Reproduction of Farmed Red and Fallow Deer in Northern New Zealand

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Abstract

Interim data are presented on reproductive performance, calving season, calf mortality, and maternal/farm influences on calf size and growth, for red and fallow deer (*Cervus elaphus* and *Dama dama*) farmed in the northern North Island. Data were obtained from farms monitored during the calving season and from postal surveys to deer farmers.

Calving and weaning rates were generally higher and more consistent between years for red deer than for fallow deer. Calving and calf mortality rates were generally higher on monitored than surveyed farms. Most surveyed farmers appeared to underestimate calf drop and calf losses, although more calf losses may have occurred on monitored farms. The frequencies of calf birth dates on monitored farms were typically skewed distributions. Red deer calving seasons were noticeably longer than those of fallow. Postmortem examination of calf deaths revealed a higher proportion of red calf deaths through starvation and dystocia, while more fallow calves died from misadventure and non-viability. In both species the mortality rate increased with decreasing birth weight.

Calf birth weights were positively related to birth date and dam March liveweight for both species; weaning weights and liveweight gains to weaning were positively related to birth weight, weaning age, and dam liveweight. Means, adjusted for the covariates, displayed significant calf sex differences. Dam age had a significant effect on fallow calf birth weight only. Farm differences observed between red deer farms are discussed in relation to nutrition and possible genetic influences.

Keywords: Cervus elaphus, Dama dama, *reproduction, calving season, calf mortality, birth weights, weaning weights, nutrition*

Introduction

Diversification of pastoral farming in New Zealand has led to a recent and rapid increase in the numbers of farmed deer. In the northern North Island much of this expansion has taken place on high-fertility land capable of alternative uses such as horticulture. There is, therefore, a need to monitor aspects of deer performance to ascertain profitability relative to other land uses. Because of the high price of breeding stock, reproductive performance is particularly important and warrants detailed investigation.

Some aspects of reproduction of red deer under pastoral conditions in New Zealand have been reported (Kelly and Whateley 1975; Kelly and Moore 1977). However, data on farmed fallow have been fragmentary and are often anecdotal. Overseas studies have likewise concentrated on farmed red deer rather than on fallow deer, particularly hind fertility and dam/calf relationships (Hamilton and Blaxter 1980; Blaxter and Hamilton 1980).

This paper presents some interim data on red and fallow deer obtained from a continuing farm monitoring programme designed to investigate reproductive rates, calving season, calf mortality, and maternal/farm influences on calf size and growth. Data are from farms within the northern North Island region.

Methods

Data were obtained from 2 sources, namely a postal survey and an on-farm monitoring of calving.

Postal survey

In April 1981 and 1982 deer farmers were asked to provide details on the number of females present before the start of calving in November/December, the calves weaned or counted in March, and the number of dead calves observed before March. Additional questions in 1982 included the number of abortions observed before calving and the number of assisted calvings.

On-farm monitoring of calving

The breeding female populations on several farms were monitored daily during the calving period,

Table 1: Sample sizes on monitored farms

Farm	2-yr-old females	Older females	Total females	Calves born	Valid calf/ dam matches
Red deer: 1981/82 season					
R1	0	22	22	21	10
R2	12	67	79	74	63
R3	0	57	57	57	42
R4	0	162	162	141	57
R5	5	132	137	118	82
R6	24	5	29	26	–
Total	41	445	486	437	254
Fallow deer: 1980/81 season					
F1	0	99	99	72	0
F2	0	69	69	56	0
F3	4	10	14	11	0
F4	–	–	–	–	–
Total	4	178	182	139	0
1981/82 season					
F1	30	98	128	112	99
F2	–	–	–	–	–
F3	7	28	35	34	0
F4	5	42	47	46	29
Total	42	168	210	192	128

between early November and late February (Table 1). Calves were ear tagged, sexed, and weighed within 24 hours of birth. Dead calves were retrieved for postmortem examination (after McFarlane 1965) to determine the cause of death.

In the 1981/82 season, attempts were made to match calves with their respective dams by multiple observations of suckling activity. On farms R1, R3, R4, R5, F1, and F4 hinds/does were weighed in March (pre-rut) and identification collars were attached in the following October (before calving). Valid calf/dam matches were not always possible and the proportion of calves repeatedly identified as belonging to a particular dam varied among farms (Table 1) depending on terrain and vegetative cover. Doubtful matches (e.g. because of cross-suckling) were edited out of the overall analyses.

Terms used in the text are defined as follows:

Calving rate: the number of calves born per 100 hinds/does present at calving.

Minimum calving rate: estimation of *calving rate* of surveyed farms based on the sum of calves weaned/counted in March and the number of observed calf mortalities prior to that period.

Weaning rate: the number of calves weaned/counted in March per 100 mated hinds/does present at calving.

Calf mortality rate: the number of calf deaths before March per 100 calves born (monitored farms).

Minimum calf mortality rate: estimation of *calf mortal rate* of surveyed farms based on the number *observed* calf deaths before March.

Minimum abortion rate: the number of abortio observed prior to calving per 100 mated hinds/do (considered an underestimate of actual abortic rate on both monitored and surveyed farms).

Minimum conception rate: the sum of the number calves counted/weaned in March, the number calf mortalities observed before March, and t number of abortions observed prior to calving, p 100 mated hinds/does.

Assisted calving rate: the number of assisted calvin per 100 mated hinds/does.

As calving periods occurred at the end ar beginning of consecutive years, they are referr to as the 1980/81 and 1981/82 seasons.

Analyses were performed separately for red ar fallow deer; data for birth weight, weaning weigh and growth rate to weaning were analysed by fittir various models using Genstat. Interaction tern were examined and found to be non-significan Results are presented as least-square mea adjusted for sources of variation which minimis residual variation.

Results and Discussion

Reproductive performance (*surveyed and monito farms*)

Table 2 presents the main parameters

reproductive performance of red and fallow deer for 2 calving seasons. Postal survey returns were combined for 3 regions, Waikato, Bay of Plenty, and South Auckland.

Overall red deer calving, weaning, and mortality rates were consistent between the 1980/81 and 1981/82 seasons. The performance of fallow does was variable between years, showing non-significant increases in both the minimum calving rate ($\chi^2 = 0.44$, 1 df, NS) and weaning rate ($\chi^2 = 3.29$, 1 df, $P < 0.10$) and a decrease in the minimum calf mortality rate ($\chi^2 = 0.90$, 1 df, NS) in the 1981/82 season. Most of this variation between years was observed on the monitored farms which accounted for 35 – 40% of the fallow does in the overall sample (compared with 10.3% for red deer in 1981/82).

The minimum abortion rate of 4.2% for fallow deer (surveyed in 1982 only) represented an important source of reproductive wastage. However, abortions were observed on only 7 of the 29 farms in the 1981/82 season. Consequently, the effects on reproductive rates were dramatic on individual farms (e.g. 10% of does aborted on farm F1 before the 1981/82 calving season). In contrast, late-term (third trimester) abortions were not a significant cause of reproductive wastage in red deer populations.

Many farmers commonly avoided disturbing hinds/does and their calves during the calving season. Consequently, it is likely that both the number of calves born and the number dying before weaning were underestimated in the postal survey data. Comparison of reproductive rates of surveyed and monitored farms (Table 2) adds some support to this hypothesis. While monitored red deer farms in the 1981/82 season had higher calving rates ($\chi^2 = 2.42$, 1 df, NS) and calf mortality rates ($\chi^2 = 7.27$, 1 df, $P < 0.01$) than surveyed farms, the weaning rates were similar ($\chi^2 = 0.46$, 1 df, NS). Although fallow deer data followed this pattern in the 1981/82 season, the calving rate on monitored farms was lower in the 1980/81 season. This may be due to the chance influence of the few monitored farms which represented a high proportion of the total sampled doe population. Higher calf mortality rates on monitored farms may have been induced to some extent by disturbance of hinds/does through handling the newborn calves. This is discussed below.

There was no significant difference in the assisted calving rates between monitored and surveyed farms for either red or fallow deer.

The reproductive performance of individual monitored farms (Table 3) varied with respect to calving and weaning rates and, to a lesser degree, calf mortality rate.

Calving season *(monitored farms)*

The frequency of birth dates for red calves born in the 1981/82 season and those of fallow calves born in the 1980/81 and 1981/82 seasons are given in Fig. 1. Both species displayed typically skewed distributions, the tail of late-born calves representing either second/third cycle conceptions or late oestrus hinds/does.

The percentage of calves born in each month of the calving period and the median calving date are presented in Table 4. The onset of calving was considerably earlier for red deer on 5 of the 6 farms than for fallow deer on all farms. However, the median calving dates for the 2 species were similar,

Table 2: Reproductive performance of deer on surveyed and monitored farms

	1980/81			*1981/82*		
Red deer	Surveyed	Monitored	Total	Surveyed	Monitored	Total
Farms (*n*)	103	–	103	103	6	109
Hinds (*n*)	3 629	–	3 629	4 218	486	4 704
Min. calving rate[1]	87.4	–	87.4	86.0	89.9	86.4
Weaning rate	80.4	–	80.4	80.3	78.8	80.1
Min. calf mortality rate[1]	7.9	–	7.9	6.7	12.4	7.3
Min. abortion rate	–	–	–	0.02	0.00	0.02
Assisted calving rate	–	–	–	2.3	2.1	2.1
Fallow deer						
Farms (*n*)	22	3	25	26	3	29
Does (*n*)	337	182	519	315	210	525
Min. calving rate[1]	86.1	76.4	82.7	79.4	91.4	84.2
Weaning rate	70.9	61.5	67.6	69.5	77.6	72.8
Min. calf mortality rate[1]	14.1	19.4	15.9	12.4	15.1	13.6
Min. abortion rate	–	1.1	–	3.2	5.7	4.2
Assisted calving rate	–	1.1	–	1.0	1.4	1.1

[1] Actual rates on monitored farms; *see* text for definitions of terms

Table 3: Reproductive performance of deer on monitored farms

Red deer	Farm:	R1	R2	R3	R4	R5	R6
		1981/82 season					
Hinds (*n*)		22	79	57	162	137	29
Calves born (*n*)		21	74	57	141	118	26
Calving rate		96	94	100	87	86	90
Calves weaned (*n*)		19	66	51	121	104	22
Weaning rate		86	84	90	75	76	76
Calf deaths (*n*)		2	8	6	20	14	4
Calf mortality rate		10	11	11	14	12	15
Assisted calvings (*n*)		0	4	2	1	3	0
Abortions (*n*)		0	0	0	0	0	0
		1980/81 season			*1981/82 season*		
Fallow deer	Farm:	F1	F2	F3	F1	F3	F4
Does (*n*)		99	69	14	128	35	47
Calves born (*n*)		72	56	11	112	34	46
Calving rate		73	81	79	88	97	98
Calves weaned (*n*)		58	45	9	93	31	39
Weaning rate		59	65	64	73	89	83
Calf deaths (*n*)		14	11	2	19	3	7
Calf mortality rate		19	16	18	17	9	15
Assisted calvings (*n*)		1	0	1	1	0	2
Abortions (*n*)		0	2	0	12	0	0

Table 4: Distribution of calving by month

Farm	Calves born: Total (*n*)	Nov (%)	Dec (%)	Jan-Mar (%)	Median calving date
Red deer: 1981/82 season					
R1	21	0	86	14	15 Dec
R2	74	47	45	8	1 Dec
R3	57	49	46	5	30 Nov
R4	141	11	82	6	9 Dec
R5	118	36	52	2	6 Dec
R6	26	12	77	12	11 Dec
Total	437	29.6	62.7	8.7	7 Dec
Fallow deer: 1980/81 season					
F1	72	0	93	6	8 Dec
F2	56	0	96	14	12 Dec
F3	11	0	82	18	13 Dec
Total	139	0	94.2	5.8	11 Dec
1981/82 season					
F1	112	5[1]	84	11	13 Dec
F3	34	0	94	6	12 Dec
F4	46	2[1]	83	15	17 Dec
Total	192	3.7[1]	85.4	10.9	14 Dec

[1] All premature, non-viable calves

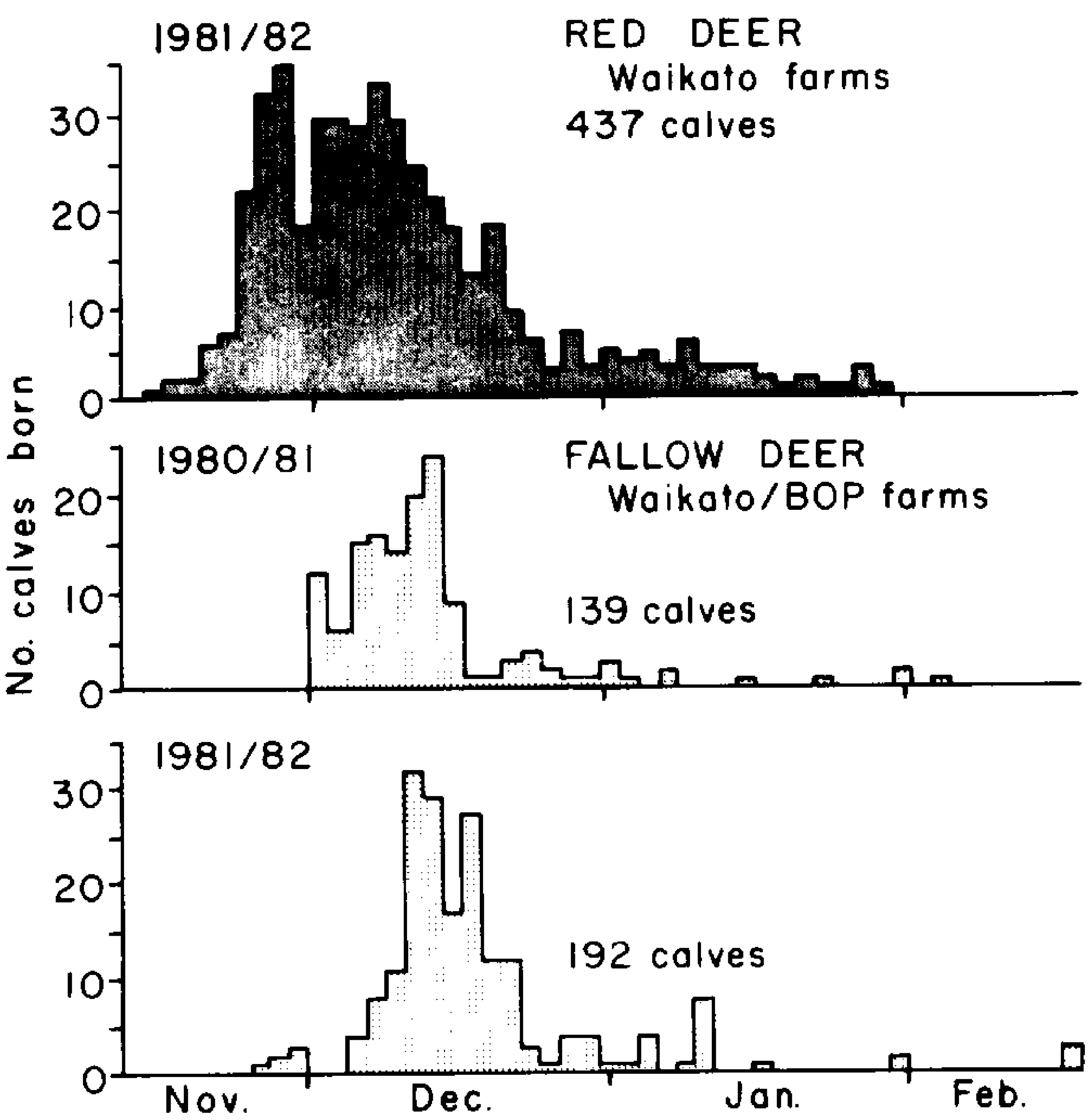

Fig. 1: Distribution of birth dates of red deer on 6 Waikato farms and fallow deer on 3 Waikato/Bay of Plenty (BOP) farms.

as were the proportions of calves born after December.

Calf mortality (*monitored farms*)

Postmortem diagnoses of calf mortalities from 4 monitored red deer farms and all monitored fallow deer farms are summarised in Table 5.

The incidence of deaths through starvation was considerably higher for red than fallow deer. Although a number of factors can lead to starvation in neonates (ill health or inexperience of the dam, calf non-viability, etc.), the starvation rate is considered to be indicative of mismothering/dam rejection problems related to calf handling. The overall incidence of deaths through starvation was 5.1% of red calves born in the 1981/82 season versus 3.4% and 3.1% respectively of fallow calves born in the 1980/81 and 1981/82 seasons. Red calves often failed to remain in the same position after tagging and weighing, and this may have led to mismothering (*see* Kelly and Whateley 1975). In contrast, fallow calves seldom moved after handling. For both species, some mismothering/dam rejection was known to have occurred before any handling of the calves; this was characterised by the presence of dried placental membranes on the calf.

The death rate due to dystocia (any parturient damage resulting in calf death) was also higher for red than fallow deer. This is reflected in the assisted calving rates presented in Table 2. Insufficient data relating to calf/dam identifications were obtained to investigate the effects of calf and dam weights on the incidence of dystocia.

Two important causes of mortality of fallow calves were misadventure (usually hung up in fences) and non-viability (undersized at birth or premature). Misadventure rates decreased in the 1981/82 season, presumably in response to changes in management with respect to calving paddocks and fences. The increase in the number of non-viable calves in 1981/82 was mostly related to 1 farm, F1, and may have been linked with the high incidence of observed abortion. Another factor to be considered is the effect of dam age on calf birth weight; this is discussed below.

For both species, decreasing birth weight was generally associated with an increasing incidence of mortality (Table 6). Marked increases in mortality were observed in red calves with birth weights 6.0 kg or less (39%) and fallow calves with birth weights 3.0 kg or less (67%).

Factors affecting calf size (*monitored farms 1981/82*)

Having observed that calf mortality was influenced by birth weight, data from monitored farms were examined in detail to determine factors influencing birth weight. Similar analyses were also done on weaning weight and growth to weaning. Major factors examined included farm, calf sex, and dam age. Additional sources of variation examined were dam's March liveweight (previous weaning), and birth date, weaning age, and birth weight of calf.

Birth weight in both red and fallow deer was positively related to both birth date and hind/doe liveweight (Tables 7 and 8). Whereas birth weights from 2-year-old fallow does were lower than those from older does, even after being adjusted for differences in doe liveweight, the same was not true for red hinds. However, only 1 of the 4 farms analysed possessed 2-year-old red deer hinds and these represented only 3.2% of all hinds, as opposed to 25% in the case of fallow does.

Even after adjusting for birth date and dam liveweight, birth weights were found to differ by sexes and farm for both red and fallow deer. For fallow there was the additional effect of dam age. Irrespective of dam size, 2-year-old does calving for the first time produced lighter calves. As calf survival was related to birth weight (Table 6), calf mortality will probably always be higher in first calvers irrespective of their liveweight relative to older does.

Weaning weights in red and fallow deer were positively related to birth weight and weaning age. Thus, for each additional 1.0 kg in birth weight, weaning weight increased by 1.4 kg in red deer and

Table 5: Postmortem diagnosis of calf deaths

Cause of death	Calf deaths (n)	% of deaths	Calf deaths (n)	% of deaths
Red deer (4 farms monitored in 1981/82 season)				
Starvation	17	42		
Dystocia	14	34		
Misadventure	8	20		
Infection	1	2		
Unknown	1	2		
Total	41	100		
Fallow deer (3 farms monitored in 1980/81 and 1981/82)				
Misadventure	10	38	2	7
Non-viable	3	11	12	42
Dystocia	3	11	7	24
Starvation	5	18	6	21
Pneumonia	2	7	0	0
Diarrhoea	1	4	0	0
Other infection	2	7	0	0
Abnormality	0	0	1	3
Unknown	1	4	1	3
Total	27	100	29	100

Table 6: Relationship of calf mortality to birth weight

Red deer: 1981/82 season Birth weight (kg):	<6	6.1−7.0	7.1−8.0	8.1−9.0	9.1−10.0	10.1−11.0	>11.0	Total
Calves born	18	38	100	111	93	49	15	424
Calf deaths	7	4	11	11	11	2	0	46
Mortality rate (%)	39	11	11	10	12	4	0	10.9

Fallow deer: 1980/81 and 1981/82 season Birth weight (kg):	<3	3.1−4.0	4.1−5.0	>5.0	Total
Calves born	27	155	133	5	320
Calf deaths	18	21	13	0	52
Mortality rate (%)	67	14	10	0	16.3

1.1 kg in fallow deer. Equally, for every extra week weaning was delayed in March, weaning weights were apparently (though not significantly) increased by 2.1 kg in red deer and 1.4 in fallow deer. The same thing was observed in the 1980/81 season in data from other farms (Asher *et al* 1981).

Dam age effects on weaning weights and liveweight gains up to weaning were not significant for either species. For fallow deer, this is in contrast to the significant dam age effect of birth weight. However, a component of the lightest birth weights will have been removed via increased calf mortalities (Table 6) and this will have had the effect of biasing weaning weights and liveweight gains to those calves of heavier birth weights, hence reducing the apparent dam age effect on these 2 characters.

Even though birth weights, weaning weights, and liveweight gains were adjusted for several covariates, significant differences were observed between red deer farms, but not between the 2 fallow deer farms.

Two confounding situations were apparent c the red deer farms, namely the level of nutritic prior to and during the calving/lactation period ar the genetic origins of the breeding stock.

Nutritional effects on weaning weights we: subjectively more obvious than any genetic effect Both farms R4 and R5 were on drought-prone pe soils and suffered from dry summer conditior during the calving season, leading to rank, di pastures. Farm R5 was most severely affected ar some hinds with calves at foot had ceased to lacta by the end of February. Farms R1 and R3 appeare to maintain reasonable-quality pastures by carefi spring/summer pasture management. Pasture c R1 was noticeably short, dense, and complete vegetative throughout the calving/lactation perio The importance of maintaining pasture qualit during this season cannot be overstressed, but requires quantification in future studies.

Factors affecting birth weight were not so easi assessed. Conclusions relating to nutritional effec

Table 7: Regression coefficients and adjusted mean values for birth weight, weaning weights, and pre-weaning liveweight gain for red deer calves and the relationships with dam weight, birth date and weight, and age at weaning derived from analysis of covariance procedures

	Birth weight (kg)	Weaning weight (kg)	Liveweight gain (g/day)
Regression coefficients (+s.e.)			
Dam weight (kg)	0.036 (0.007)***	0.074 (0.028)*	0.624 (0.281)*
Birth date	0.003 (0.005)NS	–	–
Birth weight (kg)	–	1.429 (0.268)***	5.322 (2.7227)**
Weaning age (days)	–	0.310 (0.017)	0.485 (0.176)†
Adjusted means (n)			
Overall	9.14 (177)	40.8 (176)	321 (176)
Sex			
Male	9.42 (88)	42.1 (88)	334 (88)
Female	8.85 (89)	39.4 (88)	309 (88)
s.e.d.	0.15	0.53	5.4
Dam age			
2-year-olds	9.16 (3)	43.3 (3)	329 (3)
Older hinds	9.11 (174)	38.2 (173)	314 (173)
s.e.d.	0.56	1.99	20.3
Farm			
R1	10.25 (8)	45.3 (8)	393 (8)
R3	9.20 (44)	42.6 (43)	331 (43)
R4	9.53 (49)	39.3 (49)	319 (49)
R5	7.55 (76)	35.8 (76)	242 (76)
s.e.d.	0.36	1.28	13.0

† $P < 0.10$

Table 8: Regression coefficients, adjusted birth weights, weaning weights, and pre-weaning liveweight gains of fallow deer calves (1981/82)

	Birth weight (kg)	Weaning weight (kg)	Liveweight gain (g/day)
Regression coefficients (+s.e.)			
Dam weight (kg)	0.039 (0.017)*	0.048 (0.042)NS	0.594 (0.517)NS
Birth date	0.011 (0.005)*	–	–
Birth weight (kg)	–	1.149 (0.274)***	1.764 (3.357)NS
Weaning age (days)	–	0.196 (0.013)***	0.270 (0.166)NS
Adjusted means (n)			
Overall	3.68 (121)	18.1 (107)	171 (107)
Sex			
Male	3.91 (62)	19.1 (56)	183 (56)
Female	3.47 (59)	17.0 (51)	158 (51)
s.e.d.	0.09	0.24	3.0
Dam age			
2-year-olds	3.38 (21)	17.7 (17)	166 (17)
Older does	4.00 (100)	18.4 (90)	175 (90)
s.e.d.	0.14	0.4	4.9
Farm			
F1	3.64 (96)	17.9 (83)	168 (83)
F4	3.74 (25)	18.3 (24)	173 (24)
s.e.d.	0.13	0.32	3.6

during the gestation period would be highly speculative, and most residual effects from the previous calving/lactation season would probably be accounted for via dam liveweight.

Possible genetic effects on birth weight, weaning weight, and liveweight gains cannot be ignored. Farm R5 had hinds derived mainly from northern South Island (Nelson) stock, whereas the other farms had mainly southern South Island stock. Again, indications of genetic influences are speculative at this stage and future studies may also need to investigate sire effects on these characters.

Monitoring of the farms in this study is continuing. Later investigations may clarify such matters as dam age effects on calf size, as well as examining the repeatability of dam calving date and offspring performance.

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