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ABSTRACT

Two accelerated lambing systems, Morlam using Morlam sheep (USDA, Beltsville 1966 to 1975) and Camal using Dorset ewes (Cornell 1978 to 1981), were evaluated for first lambing ages, interlambing intervals and conception probabilities. Morlam ewes were continuously exposed to rams over the year, while Camal Dorset ewes were exposed every other month. Morlam lambs were mated as early as 367 d of age and Camal Dorset lambs as early as 340 d. Early lambing was associated with higher rates of perinatal mortality (P>.05) and smaller litter size (P<.01). Lambing years among Morlam ewes and season of birth of Camal Dorset ewes influenced (P<.01) their first lambing ages. Lambing intervals averaged 293 and 303 d among Morlam and Camal Dorset ewes, respectively. Age at first lambing and season in which the previous lambing occurred with influential factors (P<.01) on lambing intervals of Morlam ewes; longer intervals resulted when ewe lambs were mated at early ages (<12 mo), and when the previous lambing occurred in winter. Estimates of conditional probabilities of conception by month given the occurrence of estrus, reflected seasonal changes in both systems. The overall probability of conception for the Morlam system (P=.16) was relatively higher than that for the Camal Dorset system (P=.14); numbers of lambings per ewe per yr were 1.28 and 1.21, respectively. Estimates of heritability for age at first lambing, lambing interval and conception probability were .31, .06 and .30, respectively.

(Key Words: Sheep, Reproductive Performance, Lambing Season, Repeatability, Heritability.)

Introduction

Accelerated lambing systems (ALS) are designed to increase the number of lambs produced per ewe per year as an economic alternative for the breeder to market a more uniform supply of lambs over the year, particularly for those conditions that favor or characterize production systems under partial or total confinement (Hogue et al., 1980). This strategy is based on: 1) breeding ewes anytime, and at least more than once a year and 2) increasing number of lambs per lambing.

Seasonal reproduction is prevalent in the northern hemisphere and represents the main constraint to any ALS. Nevertheless, breed differences regarding breeding seasonality are well-documented in the literature (Shelton, 1968; Parker, 1972), and they have been used to circumvent partially the seasonal restriction.

In this communication, an evaluation of the reproductive performance of sheep under two such ALS is reported: the Morlam system, also associated with the development of Morlam sheep by the U.S. Department of Agriculture (USDA), representing continuous exposure to the ram, and the Camal Dorset system of Cornell, representing a modification of permanent exposure. Both systems were implemented for eastern, and particulary northeastern, conditions of the United States.

Materials and Methods

Morlam. The Morlam system was introduced parallel to the development of Morlam sheep by USDA at Beltsville, Maryland from 1966 to 1975. Under semi-confinement, ewes were exposed to rams continuously, except for a short period after lambing, and their lambs were weaned at an average of 9 wk (Terrill and Lindahl, 1975).

The foundation line of Morlam was constituted in 1960 and 1961 by intermating Merino, Dorset, Targhee, Columbia-Southdale, Hampshire and Suffolk ewes to Rambouillet rams. After 1961 the flock was closed. From 1964 to 1965 ewes were mated for limited periods in December, January, April, August and September. The pattern of inbreeding was evaluated by a procedure proposed by Quaas (1976), assum-

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ing no mutual relationships in the base population and inbreeding coefficients of zero. By 1973 all lambs born were inbred with an average inbreeding coefficient of .048, a level that should not produce important depression (Lax and Brown, 1968).

Selection was practiced on the basis of lambing out-of-season, emphasis favoring those ewes lambing in the summer and fall and those having more lambs per ewe per year (Terrill and Lindahl, 1975). Ewes remained in the flock until they were about 7 to 8 yr old. Starting in 1974, ewes were transferred gradually to Cornell University.

Camal Dorset. Camal, the acronym for Cornell Alternate Month Accelerated Lambing, was a system operated under semi-confinement on Dorset sheep at the Teaching and Research Center of Cornell University from 1978 to 1981. Complete management details of this system are given in Hogue et al. (1980). Briefly, the flock is divided initially into four subflocks that are exposed to breeding in succession at bimonthly intervals. Ewes from the first subflock are exposed again with those from the second, and again with those from the third, etc. By combining subflocks, ewes have the potential of lambing every 6, 8 or 10 mo, if they are bred during the first, second or third successive breeding periods (opportunities), respectively. Thus, rams are put with all ewes, including lactating ewes, every other month.

The foundation flock of Dorset ewes was constituted in 1962 and managed to lamb once a year until 1970. From 1971 to 1977 a system of two mating periods per year was implemented in the flock. With 1965 as a base, calculated inbreeding coefficients were generally lower than those recorded in the Morlam group. By 1981, 68% of the ewes were inbred with an average inbreeding coefficient of .038.

Data Analyses. Table 1 presents the traits, models and systems analyzed. Analyses of age at first lambing and inter-lambing intervals were based on fixed and mixed linear models where rams and dams within rams, as random components, contributed to variance components associated with differences among sires of paternal half-sibs and among ewes having repeated measurements, respectively.

Models in table 1 excluded interaction terms because preliminary analyses, testing the contri-

TABLE 1. MODELS AND MODEL COMPONENTS INVOLVED IN THE ANALYSES OF THREE REPRODUCTIVE TRAITS

	Trait			
	Age at first lambing		Lambing interval	Conception
Model components[a]	Morlam	Camal	Morlam	Morlam
Season of birth (i)	x	x		
Lambing year (j)	x	x	x	x
Breeding month (k)				x
First lambing age (l)			x	
Previous lambing				
Birth type (m)			x	
Season (i)			x	
Ewe age				
As main effect (n)				x
As covariate			x	
Sires (p)	x		x	x
Dams within sires (q)			x	
Records, no.				
No. sires	36	39	39	
No. ewes/sires			350	
Total records	450	326	1,176	1,176

[a]i: winter (i=1), spring (i=2), summer (i=3) and fall (i=4); j: years: 1966 (j=1) ,..., 1975 (j=10) for Morlam, or 1978 (j=1) ,..., 1981 (j=4) for Camal Dorset; k: January (k=1) ,..., December (k=12); l: age classes, mo: <12 (l=1), 12–17 (l=2), 18–23 (l=3), 24–30 (l=4), and >30 (l=5); m: singles (m=1) or multiples (m=2); n: ewe age classes, yr: <1 (n=1), 1–2 (n=2),..., >7 (n=8).

bution of all possible interactions with the pooled, within-subclass mean squares, found them to be nonsignificant.

Least-squares procedures were utilized to estimate fixed effects. Best linear unbiased estimators (BLUE) of differences among the levels of a given fixed effect were then obtained by subtracting the least-squares solutions of those levels from a selected reference one. Maximum likelihood procedures (ML) (under the assumption of normality) were used to estimate variance components. Heritabilities were calculated as $h^2=4 \cdot Vs/Vt$ and repeatabilities as $r = Va/Vt$ where Vs, Va and Vt represent variance components associated with sires of paternal half-sibs, ewes having repeated measurements and total phenotypic variance, respectively.

Chi-square tests concerning first lambing age were performed on original counts.

Conception was analyzed by a nonlinear method as described in Iniguez (1984). This method assumed that, under the breeding conditions of ALS, a given ewe will cycle regularly at fixed postpartum (30 d) and inter-estrus (17 d) intervals until the occurrence of a successful and seasonally influenced mating (conception). Thus, conditional to estrus presentation, conception was modeled as a probability by a geometric density that summarizes a series of failures to conceive ended by a success to conceive. Parameter estimation assumed that the conditional probabilities were explained by a logistic function. A likelihood ratio test, equivalent to the deviance criterion (Nelder and Wedderburn, 1972), was used in testing the statistical significance of effects included in table 1.

Due to sampling size, estimation and tests of hypotheses were mainly performed, as shown in table 1, on 10 yr of records of Morlam (1966 to 1975). Analyses by models in table 1 excluded records from ewes with unknown sire. No such exclusions were made in tables 4, 5 and 6.

In order to contrast the change conditioned by breeding strategies of both ALS, lambing records collected before the implementation of Morlam and Camal Dorset were included in the analyses of probabilities of conception. Thus, records from 1964 to 1965 among the foundation animals of Morlam ewes and from 1971 to 1977 among the foundation animals of Camal Dorset ewes, were used as reference in table 9.

Results and Discussion

Age at First Lambing. The influence of birth season and lambing years on first lambing age was analyzed with the model presented in table 1. Results of the statistical analyses for each ALS are shown in table 2, in addition to raw averages and BLUE of deviations among levels of each effect.

Statistical significance of year effects was evident only for the Morlam system. First lambing ages were, in general, larger in Morlam than those found in Camal Dorset, although considerable reduction occurred in the first system during the years 1968 to 1973 (table 2). From 1974 to 1975 ewes were gradually transferred to Cornell University, as noted before, and early lambing was simultaneously removed as a goal of the system. This could explain the increase in age at first lambing corresponding to those final years. If gestation lengths were fixed at 150 d, then ewe lambs were mated as early as 367 d of age in the Morlam system and as early as 340 d of age in the Dorset Camal system. Feasibility of producing changes in the level of age at first breeding to as early as 240 d, or even earlier, was reported by Fahmy et al. (1980) and Cedillo et al. (1977).

The intensity with which precocious ewe lambs were used in both systems is shown in table 3, where the data are examined in arbitrary categories of age at first lambing. Regarding the whole range of years, the average percentages of Morlam ewe lambs whose ages were 11 to 17 mo and 18 to 24 mo were 29 and 45%, respectively. On the other hand, for the same two age categories the averages for Camal Dorset ewe lambs were 50 and 40%, respectively. It was not possible to determine if the differences reflected by the preceding figures represented inherent breed differences in age at puberty, or if they were a function of system effects.

Statistical significance of, and responses to, effects of birth season were not consistent in both systems. Significant differences due to birth seasons were found only for Camal Dorset (table 2). It was not known whether this situation was conditioned by the system, by the breeds or both causes.

Possible relationships between the seasonal distribution of first lambings and the season of birth were examined for Morlam ewes. Data ignoring age at first lambing, such as the arrays presented in table 4, did not reflect any apparent association ($\chi^2_{(9)} = 13.89$, $P>.05$) between season of first lambing and season of birth. At least three groups of age at first lambing were included in table 4. Values making up this table were regrouped in arbitrary categories of age

TABLE 2. EFFECT OF LAMBING YEAR AND BIRTH SEASON ON AGES AT FIRST LAMBING IN MORLAM AND CAMAL DORSET ACCELERATED LAMBING SYSTEMS

Morlam system					Camal Dorset system				
Effect	Diff[a]	SE	Raw mean, d	N[b]	Effect	Diff[d]	SE	Raw mean, d	N
Years**					Years[d]				
[1966][c]	0	0	755	10	[1978]	0	0	526	61
1967	− 8	11	733	47	1979	−29	2	490	71
1968	−187	13	566	38	1980	−11	2	500	90
1969	− 68	11	680	45	1981	11	2	523	104
1970	− 89	11	658	47					
1971	−188	9	543	67					
1972	−180	9	550	68					
1973	−210	10	517	63					
1974	−106	13	619	39					
1975	− 2	16	732	26					
Birth season[d]					Birth season**				
[Winter]	0	0	640	194	[Winter]	0	0	521	166
Spring	− 7	10	622	84	Spring	−71	6	451	51
Summer	− 15	9	626	45	Summer	19	5	538	49
Fall	− 60	8	551	127	Fall	− 2	5	508	60

[a]Diff=estimates of deviations from reference class.

[b]Class numbers.

[c]Reference class from which deviations were taken are in brackets.

[d]Not significant (P>.05).

**P<.01.

(months) at first lambing, namely: early (11 to 17 mo), medium (18 to 24 mo) and late (> 24 mo). Season of first lambing was associated with season of birth in the early and medium groups ($\chi^2_{(9)}$ = 99.98 and $\chi^2_{(9)}$ = 66.66, both with P<.01, respectively), while independence, as shown in table 4, was observed among late ewe lambs ($\chi^2_{(9)}$ = 12.13, P>.05).

Given the seasonal restrictions associated with continuous breeding systems such as Morlam, the opportunities for precocious first lambings to occur are expected to be conditioned to a great extent by the birth season. This effect can be appreciated in table 5, which contains the distribution of first lambings at the three arbitrary age categories for each birth season

TABLE 3. DISTRIBUTION (%) OF EWE LAMBS BY CATEGORIES OF AGE (MONTHS) AT FIRST LAMBING IN MORLAM AND CAMAL DORSET SYSTEMS WITHIN YEAR

		Morlam system					Camal Dorset system		
		Age, mo					Age, mo		
Year	N[a]	11–17	18–24	>24	Year	N	11–17	18–24	>24
1966	10	0	13	87	1978	61	53	35	12
1967	47	13	51	36	1979	71	54	36	9
1968	38	37	53	9	1980	90	45	45	10
1969	45	8	46	46	1981	104	48	43	9
1970	47	22	56	22					
1971	67	55	37	8					
1972	68	37	55	8					
1973	63	47	37	15					
1974	39	39	54	7					
1975	26	36	44	20					

[a]Class numbers.

TABLE 4. DISTRIBUTION[a] (%) OF MORLAM EWES BY SEASON OF FIRST LAMBING WITHIN SEASON OF BIRTH

Season of birth	Season of first lambing: Winter	Spring	Summer	Fall	N[b]
Winter	51	27	4	18	203
Spring	58	19	2	20	93
Summer	69	16	0	14	49
Fall	68	17	2	13	126
N[b]	277	101	13	80	

[a]Analyzed by chi-square ($\chi^2_{(9)}$ = 14.89, P>.05).
[b]Marginal totals.

for Morlam ewes. Ewes born in fall and winter had greater chances to lamb early (62 and 37%, respectively) than those born in other seasons ($\chi^2_{(6)}$ = 59.55, P<.01). For instance, ewes born in the summer will be exposed to breeding during their 6th to 12th mo (in order for them to lamb during their 11th to 17th mo of age as precocious ewe lambs) in a season of low reproductive activity (December to end of July) compared with ewes born in winter or fall whose exposure would occur under a season of better reproductive activity. These results agree with those of Dyrmundsson (1981).

Perinatal mortality, as well as frequencies of multiple births, were observed within arbitrary age categories to examine trends associated with age at first lambing. Table 6 condenses the information for five age categories at first lambing for the Morlam system. Fewer live lambs per ewe were produced among precocious ewe lambs, because of higher rate of perinatal mortality (although statistically nonsignificant) and(or) decreased frequency of twins ($\chi^2_{(4)}$ = 19.73, P<.01). Similar trends were found in other analyses (Branford-Oltenacu and Boylan, 1981; Dyrmundsson, 1981).

Maximum likelihood estimates of variance components for age at first lambing were evaluated only for Morlam ewes and with the mixed linear model included in table 1. For 450 observations involving 36 sires, the estimates of sire and residual components of variance were Vs = 1,106 and Ve = 13,256 respectively; thus the heritability estimate was h^2 = .31. Estimates of genetic variability for this trait are not well documented in the literature.

Interval Between Lambings. The influence of age at first lambing, season and birth type of the previous lambing, in addition to the current age and lambing year, on inter-lambing intervals of Morlam ewes was evaluated by the linear model shown in table 1. A summary containing the statistical tests of hypotheses is presented in table 7 and 8.

Age at first lambing was found to be a significant source of variation (table 7). The results suggested that precocious ewe lambs had the longest future lambing intervals (at least 94

TABLE 5. DISTRIBUTION[a] (%) OF MORLAM EWES BY AGE AT FIRST LAMBING WITHIN SEASON OF BIRTH

Season of birth	Age classes at first lambing, mo: Early (11–17)	Medium (18–24)	Late (>24)	N[b]
Winter	37	45	17	203
Spring	19	70	11	93
Summer	20	63	16	49
Fall	62	25	13	126
N[b]	182	220	69	

[a]Analyzed by chi-square ($\chi^2_{(6)}$ = 59.55, P<.01).
[b]Marginal totals.

TABLE 6. SURVIVAL (%) AND BIRTH TYPES (%) AT FIRST LAMBING OF MORLAM EWES WITHIN AGE OF EWE CATEGORIES

	Lambs produced[a]			Birth type[b]		
Age, mo	Alive	Dead	N[c]	Single	Multiple	N
10–13	60	40	20	95	5	19
14–17	71	29	180	88	12	163
18–21	71	29	119	77	23	98
22–25	66	34	134	74	26	122
>25	80	20	93	67	33	69

[a]Analyzed by chi-square ($\chi^2_{(4)}$ = 5.18, P>.05).

[b]Analyzed by chi-square ($\chi^2_{(4)}$ = 19.73, P<.01).

[c]Perinatal counts (including up to 2 wk after birth).

d longer) than older ewe lambs (older than 12 mo of age). Whether long intervals was a resonse to carry-over effects through the productive life of a precocious ewe, or was confined to the initial part of its life, was not investigated.

Season of the year in which previous lambing occurred conditioned (P<.01) the length of intervals (table 7). Longer intervals resulted when the previous lambing occurred in winter, with the shortest if it occurred during the summer, preceding the season of higher estrus activity (fall). Thus a ewe with a potential for short intervals, could be ranked low if, by accident, she happened to lamb early in the year.

Birth type of previous lambing produced only negligible differences (P>.05, table 7). If the birth type of previous lambing does not have any effect on the intervals as a general response for all breeds, then utilization of prolific sheep in ALS is an open alternative.

Ewe age in days, treated as a covariate (table 1), had a significant effect on inter-lamb-

TABLE 7. ESTIMATES OF EFFECTS OF FIRST LAMBING AGE, SEASON AND TYPE OF BIRTH OF PREVIOUS LAMBING ON LAMBING INTERVALS OF MORLAM LAMBS

Factor	Diff[a]	SE	N[b]
First lambing age, mo**			
[<12][c]	0	0	14
12–17	− 94	1.5	399
18–23	−113	1.5	456
24–30	−110	2.0	246
>30	−118	4.4	61
Season of previous lambing**			
[Winter]	0	0	452
Spring	− 27	.5	260
Summer	− 70	.9	147
Fall	− 43	.1	317
Birth type of previous lambing[d]			
[Singles]	0	0	764
Multiples	− 11	.3	412

[a]Diff = estimates of deviations from reference class.

[b]Class numbers.

[c]Reference class from which deviations were taken.

[d]Not significant (P>.05).

**P<.01.

ing intervals. The corresponding linear regression coefficient suggested an increase in length of the lambing interval as the ewes become older, with a rate of 4.38 d per yr of age (b =.012 ± .06, P<.05).

Differences among lambing years influenced significantly the intervals in the Morlam system. Table 8 contains this information, in addition to yearly averages of inter-lambing intervals for both accelerated lambing systems. Morlam from 1966 to 1973, excluding years 1969 to 1971, and Camal Dorset from 1978 to 1981 showed a consistent reduction in the average interval length with no apparent trend in the change of variation coefficients. While in both systems average intervals were less than 365 d for the whole range of years, shorter intervals were achieved by Morlam.

Maximum likelihood estimates of repeatability and heritability for 1,176 observed lambing intervals consisting of repeated measures on 350 ewes nested in 39 sires (table 1) were r = .25 and h^2 = .06, respectively.

Conception. Based on assumptions and methods presented in Iniguez (1984), conditional probabilities of conception given the occurrence of estrus (P) were estimated for each month from Morlam and Camal Dorset data. Because these values (P) were calculated assuming that all ewes were cycling and only on the basis of available non-pregnant ewes in a month, they could be alternatively interpreted as conditional probabilities given that non-pregnant ewes were exposed to rams in such a month. In fact the estimates agree very closely with the proportions of conceptions per month out of the total conceptions in the year. Estimated ML probabilities are displayed in figure 1.

Cyclical and similar patterns with months of high conception followed by months of low conception are evident for both groups in figure 1. The highest probability of conception occurring later in the year, was obtained in Camal Dorset. From May through September, however, Morlam showed higher conception, which is reflected in a better estimate of overall probability of conception P* (figure 1).

A zigzag fluctuation over time characterized conception successes in Camal Dorset, reflecting the breeding strategies of this system. As stated before, Camal Dorset ewes were allowed to breed only every other month, such that no conceptions would be expected for non-breeding months. Nevertheless, estimated values for those months were not necessarily zero, because ewes mated earlier in a breeding month could lamb in a month corresponding to a non-breeding month if the gestation period were less than 150 d, yet was estimated to be 150 d.

The two ALS consistently increased the average chance of breeding ewes successfully in

TABLE 8. AVERAGE LAMBING INTERVAL PER YEAR (DAYS) AND COEFFICIENTS OF VARIATION (CV, %) IN MORLAM AND CAMAL SYSTEMS

Morlam system						Camal Dorset system			
Year**	Diff[a]	SE	Raw mean, d	N[b]	CV	Year	Raw mean, d	N	CV
[1966][c]	0	0	331	41	39	1978	318	120	32
1967	− 8	2.5	305	73	32	1979	306	155	33
1968	−56	2.1	277	99	23	1980	295	156	29
1969	−35	2.0	288	115	29	1981	295	157	24
1970	−21	1.5	290	177	25				
1971	−32	1.5	290	177	25				
1972	−50	1.5	267	176	31				
1973	−60	2.6	265	159	40				
1974	−42	2.0	286	104	40				
1975	− 7	2.0	314	113	37				

[a]Diff = estimates of deviations from reference class.

[b]Class numbers.

[c]Reference class from which deviations were taken are in brackets.

**P<.01.

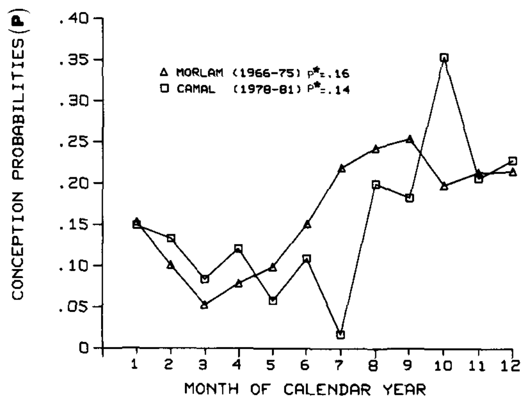

Figure 1. Estimates of conditional conception probabiliyies given the occurrence of estrus (P) and of overall conception probabilities (P*) for Morlam and Dorset Camal systems.

months other than the traditional ones under less intensive systems. The changes are reflected in table 9, which contrasts Morlam and Camal Dorset years with those before their implementation. Apparently, Morlam achieved a higher increase in the overall probability of conception, from a starting value of .12 to .16, whereas Camal Dorset increased to only .14 from a similar starting value (P* =.12).

In order to show the impact of the systems in changing the number of lambings per year, table 9 also was organized with the inclusion of estimated lambing intervals after transforming the probabilities of conception as:

$$\text{estimated interval} = (150 + 30) + 17/P^*,$$

where P* represents the overall conception probability, whereas 30, 17 and 150 represent the assumed postpartum estrus, inter-estrus and gestation intervals, respectively. Morlam and Dorset Camal systems exceeded the annual (theoretical) system by 28 and 21%, respectively. According to Hogue et al. (1980), Camal Dorset (where breeding opportunities occurred every other month) would condition a number of 2.0 lambings per ewe per yr if the ewes were bred at their first breeding opportunity, or 1.20 lambings per ewe per yr, if they were bred at their third opportunity (having failed to conceive in the previous two opportunities). Apparently the estimate obtained for Camal Dorset (1.21 lambings per ewe per yr) would fit the condition of being bred at the third attempt which corresponds to an interval of approximately 10 mo. Morlam on the other hand approached the theoretical expectation of 1.33 lambings if the ewes were bred at the first mating opportunity in systems called "four in three years."

Estimates of differences between the levels of effects influencing conception, are presented in logit units in table 10. Because a given difference represents the logarithm of the ratio of the probability for a given month to that for the month selected as base, the transformation to probability ratios also was included in table 10. Breeding month effects represented by 12 mo of the year influenced the probability of conception (P<.05). One-half of the year was characterized by low chances of conception

TABLE 9. OVERALL PROBABILITIES OF CONCEPTION, ESTIMATED AVERAGE LAMBING INTERVALS AND NUMBER OF LAMBINGS PER EWE PER YEAR IN MORLAM AND CAMAL DORSET SYSTEMS

Year	Estimated average lambing interval, d	Overall probability of conception	No. lambings per ewe per year
Morlam			
1964–1965[a]	322	.12	1.13
1966–1975[b]	286	.16	1.28
Camal Dorset			
1971–1977[c]	322	.12	1.13
1978–1981[d]	301	.14	1.21

[a]Years before the implementation of Morlam system.

[b]Years under Morlam system.

[c]Years before the implementation of Camal Dorset system.

[d]Years under Camal Dorset system.

TABLE 10. ESTIMATES OF EFFECTS OF SEASON (MONTH) AND LAMBING YEAR ON CONCEPTION PROBABILITIES OF MORLAM EWES

Breeding month**				Lambing year**			
Month	Diff[a] logits	Prob ratios[b]	Ns/Nt[c]	Year	Diff logits	Prob ratios	Ns/Nt
[Jan][d]	0	0	65/428	[1966]	– 0	0	41/634
Feb	– .578	.56	59/568	1967	– .162	.85	73/647
Mar	–1.282	.28	47/860	1968	+ .349	1.42	99/520
Apr	– .854	.42	74/963	1969	+ .015	1.00	115/683
May	– .606	.54	94/1048	1970	– .162	.85	119/854
Jun	+ .092	.91	141/959	1971	+ .104	1.11	177/1115
Jul	+ .484	1.62	188/890	1972	+ .107	1.11	176/893
Aug	+ .687	1.99	153/661	1973	+ .145	1.16	159/717
Sep	+ .773	2.17	118/461	1974	– .484	.62	104/626
Oct	+ .511	1.67	72/357	1975	–1.000	.37	113/1197
Nov	+ .604	1.83	71/348				
Dec	+ .902	2.46	94/343				

[a]Diff = Estimates of deviations from reference class in logit units, where logit = ln (P/(1-P) and P is the occurrence.

[b]Prob. ratios: logit units transformed into probability ratios.

[c]Number of successful conceptions (Ns) out of total number of estruses (Nt).

[d]Reference class from which deviations were taken are in brackets.

**P<.01.

which improved at the end of spring, a trend that is evident also in figure 1.

Ratios corresponding to the significant effect of lambing years, among Morlam ewes, patterned an opposite trend to that observed for inter-lambing intervals (tables 8 and 10). In fact, the probability of conception increased during years under which the lambing interval decreased. Although younger ewe lambs apparently conditioned a lower probability of conception, differences due to current age of the ewe did not have a significant effect on the chance to conceive.

Heritability of probability of conception, estimated by ML procedures from 1,176 records involving 39 rams, was $h^2 = .30$.

Conclusions

Evaluation of a particular accelerated lambing system should involve examination of all possible components of reproductive efficiency. The net impact should finally be evaluated from the total number of lambings in conjunction with the total weight of lambs weaned per ewe per year. Because of data restrictions, evaluations in this study involved only a partial subset of reproductive efficiency components.

General conclusions suggested by this evaluation are: 1) both systems were effective in reducing the age at first lambing and the lambing intervals in addition to increasing the lambings per ewe per yr from 21 to 28%, as compared with what is expected under an annual management plan. 2) Under continuous exposure to breeding (Morlam system), previous lambing season and first lambing age conditioned significant differences on lambing intervals lengths. 3) Consideration of prolificacy could be a feasible alternative if implemented in continuous systems, such as Morlam. 4) The presence of moderate genetic variation for age at first lambing and for conception probabilities, suggests that improvement in these traits, by genetical changes, could also be expected if appropriate breeding plans are introduced as strategies in accelerated lambing systems. Nevertheless, genetic variation per season needs to be estimated in considering such breeding plans.

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