A COMPARISON OF LAMB SURVIVAL IN FOX PROOF AND UNPROTECTED ENCLOSURES

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Summary

Survival of lambs born in a flock of 355 ewes was studied in three fox-proof and three unprotected enclosures, each of 4 acres (1.6 ha), at Minnipa, South Australia. -Observations were made on fox activity and the behaviour of ewes and lambs.

Although foxes were frequently seen, their exclusion by protective fencing did not reduce lamb mortality, and mutilation of carcasses by foxes was confined to lambs which might have been expected to die from other causes. A low level of "primary predation" (1-2%) was suspected when two healthy lambs vanished from the paddock.

I. INTRODUCTION

In many areas of Australia, carcasses of lambs collected from the field have been considerably mutilated by foxes and other predators. However, evidence from autopsy suggests that most mutilated lambs were dead or dying when damaged by foxes. (McFarlane 1964; Dennis 1965; Moore, Donald and Messenger 1966.) There is also evidence that most deaths due to primary predation by foxes are caused by a few individual animals, and that most foxes are merely scavengers (McIntosh 1963; McFarlane 1964). Alexander et ***al.*** (1967) found that it was possible to observe the behaviour of foxes in a flock of lambing ewes, and further observations are reported here. First results from a study on the importance of fox predation in an area where foxes were known to be plentiful are also reported.

II. METHODS AND MATERIALS

(a) Sheep

The observations were made on a flock of 355 ewes, aged two to six years, at the Minnipa Research Centre, situated in a wheat sheep area of South Australia (Alexander et *al*. 1967). The ewes were joined in November 1966 after vasectomized rams had been withdrawn. Joining was planned so that the peak of lambing coincided with the full moon on April 24, 1967. The ewes which had mated in the first 15 days, and which had not returned to service, were selected for study.

A week before the start of lambing, the ewes were randomised into six groups according to age, body weight and date of service, and placed in six enclosures. On April 17, and again on April 30 and May 25, ewes were subjectively scored as pregnant, recently lambed or not recently pregnant; the girth, udder development and state of the vulva were used as criteria.

Continuous 24 h observations were made at site 3 from April 17 to April 30. At the other two sites observations were made at night following evidence of predatory activity. The ewes and lambs remained in the enclosures until marking time (May 25).

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(b) Enclosures

At each of three sites, approximately two miles apart, and near to natural scrub vegetation, a fox proof and an unprotected enclosure were erected; enclosures were 1.6 ha (4 acre) in area. The unprotected enclosures were fenced with Ringlock* wire mesh (approx. 15 x 30 cm) about 1 m high. The wire netting mesh (approx. 4 x 4 cm) of the fox proof enclosure was 6 ft (1.8 m) high, and extended 6 in. (15 cm) below ground level. An electrified wire connected to an Anders† 6V fence unit was extended around the enclosure, and was supported 15 cm outside the top of the fence.

Observation posts were located in the lanes which separated the protected and unprotected enclosures.

(c) Experimental Procedures

Neighbouring sheep producers were persuaded not to shoot foxes for one month before or during lambing. To attract foxes, offal was placed near each site one week before lambing.

During the trial, the progress of lambs from birth towards successful sucking was observed and recorded at one site. At the other sites, lambs were weighed twice daily and weight increases were taken as an indication of satisfactory progress. The movements of foxes were plotted on plans of the enclosures and notes were made of fox activity and the behaviour of ewes and lambs. Binoculars were used at night. When visibility was poor a spotlight was also used.

After April 30, a daily check on numbers was made until May 5. A daily search for carcasses was made in and around the enclosures until marking time (May 25).

Post mortem examinations were carried out according to the method of McFarlane (1965). The carcasses were returned to the sites where they were found.

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TABLE 1

Nos. of ewes and lambs in protected and unprotected enclosures.

Site	Number of ewes		No. of singles		No. of Twins		Total Lambs Born	Total Lambs Died
	Joined	Lambed	Born	Died	Born	Died		
Unprotected								
1	60	60†	45	4	28	7	74*	12*
2	58	56†	43	0	24	6	67	6
3	59	57	37	0	38	5	78‡	6§
Totals	177	173	125	4	90	18	219	24
Protected								
1	57	56	39	4	34	10	73	14
2	60	59	49	3	20	5	69	8
3	58	56	45	2	22	3	67	5
Totals	175	171	133	9	76	18	209	27

*Includes one lamb, either a single or multiple.
†Includes ewe apparently lambed, but lamb(s) never seen.
‡Includes three triplets.
§Includes one triplet.

TABLE 2
Causes of Death of Lambs.

Single Births			Multiple Births		
Cause of Death	No. of Lambs Exposed	Foxproof	Cause of Death	No. of Lambs Exposed	Foxproof
Poor lamb vigour or behaviour	1	5	Poor lamb vigour or behaviour	5	7
Poor maternal behaviour	3	2	Early separation from mother by one twin	9	4
Other	—	2	Still births	—	4
			Early separation and/or poor lamb vigour	1	1
			Possibly taken by Fox (missing May 25)	2	—
			Other	2	2

*One lamb (single or multiple) died as a result of poor maternal behaviour.

III. RESULTS AND DISCUSSION

In the unprotected enclosures, 219 lambs were born and 11% died. In the protected enclosures, 209 lambs were born and 13% died (Table 1). There was no significant difference between the two types of enclosure in numbers of lambs dying, either at single sites or for all sites combined.

Causes of death for both single and multiple births are shown in Table 2. There was an unexplained difference ($P<0.05$) in total numbers of deaths between site 1 (26 lambs) and sites **2** and 3 (14 and 11 lambs).

Observations and autopsy provided no evidence that predation was the primary cause of death. Two twin lambs were gaining weight satisfactorily but disappeared from the paddock (Table 3), and two ewes appeared to have lambed, but no lambs were seen.

Eight ewes were classed as not having lambed (Table 1); they were judged to be not pregnant when they entered the enclosures. There was no evidence of undetected removal of unidentified twins from the exposed enclosures; more twins were found in these than in the protected enclosures.

Observations at sites 2 and 3 confirmed that the fox acted mainly as a scavenger. Between 8 and 22 sightings of foxes were made each night and their length of stay varied from one minute to four hours. As in a previous study (Alexander ***et al.*** 1967), foxes were not disturbed by the spotlight and were mainly interested in the placenta and dead lambs. No healthy lambs were seen to be killed but one attack on a lamb, separated from its mother, was witnessed. The fox seized the lamb four times by the tail and threw it to the ground, but then went away. There was no evidence of foxes in the "fox-proofed" paddocks.

In this study there was a low incidence of primary predation by foxes ($<2\%$) as in the results obtained at Minnipa by Moore, Donald and Messenger (1966). However, during the present observations there was an abundant **supply** of other food available to foxes, which could modify the behaviour of foxes towards young lambs.

TABLE 3

Mutilated and Missing Lambs (Damage attributed to Foxes).

Age at death (days)	Weight Loss* (g)	Observations	Post Mortem Findings
1(S)†	150	Lamb found mutilated 20′ outside fence. Mother nervous.	Fat reserves depleted. Teeth marks and haemorrhage visible. Ribs broken and internal organs missing.
?(?)‡		Lamb(s) never seen with mother.	—
<1(?)	?	Lamb(s) never seen but disturbed lambless ewe found.	—
2(T)	450	Early separation from mother.	Remains found on fence (head, one hind leg and skin). Teeth marks and haemorrhage visible
1(T)	150	Early separation from mother.	Teeth marks and haemorrhage visible. Internal organs missing. Fat reserves depleted.
10-30(T)	?	Gained weight; missing May 25.	—
7-27(T)	?	Gained weight; missing May 25.	—
1(T)	150	Poor birth vigour. Foxes seen carrying object during night. (?) Missing April 26.	—
1(T)	50	Early separation from mother. Foxes had been seen several times during night where lamb was found.	Post mortem mutilation. All internal organs missing. Fat reserves depleted.

*From first to last weighing.

†S, single lamb; T, twin lamb.

‡Ewe appeared to have lambed; lamb(s) may have been removed by foxes or adopted by ewe(s).

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