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Liveweights, growth rates, and mortality of farmed red deer at Invermay

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Abstract Liveweights, growth rates, and mortality of farmed red deer at Invermay are reported from the first calving season in 1973 to March 1984, over which time 901 calves were weaned. Calf birth weights increased by 3 kg and the overall sex ratios at birth and weaning did not differ significantly from 50 : 50. Mortality of young calves, mostly perinatal and including stillbirths, averaged 13% for males and 8% for females over the years but reduced to 8% overall for the last five calving seasons. Growth rates from birth to weaning were mostly less than 300 g per day in the 1973 - 74-born cohorts but growth rates closer to 400 g per day were recorded in male calves born in the 1982 - 83 seasons. Weaning weights when calves were aged about 3 months increased over the years by 10 kg to 47 kg (males) and 45 kg (females). Seasonal growth rates of young deer showed considerable variation with year but were characteristically high over spring - summer, low in winter, and intermediate over the calves' first autumn. On average, growth rate of males was higher than that of females by 8% in autumn, 76% in winter, and 48% during spring - summer. Mortality of calves was highest in early winter averaging 2.3% (13/571). Mortality of hinds averaged 1.3% per annum and that of stags, 1.9%. The mean liveweights of stags and hinds with age are given up to 5 and 10 years of ages respectively. Hind liveweight changes between mating and the end of winter were found to have a potential in pregnancy diagnosis.

Keywords deer; red deer; liveweights; growth rates; mortality

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INTRODUCTION

The study of red deer at Invermay was initiated in 1973 to determine the feasibility of deer farming as a diversification in pastoral land use. This involved the development of appropriate management techniques and performance recording. From 1975, liveweight recording was systematised over the deer farm to monitor performance and to produce benchmark data for the developing deer farm industry.

In this paper liveweight and mortality data collected between 1973 and 1984 are analysed, presented, and discussed. Inevitably, there are gaps in the data collected because of experimental work undertaken and changes in approach, but it is nevertheless a valuable data base which reflects improvements in deer farming knowledge. The substantial amount of weight-for-age data presented will provide a basis for models predicting weight-for-age venison yields, as stag carcass dressing % and composition for age have been reported (Drew 1985).

Comparisons are made with the performance of a farmed red deer herd in a much harsher farming environment at Glensaugh, Scotland, as there has been conjecture over the best type of land for red deer farming.

METHODS

The source of the red deer stock and a description of the Invermay deer farm have been described by Moore et al. (1985). The climate is one of warm summers and cool winters, with a mean annual rainfall of 687 mm. Pasture production is seasonal with only 6% of the annual yield grown in winter, compared with 38% in spring, 38% in summer, and 18% in autumn. A fuller description of vegetation, pasture production, and soil type is given by Round-Turner et al. (1976).

The deer mainly grazed on pasture throughout the year with supplements over winter of lucerne hay, meadow hay, silage, barley, and barley-lucerne nuts depending on availability.

From 1975, breeding management of the deer was based on single-sire mating groups of up to 45 hinds. Hinds were set-stocked for calving by mating

group with dry hinds or late calvers run in a separate group. Calves were usually weaned pre-rut (March) at about 3 months of age and run together as one group or by sex until the following January, when sexes were separated if not so already. Some calves born in the 1974 season suffered from heavy burdens of lungworm (*Dictyocaulus viviparus*). Subsequently calves were drenched 3-weekly over autumn with anthelmintics and once or twice the following spring. Adult hinds were drenched pre-mating (March) and pre-calving (November). Stags were drenched after their antler in velvet and any regrowth of this had been removed during November - January. The deer also received selenium and copper and were vaccinated against clostridial diseases.

Most calving groups were monitored for performance over calving but some were checked infrequently. First calvers (2-year-old hinds) were generally not disturbed to minimise loss of calves through mis-mothering. Data given for the sex ratio at birth and mortality of new-born calves (including stillbirths) were from monitored calving groups. Birth weights were recorded in 1973 and 1974, but this was then mostly discontinued because of high calf mortality, and resumed from 1981 without abnormal losses. Where new-born calves were weighed, this was within 36 h of birth and to the nearest 0.1 kg. All calves were weighed at weaning (3 months), pre-winter (6 months), post-winter (9 months), and at the end of spring - summer (15 months). Stags were weighed post-winter and in late summer (February). Hinds were weighed at mating, pre-winter, post-winter, and pre-calving. Deer were weighed to the nearest 0.5 kg at weaning and at subsequent weighings.

Cohorts will be referred to by the year they were sired even though some calves were born early in the year after their conception. Groups of cohorts from consecutive years will be denoted by hyphenation, e.g., 1973 - 78.

RESULTS

Calf birth weight

Table 1 summarises the birth weights recorded for calves from hinds aged 3 years or older. Mean birth weights increased by about 3 kg to 9.5 kg (male) and 9.1 kg (female) in the 1981 - 83 cohorts compared with the 1973 cohort.

Sex ratio of calves and perinatal mortality

During the 1973 - 83 calving seasons, 736 red deer calves were born in groups monitored over calving. The sexes of eight dead calves were not recorded. The sex ratio in monitored groups was 51 : 49 in favour of males at birth and 50 : 50 at weaning. Although this varied between 61 : 39 and 40 : 60 over years (Fig. 1), in only one instance was this significantly different from 50 : 50. For all calves (n = 901) alive at 3 months, the overall sex ratio was 49 : 51 in favour of females. Over the 11 calving seasons, perinatal calf mortality (including stillbirths) averaged 13.1% for males, 7.9% for females, and 11.7% overall. However, perinatal calf mortality was very high in 1973 - 74 at 25% and 21% respectively (Drew & Kelly 1975) compared with only 8% for the last five calving seasons. No analysis of neonatal mortality and birth weight was undertaken because all the 1973 - 74 calves dying from trauma were not positively identified. Mortality of calves from the first week of life to weaning was less than 1%.

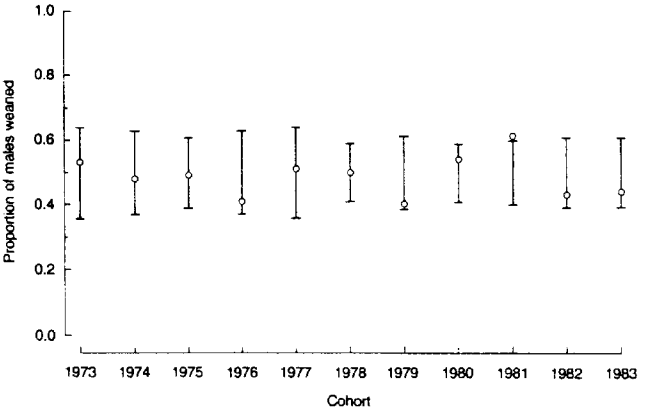

Fig. 1 Proportion of males weaned (○) by cohort with 95% confidence bounds (I) when proportion of males is 0.5.

Table 1 Means and standard deviations (SD) of birth weights of red deer calves (including stillbirths) by sex and year.

Year of birth	Birth weights (kg) Male Mean ± SD	*n*	Female Mean ± SD	*n*
1973	6.4 ± 1.2	36	6.2 ± 1.0	30
1974	7.4 ± 1.5	27	7.5 ± 1.1	30
1976	8.5 ± 1.0	13	7.7 ± 1.4	12
1981	9.4 ± 0.9	15	8.9 ± 1.4	5
1982	9.6 ± 1.2	23	9.0 ± 0.8	27
1983	9.5 ± 1.3	19	9.3 ± 1.1	15

Weaning weights and gain to weaning

Table 2 summarises weaning weights recorded in March. Liveweights at weaning were distinctly higher for the 1978 - 83 cohorts than for the 1973 - 77 cohorts.

Table 2 Means and standard deviations (SD) of weaning weights of 750 red deer calves by sex and year.

Year of birth	Weaning weight (kg) Male Mean ± SD	*n*	Female Mean ± SD	*n*
1973	37.7 ± 7.1	26	35.9 ± 7.3	23
1974	29.3 ± 7.5	27	33.4 ± 6.2	29
1975	38.5 ± 6.6	35	37.3 ± 6.6	38
1976	39.0 ± 6.7	22	33.4 ± 8.7	25
1977	36.8 ± 6.6	16	39.9 ± 7.0	26
1978	48.9 ± 6.8	58	44.4 ± 5.8	57
1979	46.7 ± 6.6	35	44.7 ± 5.4	53
1980	46.6 ± 4.9	45	41.4 ± 4.7	38
1981	44.7 ± 7.5	42	41.2 ± 6.0	27
1982	49.0 ± 5.3	29	46.6 ± 4.5	38
1983	46.9 ± 7.9	26	45.3 ± 5.7	35

Some of the calves for which birth weights and dates were known (Table 1) were picked up for hand-rearing and these were excluded from further analysis. Other calves for which birth weight and birth date were recorded in 1973 - 74 and 1982 - 83 were used to calculate their growth rate to weaning (Table 3). The growth rate of male calves was higher than that of females for all groups, except for the 1974 cohort in which the mean birthweight of surviving male calves was 0.4 kg lower than that of females. Growth rates of 1982 - 83 male and female calves averaged 39% and 14% higher, respectively, than those of 1973 - 74 calves.

Weaning to 15 months

Table 4 gives growth rates from weaning for all deer which were alive to 15 months of age. Excluded are data for the 1973 cohort used in stocking rate trials, 1974-born males which were castrated, the 1980-born calves where weaning occurred both pre- and post-rut, and the spring - summer growth rates of the 1981-born males because of their use in grazing trials.

Mortality of weaned calves

The mortality of red deer calves from weaning to 15 months of age was higher for the 1974 - 78 cohorts at 9.6% compared with 1.2% for the 1979 - 83 cohorts, with no deaths over the last 2 years. The proportion of male calves dying between 3 and 15 months of age was on average 5.9% compared with 3.4% for females.

Mortality was highest during June - July, with 13 out of 571 calves which entered winter dying (2.3%). Of the seven deaths recorded in April - May, five occurred in the 1974-born cohort. Weaning weights for this cohort were the lowest recorded; the five calves that died had an average weaning liveweight of 21 kg and high levels of infection with lungworm (*Dictyocaulus viviparus*). Causes of mortality in the other calves cannot be accurately assessed from post-mortem reports. Mortality of stock over spring - summer was rare with only three deaths recorded.

Liveweights of hinds and stags

Hind liveweight

Table 5 shows mean hind liveweights over age for those hinds alive at March 1984 from cohorts born from 1973 to 1978. An improvement in liveweight for age over time is evident. The last weight listed for each hind cohort is for March 1984. Pasture production over this last summer - autumn period was exceptional with a longer growing period than normal. Hence the increase in the last hind liveweight recorded for each cohort is indicative of a change in body condition rather than further growth.

Liveweights for the ages 5 - 7 years (Table 5) were averaged for the 1973 - 76 cohorts to obtain mature liveweight. On average the percentage mature liveweight reached by age was 39% at 0.3 years, 72% at 1.3 years, 84% at 2.3 years, and 93% at 3.3 years.

Table 3 Comparison of birth date, weaning age, and weaning weight for male and female red deer calves born in the 1973, 1974, 1982, and 1983 seasons.

Calf sex and year of birth (*n*)	Birth date Mean ± SD	Weaning age (days) Mean	Weaning weight (kg) Mean ± SD	Calf gain (g per day) Mean ± SD
Males				
1973 (26)	11 Dec ± 14	105	37.7 ± 7.1	295 ± 51
1974 (19)	18 Dec ± 9	93	32.8 ± 6.2	275 ± 64
1982 (19)	6 Dec ± 16	105	49.0 ± 4.4	383 ± 45
1983 (10)	25 Nov ± 9	101	50.7 ± 5.3	409 ± 43
Females				
1973 (23)	6 Dec ± 12	110	35.9 ± 7.3	279 ± 53
1974 (24)	22 Dec ± 10	89	35.2 ± 4.3	312 ± 43
1982 (26)	2 Dec ± 16	109	45.3 ± 4.6	335 ± 40
1983 (10)	16 Nov ± 11	110	47.8 ± 4.2	357 ± 39

Table 4 Post-weaning mean growth rates of young red deer over autumn (Apr - May), winter (Jun - Aug), and spring - summer (Sep - Mar). M = male, F = female.

Year of birth	Numbers of calves		Mean growth rate (g per day)					
			Autumn		Winter		Spring - summer	
	M	F	M	F	M	F	M	F
1974	10	27	103	93	6	29	250	172
1975	26	40	66	74	41	16	251	180
1976	13	12	159	186	41	29	243	143
1977	6	5	74	81	122	61	236	174
1978	38	54	18	4	102	63	239	170
1979	18	26	125	96	103	45	256	156
1981	21	29	119	114	102	60	-	161
1982	33	44	161	111	60	25	218	151
Mean ± SD			103 ± 48	95 ± 50	72 ± 41	41 ± 19	[illegible]	163 ± 13

Table 5 Means, standard deviations, and range of hind liveweights (kg) with age.

Age in years	Liveweights (kg)					
	Born 1973 n = 19	Born 1974 n = 17	Born 1975 n = 12	Born 1976 n = 8	Born 1977 n = 11	Born 1978 n = 39
0.3	35 ± 8 (20 - 45)	34 ± 6 (21 - 41)	39 ± 7 (26 - 49)	40 ± 7 (29 - 49)	42 ± 9 (27 - 53)	45 ± 5 (31 - 55)
1.3	70 ± 6 (60 - 83)	69 ± 7 (54 - 78)	77 ± 5 (65 - 83)	74 ± 8 (63 - 87)	83 ± 9 (73 - 102)	76 ± 7 (62 - 92)
2.3	79 ± 7 (67 - 92)	83 ± 9 (62 - 94)	94 ± 5 (86 - 102)	83 ± 10 (71 - 103)	95 ± 9 (82 - 110)	87 ± 8 (72 - 109)
3.3	93 ± 9 (80 - 110)	94 ± 9 (70 - 104)	98 ± 5 (91 - 106)	90 ± 9 (75 - 106)	98 ± 9 (88 - 112)	96 ± 9 (81 - 118)
4.3	97 ± 8 (81 - 111)	92 ± 8 (70 - 106)	104 ± 7 (92 - 114)	93 ± 11 (80 - 115)	106 ± 11 (93 - 128)	98 ± 9 (83 - 121)
5.3	93 ± 7 (82 - 106)	98 ± 9 (76 - 110)	104 ± 7 (93 - 113)	99 ± 11 (87 - 120)	106 ± 10 (95 - 127)	103 ± 7 (90 - 127)
6.3	97 ± 6 (86 - 108)	96 ± 9 (70 - 108)	111 ± 8 (95 - 123)	101 ± 10 (89 - 121)	109 ± 12 (85 - 127)	
7.3	97 ± 8 (87 - 115)	100 ± 9 (73 - 112)	111 ± 8 (93 - 121)	105 ± 14 (84 - 130)		
8.3	101 ± 7 (86 - 114)	102 ± 10 (76 - 117)	115 ± 9 (102 - 129)			
9.3	101 ± 8 (89 - 118)	105 ± 12 (71 - 119)				
10.3	102 ± 7 (92 - 120)					

In 1981 one stag sired calves from only three out of 20 hinds. Seasonal weight changes of these hinds, together with other non-calving hinds from other mating groups, were compared to those of calving hinds run in the same herd from May to November (Table 6). Median date for calving was 5 December. Liveweight changes between March and September for calving hinds ranged between +9 and −5.5 kg and were significantly greater than those for non-calving hinds, which ranged between +1 and −15.5 kg. Assuming the liveweights for these two groups were normally distributed with common variance but different means, a critical liveweight change from March to September of −4.3 kg can therefore be used to identify pregnant hinds correctly with a probability of 0.95 and to identify non-pregnant hinds correctly with a probability of 0.73.

Table 6 Comparison of mean pre-mating (23 Mar) liveweights of pregnant and non-pregnant adult red deer hinds and liveweight changes from then to the beginning of winter (May), end of winter (Sep), and to pre-calving (Nov).

	Pregnant (n = 33)	Non-pregnant (n = 21)	SED
Pre-mating liveweight (kg)	94.7	96 .6	2.2
Change of liveweight (kg)			
23 Mar - 27 May	4.6	2.6	0.8
23 Mar - 8 Sep	1.7	−6.5	1.0
23 Mar - 11 Nov	14.2	−4.1	1.2

Stag liveweight

Records of stag liveweights are limited because many stags were slaughtered at young ages for venison and carcass evaluation. The February (late summer) stag liveweights (Table 7) are for all those stags alive at last weighing. Wide variation in stag liveweights at various ages were recorded. At 0.3 years stags ranged over 40 kg in liveweight, at 1.2 years over 51 kg, at 2.2 years over 69 kg, at 3.2 years over 89 kg, at 4.2 years over 91 kg, and older stags 109 kg. Stags do not appear to reach mature liveweight until 5.2 years of age or older with liveweight at 1.2 years of age less than 50% of liveweight at 5.2 years of age.

Table 7 Means, standard deviations, and ranges of stag liveweights with age.

Age in years	Liveweights (kg) Born 1975 n = 12	Born 1978 n = 36	Born 1979 n = 13
0.3	40 ± 7 (22 - 52)	49 ± 7 (28 - 62)	52 ± 4 (47 - 60)
1.2	89 ± 8 (73 - 103)	95 ± 9 (77 - 117)	106 ± 10 (91 - 124)
2.2	120 ± 12 (99 - 138)	134 ± 14 (102 - 157)	143 ± 18 (107 - 168)
3.2	152 ± 16 (122 - 172)	161 ± 19 (117 - 199)	184 ± 17 (148 - 206)
4.2	180 ± 20 (146 - 210)	183 ± 21 (139 - 220)	212 ± 14 (180 - 230)
5.2	192 ± 21 (154 - 232)	212 ± 20 (170 - 263)	

Hind and stag mortality

Hind mortality

Mortality was low for farm-bred hinds aged up to 11 years. Over 1028 hind years, mortality averaged 1.3% per annum. Causes included malignant catarrhal fever, yersiniosis, dystocia, and misadventure.

Stag mortality

Mortality of farm-bred stags averaged 1.9% per annum for 532 stag years. Mortality for stags aged 15 - 27 months was less than 1% per annum but **higher (4%) for stags aged 28 - 39 months.** The number of stags over 5 years of age was small and did not provide usable information. Most of the stag deaths occurred over winter and appeared to be the result of a starvation/exposure syndrome as described by McAllum (1980).

DISCUSSION

Improvements in the performance of the farmed red deer can be attributed to the adaptation of the deer to farming, improvement in their farm environment, and improvement in management of the herd. Further improvements have resulted from an understanding of the nutritional requirements of farmed red deer by age and sex class (Fennessy & Milligan 1987).

Birth weights of calves at Glensaugh averaged 6 - 7 kg, similar to those recorded at Invermay in 1973 - 74. Asher & Adam (1985) reported birth weights for red deer calves of 9.4 kg (male) and 8.9 kg (female) in a survey of Northern North Island farms. These birth weights are similar to those recorded in later years at Invermay.

The variation in the sex ratio of embryos from wild shot hinds is similar to that for calves born in our study. Miller (1932) found a sex ratio of 60 : 40 in favour of males and Lowe (1969) reported a ratio of 38 : 62 in favour of females. In the Glensaugh study overall sex ratio at birth was 53 : 47 in favour of males but there was an unexplained preponderance of male calves in even-numbered years and female calves in odd-numbered years (Blaxter & Hamilton 1980).

The mortality of deer calves was an important consideration in the feasibility of economically farming the red deer. At Glensaugh mortality of calves, including stillbirths, from birth to 3 months of age averaged 11.6% and was related to calf sex and birthweight. A large proportion (72%) of the dead calves at Glensaugh were males with mortality being 100% for calves less than 4 kg at birth, 5% for calves weighing 6 - 7 kg at birth, and rising again to 13% for calves over 8 kg. The high calf mortality recorded at Invermay in 1973 - 74 was associated with lighter mean birth weights but largely resulted from trauma caused by hinds beating calves (Drew & Kelly 1975). Calf mortality in the Glensaugh and Invermay herds may be higher than for commercial herds because of disturbance to calving groups for experimental recording.

Blaxter & Hamilton (1980) also found young males gained weight at a greater rate than females. The lactational demand on the hind by the male calf is greater than by the female (Clutton-Brock et al. 1982) and therefore male weight gain is more likely to be lower than expected when hind milk yield is reduced. This suggests poorer nutrition of hinds or stress in 1973 - 74 adversely affected calf growth to weaning through lower birth weights and also reduced hind milk yield.

Our farm management records and the research of Loudon et al. (1984) suggest nutrition over calving affected calf growth to weaning in 1973 - 74. With the 1973 - 74-born cohorts pasture was allowed to go rank to provide cover for the calves, whereas the 1982 - 83-born calves and their dams grazed vegetative pasture with artificial hides of pine tree branches provided. Growth rates of Scottish red deer calves have been shown to increase considerably with the quality and quantity of pasture on offer over lactation (Loudon et al. 1984). Their study showed that calf growth rates can vary

by 100 g per day depending on the quality and quantity of pasture. At a 100-day weaning, this difference can account for 10 kg in weaning weight. There were marked improvements from the 1978 cohort on. Although an increase in birth weights is likely to be related to the higher weaning weights of the 1982-83 calves compared to the 1973-74 calves, improved pasture quality and perhaps also heavier dam weight contributed to the increased weaning weight of the calves in 1982-83.

The characteristic seasonal growth pattern of young red deer with low winter gain, high spring-summer gains, and intermediate gain over their first autumn has been shown in other studies (Adam & Asher 1986) and in pen-fed deer (Blaxter et al. 1974; Fennessy 1982). Results from these studies indicate that higher autumn growth rates of calves can be achieved and that potential for calf growth over their first autumn is higher than in their first winter.

High growth rates of young weaned calves over autumn have been achieved in hand-reared penned deer with stags growing at 330 g per day and hinds at 250 g per day (Blaxter et al. 1974). These growth rates are considerably higher than the autumn growth rates of naturally reared calves at Invermay where overall autumn growth rate is probably depressed by a growth check at weaning and a reduction in the quantity of pasture on offer as winter approaches. In a study of farmed deer by Adam & Asher (1986), autumn gains of 200 g per day were shown to be possible, but trials indicated that to achieve this, pasture offer must exceed expected maximum daily intake by a factor of at least 3. Their study also showed that increasing autumn stocking rates of male red deer calves from 16 to 24/ha reduced average autumn gain from 137 to 87 g per day.

The average seasonal growth rates of males compared to females (Table 4) have important implications for management of calves. The difference between autumn growth rates (8%) suggests sexes need not be separated for efficient feeding. Growth potential over winter is higher for males (+76%) and if male winter gains are economically important then separation of calves by sex for preferential winter feeding of males may be beneficial. Over spring-summer, the (+48%) difference in male growth is important in feed budgetting particularly when stock are strip-grazed.

In our study the highest mortality of weaned calves occurred over winter. In early winter young deer are susceptible to the combined effects of cold stress, wind chill, and adaptation to a diet of supplements, although it is difficult to attribute death to these factors. Blaxter et al. (1981) found the heaviest mortality in calves (12.9%) occurred in early winter during the first 2 months after weaning. In their study, failure of naturally reared calves in one year to quickly learn to eat concentrate feed was partly responsible for the high overall mortality. In the overall winter mortality, contrary to expectation, no association between weight of calf at weaning and mortality was found.

Table 8 Comparative performance of red deer farmed at Glensaugh and Invermay.

	Glensaugh	Invermay
Stocking rate		
hinds per ha	1	10
Calving (%)	72	91
Output of weaned calves		
kg per ha	27.5	394
kg per hind	27.5	39.4
Liveweights (kg)		
15-mth stags	68	96
15-mth hinds	59	74
5-yr stags	114	207
7-yr hinds	78	102

Blaxter et al. (1981) reported the mature weight of 82 kg for farmed Scottish hinds which is substantially lower than the 100 kg plus for hinds shown in Table 5. Liveweight of the Scottish hind was affected by year, age, and whether or not the hind produced a calf. Adult hinds declined slightly in weight with age from 82 kg after three breeding seasons to 73 kg after eight seasons when the hinds were aged 9 years. No such decline was apparent in the mating liveweights of the oldest Invermay hinds (Table 5) probably because of better nutrition.

Liveweight changes of adult hinds from mating to end of winter appear from our study to be a seasonable indicator of whether or not they will produce a calf. Errors in predictions are likely to arise from the reabsorption or abortion of the foetus post-winter, in unhealthy and victimised pregnant hinds which have lost liveweight, and late mated hinds in whom the conceptus is still relatively light by the end of winter.

The hind mortality rate of 1.3% in our study is similar to the 1.8% per annum reported by Blaxter et al. (1981) for hinds up to 9 years of age.

Table 8 highlights the performance of red deer of similar genotype farmed under harsher environmental conditions at Glensaugh, Scotland (Blaxter et al. 1974). Production of weaned calves at Invermay was calculated using an 84% weaning (Moore 1984) and weaning weights of the 1982-83 cohorts (Table 3). The 14-fold better production of weaned calves at Invermay clearly reflects the environmental differences between Glensaugh and Invermay. This comparison has implications not only for selection of red deer farm sites but also

for the management of wild red deer for sustained yield.

At Glensaugh winter lasts 6 months compared to 3 months at Invermay. As a result the quality and seasonal production of grazing is much greater on Invermay. In the Scottish study lower birth weights and calf growth rates produce 15-month liveweights substantially below those achieved at Invermay. This adversely affects production, as stag liveweight at 15 months is strongly related to later liveweight and velvet antler weights (Moore et al. 1988). Similarly the liveweight of yearling hinds is critical for successful mating at 16 months (Kelly & Moore 1977; Hamilton & Blaxter 1980). Calving performance for hinds aged 2 years averaged 41% at Glensaugh compared to 90% for hinds over 65 kg at Invermay. Obviously deer production is enhanced when they are farmed well on the better classes of agricultural land and fencing costs of course are reduced per head of stock on land of higher carrying capacity.

Scottish red deer have the genetic potential to grow bigger when nutrition is improved. For instance, young pen-fed stags from Scottish wild stock fed to appetite can be grown to over 110 kg at 15 months, compared to 70 kg or less for 15-month-old farmed stags at Glensaugh (Blaxter et al. 1974; Hamilton & Blaxter 1981). However, the costs of improving nutrition through feeding supplements has to be reckoned with. Adam's (1985) study on indoor winter feeding of young Scottish stags showed that the 16-month venison produced by stags on a low plane winter diet was more cheaply produced per kg than that of better winter-fed stag calves. This finding may not apply to outdoor winter feeding where underfeeding may result in mortality as a result of cold stress.

The low mortality of the Invermay deer indicates that it is possible to manage them satisfactorily, which was the main early objective, and that our observations and records are for deer farmed under good management. Some of the improvement in performance has been achieved by selection of sires and some culling of breeding hinds. Many commercial deer farms have culled young stock to a highly variable degree with stock sold to other farms. Therefore, their performance records are often not representative of the original weaned cohorts. Hence we consider out data on growth rates and liveweights of young deer to 15 months of age provide valuable benchmark data. Comparison of performance parameters can be made, using the means and standard deviations, between this red deer herd and another. These comparisons, while somewhat subjective in nature, can at least produce leverage in seeking improvements in deer performance.

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