loss was observed during the wintering period. The biggest calculated liveweight loss was 55.1 g day^{-1} (in 2013) and 50.7 g day^{-1} (in 2014), which was compensated over the spring and summer seasons, so that at the age of 1.5 years the lowest liveweight among hind calves was 82.4 kg (in 2013), and the highest 129.6 kg (in 2014). All reared hind calves under the breeding program requirements can be used for breeding and the obtained results may serve for the purpose of further studies.
4. In the group of spikers, over the wintering period the liveweight gain per day considerably decreased, down to 72.2 g (in 2013) and 35.9 g (in 2014), while no liveweight loss was detected. Yet, at the age of 1.5 years just 11 bull calves born in 2013 scored 7 points and more, while in 2014 the breeding animal requirements were met by mere 2 spikers only. The results may be explained by the influence of various factors. Additional research would be required in the future to assess the influence of such factors.

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