FERTILIZATION RATE AND EARLY EMBRYONIC MORTALITY IN EWES IN NORTH WEST QUEENSLAND

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Summary

The extent and nature of prenatal losses up to *20* days *post-coitum* were examined in three groups of ewes joined at intervals over the period September to December at at a time when ambient temperatures were high (>35°C). Fertilization rates ranged from 72.7 per cent to 80.4 per cent whilst the proportions of abnormal ova noted were similar to those recorded from more temperate areas of Australia.

Embryonic mortality post-fertilization was not of great magnitude, the primary cause of prenatal loss to *20* days being fertilization failure.

I. INTRODUCTION

Within the sheep areas of semi-arid north west Queensland, reproductive rates are low, the average lamb marking percentage for the 20 year period 1946-1965 being only 41.0 per cent, with a range of from 19.0 to 48.9 per cent (Murray 1969). The severe environmental stresses experienced by sheep are believed to contribute towards this poor reproductive performance (Moule 1956). During the period October to March, mean monthly maximum temperatures exceed 35°C (Farmer, Everist and Moule 1947) and daily maxima may reach the vicinity of 46°C. The area receives a predominantly summer rainfall and, as a result, the nutritional value of the Mitchell grass (*Astrebla* spp.) pastures deteriorates during the late winter and spring months. As a consequence, sheep are usually on a sub-maintenance plane of nutrition during the last three to four months of the year (Smith 1964). The majority of ewe flocks in the region are mated during the period October to November and are thus subjected to both high temperatures and a poor plane of nutrition during this period.

Numerous hot room studies (Dutt, Ellington and Carlton 1959; Alliston and Ulberg 1961; Ryle 1961; Dutt 1963, 1964; Smith, Bell and de Chaneet 1966; Thwaites 1967, 1968, 1969) have indicated that exposure of ewes to continuous heat stress during joining and early pregnancy may result in failure of fertilization

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and high embryonic mortality. With the exception of the work of Ryle (1961) and Thwaites (1969), studies have involved animals which have been relatively unadapted to high temperatures, and thus the temperature stresses imposed on the experimental animals may differ from those experienced by animals in the field.

Maternal undernutrition during early pregnancy has been shown to increase the level of embryonic mortality (Edey 1965, 1966) and reduce the number of lambs born (Bennett, Axelsen and Chapman 1964). Thus, the submaintenance nutritional levels which can be experienced by ewes at mating may further contribute to the low reproductive rates experienced in this region.

Comparatively little information is available of the stages of prenatal losses in ewes in this 'environment. Moule (1960, 1966) has indicated that embryonic losses may be an important cause of reproductive wastage, however Smith (1964) found no evidence that embryonic mortality was of importance as a cause of reproductive wastage.

The purpose of the present paper is to describe experiments carried out to determine the nature and extent of prenatal losses in ewes joined during the spring and early summer in semi-arid north west Queensland.

II. MATERIALS AND METHODS

Merino ewes aged from three to six years were used in the experiments. These animals had been born and reared in the environment and were the progeny of animals bred in the region for two generations. Three separate experiments were conducted over the spring and summer of 1968, joining dates being indicated in Table 1. Mean maximum temperatures over the joining periods, together with the range of maximum temperatures experienced, are also indicated in Table 1. During the experimental periods, ewes were grazed on poor quality Mitchell grass (*Astrebla* spp.) pastures which did not maintain body weights of the experimental animals. Ewes were joined with 2½ per cent of rams fitted with marking crayons (Radford, Watson and Wood 1960) for a period of six weeks. Oestrus was recorded daily, and marked ewes were allocated to two groups as follows:—

Group 1 Laparotomy was performed approximately 56 h after detection of oestrus, and ova were recovered by flushing the fallopian tubes (Hunter, Adams and Rowson 1955) with warm physiological saline. Recovered ova were examined using interference microscopy, all uncleaved ova being stained and re-examined for the presence of pronuclei (Mattner 1963). The criteria of fertilization was the presence of two or more blastomeres of equal size or, in the case of uncleaved ova, the presence of male and female pronuclei.

Group 2 Animals which did not return to service within 20 days were slaughtered. The reproductive tracts were examined within 10 min of slaughter, the number of corpora lutea counted, and the uterus opened in warm physiological saline for removal of the embryo and membranes. The assessment of viability used- was similar to that described by Quinlivan et *al.* (1966). In addition, vascularity of the chorio-allantois and size of embryo and membranes were taken into account in determining viability.

Data obtained for fertilization rates and embryonic mortality in the three experiments were examined by chi-square analysis.

III. RESULTS

Table 1 summarizes the information obtained from examination of recovered ova for evidence of fertilization. In the three experiments, fertilization rates ranged from 72.7 to 80.4 per cent though there were no significant differences in the proportions of fertilized ova between experiments. Over the three experiments, the incidence of morphologically abnormal ova was 12.0 per cent.

Abnormalities noted included four ova with the vitellus of irregular or ovoid shape, two ova showing evidence of fragmentation of one or more blastomeres and one ova -with apparent breakdown of the vitelline membrane. The remaining three ova had one-or more cracks on the zona pellucidae and showed no evidence of cleavage.

Table 2 gives information on embryos and/or embryonic debris recovered from ewes slaughtered 20 days after joining. Only observations from those ewes which had not returned to service within 20 days are included in the data. Differences in the proportions of non-viable embryos in the three experiments were not significant. All animals which had returned to service underwent laparotomy within two days of returning. Of these, 14 animals had recent ***corpora lutea*** and 2 had mature ***corpora lutea,*** both associated with a viable embryo.

An estimate of the proportion of embryos lost between fertilization and 20 days may be obtained from a comparison of the proportion of ewes with fertilized ova (Table 1) and the proportion of ewes with viable embryos at 20 days (Table 2). Analysis of this data indicated that there were no significant differences, suggesting that in these experiments post-fertilization losses to day 20 were not a major cause of reproductive wastage.

TABLE 1

Fertilization rate of recovered ova (joining dates, mean maximum temperatures and range of maximum temperatures experienced are also indicated)

	Experiment 1	Experiment 2	Experiment 3	Total
Date of Commencement of Joining	13.ix.68	28.x.68	18.xi.68	
Mean maximum ambient temperatures over joining period (°C)	34 0°	38.6°	38.5°	
Range maximum ambient temperatures over joining period (°C)	29.4°-39.4°	32.2°-42.8°	32.2°-42.8°	
No Ewes	21	55	29	95
No. ova shed*	24	56	28	108
No. ova recovered				
No. ova fertilized	12	37	16	65
No. ova not fertilized	3	3	3	9
No. abnormal ova	1	6	3	10

* Estimated from *corpora lutea* counted.

TABLE 2

Embryonic viability at 20 days

	Experiment 1	Experiment 2	Experiment 3	Total
No. animals allocated to group				
No. non-returns to day 20	20	48	23	91
No. *corpora lutea* in non-returns				
No. *corpora lutea* represented by viable embryos	12	39	20	71
No. non-viable embryos	7	11	4	22

IV. DISCUSSION

In the experiments reported, failure of fertilization was the most common cause of wastage. Losses of potentially fertilizable ova were respectively 25.0, 19.6 and 27.3 per cent for the three experiments. These losses are higher than those reported for Merino ewes in more temperate environments where fertilization rates have ranged from 86.0 to 100.0 per cent (Mattner and Braden 1967; Fels 'and Neil 1968). However, they are lower than those experienced by ewes which have been subjected to hot room conditions (Dutt, Ellington and Carlton 1959; Alliston and Ulberg 1961; Dutt 1963, 1964).

The proportion of ova classified as abnormal is similar to that recorded by Braden (1964) for ewes in temperate Australia, and there is no evidence to suggest that the high ambient temperatures experienced by sheep in these experiments resulted in a greater proportion of abnormal ova such as has been recorded under hot room conditions (Dutt 1963, 1964).

With the advent of high air temperatures, rams joined in the early summer may suffer seminal degeneration soon after being joined with ewes (Moule and Waites 1963). This factor could contribute to the results obtained. However, limited evidence from this environment suggests. that semen quality usually remains satisfactory during the spring and early summer months (Smith 1962).

Post fertilization losses were relatively small and similar to that recorded by Mattner and Braden (1967) for sheep in Southern Australia. Ryle (1961) and Thwaites (1969) have suggested that animals which are subjected to a diurnally variable heat stress, or which are acclimatized to high temperatures, suffer a lower level of embryonic mortality than do unadapted animals subjected to continuous heat stress. The present results, obtained with animals born and reared in a hot environment, and subjected to a diurnally variable heat stress, tend to support this view.

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