Reproductive wastage in sheep

R W. Kelly

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By R. W. Kelly, Principal Officer, Sheep and Wool Branch

The average lambing performance of Western Australia's ewe flock fluctuates between 60 and 70 per cent. Although this level of performance and variation between years is important for the sheep industry, individual farmers are more concerned about the performance of their own flocks.

Figure 1 shows the range in lambing performances that existed between farms in this State in 1983-84. The seriously poor performance of many flocks is apparent—28 per cent of farms had less than a 60 per cent lambing. By contrast, 24 farms had performances better than 100 per cent. The reasons for the large differences between farms (and between years for each farm) lie in the number of eggs a ewe sheds at mating, and the wastage that follows through to lamb marking.

This review examines the sources of reproductive wastage in the ewe. It establishes the importance of the research outlined in the following three articles to improve the performance of ewes.

Natural wastage
The production of live lambs in breeding flocks is the end result of a large number of interrelated, complicated and, in many cases, poorly understood events in the ewe and the ram.

Reproduction in sheep is an extremely wasteful process, as indicated by the large difference between potential production and lambs produced. A ewe could produce about 40 000 lambs if all of the potential eggs in her ovaries developed, while a ram produces 10 000 million sperm a day. In a lifetime, however, a flock ewe produces only five to 10 lambs, and a flock ram sires up to about 200 lambs.

Much of this wastage between potential and actual offspring cannot be prevented. For example, whereas only one sperm is need to fertilise an egg, millions of sperm must be deposited in the ewe's vagina to ensure fertilisation.

Despite these high levels of wastage which exist in all breeds of sheep, the range in lambing performances shown in Figure 1 indicates that farmers, through management, can influence the reproductive performance of their sheep.

Potential number of eggs
The lifetime stock of eggs that could produce lambs is established in the unborn ewe, 50 days before birth. These eggs are in the ewe's
ovaries. Each egg is surrounded by a number of other cells, the whole unit being called a follicle. Large follicles can be seen on the surfaces of the ovaries as watery blisters.

For much of an ewe’s life the follicles remain relatively undeveloped, but at any point in time some follicles resume their growth towards maturity. The period of growth is about six months, and it may culminate in ovulation, when the egg is shed from the follicle. The egg finds its way into the fallopian tube where it may be fertilised, and from there to the uterus.

In a lifetime an ewe may ovulate about 50 eggs, the number being influenced by her fertility (number of times that she ovulates), the number of eggs shed at each ovulation (ovulation rate), and the number of pregnancies (pregnancy and lactation interrupt ovulation).

During the period taken for a follicle to grow from a relatively undeveloped state through to maturity, there is little change in its size. Most of the increase in size takes place during the last 48 to 72 hours before the follicle reaches the pre-ovulatory stage. During these last two to three days the follicle can grow from about two millimetres in diameter up to five to 10 mm in diameter.

Follicles are growing through to the pre-ovulatory stage at all times during the life of an ewe. Only when this pre-ovulatory stage coincides with the hormonal conditions that induce ovulation will the egg be shed. Most follicles either die during development or do not reach maturity at a time synchronous with the hormonal conditions of ovulation.

**Influences on ovulation rate**

Ovulation rate can be influenced directly or indirectly by selection of the sheep (genetics), ewe liveweight and nutrition, age of ewe, time of year, hormonal treatment and immunisation to change the levels of certain hormones. These factors may operate at different stages throughout the establishment, growth and maturation of the follicle.

Many of the techniques used to increase ovulation rate rely on increasing the number of available follicles in the weeks or days leading up to mating. They include supplementary feeding with lupins and immunisation, both of which are described in the next articles.

The number of eggs shed when an ewe comes into ‘heat’ (oestrus) determines the maximum number of lambs that can be born, since identical twins (two lambs from the one egg) are rare in sheep.

**Factors affecting the number of lambs born**

For pregnancy to occur, the shedding of the eggs(s) from the ovary must coincide with the deposition, establishment and maintenance of a population of sperm in the ewe’s reproductive tract. If the egg is fertilised, the developing embryo passes into the uterus where it has to survive and grow during the five months to birth.

Wastage can occur during three distinct phases:

- The period leading up to and including fertilisation.
- During embryonic development, from fertilisation through to the 30th to 40th days of pregnancy.
- During foetal development, from the 35th day to birth.

**Failure of fertilisation**

Fertilisation involves the successful fusion of sperm and egg. The ram must find a ewe that is in heat and deposit enough sperm in...
the vagina to establish a pool of sperm in the cervix. The sperm must then move from the cervix through the uterus and into the fallopian tube (Figure 2). At the same time an egg must be shed from the ovary.

Conditions influencing these events, some particularly important in Western Australia, include:

- Joining during the period from July to January when many ewes are not ovulating spontaneously. The Department of Agriculture recommends the use of ‘teaser’ wethers (hormone-treated wethers) for 14 days immediately before the introduction of entire rams to ensure that ewes come into heat and ovulate. (See Farmnote No. 136/79—Teasing Merino ewes for early breeding).
- Low liveweight of ewes. The proportion of ewes that fail to lamb increases as their liveweight decreases, particularly in maiden ewes. This can be caused by their failure to ovulate or a reduction in ‘sexual drive’ of the lighter ewes and so their ability to compete with other ewes for the ram’s attention.
- Oestrogenic pastures. Sperm transport within the ewe can be adversely affected if the flock is joined on pastures containing oestrogenic clovers or if it has a history of grazing such pastures. Research has shown that an average 32 ewes were dry per 100 ewes mated in commercial flocks with a history of grazing oestrogenic pastures compared with 14 dry ewes in flocks grazing non-oestrogenic pastures.
- High temperatures which can depress mating activity by affecting the behaviour of both ram and ewe.

**Embryo mortality**

Most of the losses that occur from fertilisation through to lambing are in the first month of pregnancy. During this month the embryo grows from a diameter of about 170 microns (eight times the diameter of a wool fibre) until it takes on the external appearance of a lamb, and is two to four centimetres long and weighs from one to six grams. All of the lamb’s tissues and organs are formed in this period.

For the first two weeks the growing embryo depends solely on uterine secretions for its nutriment, because the placenta only starts to develop from the 15th day of pregnancy. Most losses occur during the period through to about the 20th day of pregnancy when the embryo is developing rapidly and there are changes in how it receives its nutriment.

Embryo survival depends on many considerations.

- Ovulation rate. The survival rate of an egg is greatest when only one egg is shed and decreases as the number of eggs shed increases at mating (Table 1). These losses are not sufficient to cancel the advantages of using techniques to increase ovulation rate.
- Temperature and time of joining. In Western Australia December and January are the worst months for embryo survival. Just how temperature and time of joining interact has not been determined. This period of joining usually has the highest levels of embryonic deaths compared with other joining times.
- Mineral deficiencies, specifically selenium, have been reported to result in the embryo dying when it is about four weeks old. However, research in this State in the 1960s failed to demonstrate that selenium treatment improves the reproductive performance of ewes.

Farmers often question the effect of nutritional changes about the time of joining on embryonic deaths. Experimental evidence indicates that the levels of nutritional change that exist on farms are not important, as unless ewes are almost starved for 7 to 21 days embryo mortality will not be affected. However, marked changes in nutrition should be avoided as they will affect ovulation rate.

**Foetal period**

From the time the ewe is 30 to 40 days pregnant through to lambing, less than 5 per
cent of developing foetuses are lost. However, some losses do occur which, in particular, may affect the survival of healthy twin or triplet foetuses. These losses have largely been unrecognised in the past. The recent development of real-time ultrasound scanning which produces images of lambs in the uterus has allowed us to identify this wastage. See ‘Pregnancy diagnosis using ultrasound’ on page 32.

During foetal development, the placenta rapidly increases in size (Figure 3). The placenta is the means by which the foetus obtains nutriment from the ewe, and is attached to the inner wall of the uterus at specific sites called caruncles. These doughnut-like structures are from two to five centimetres in diameter.

The placenta is important because its size influences the amount of nutriment that can pass from the ewe to the foetus, and because it produces hormones which influence milk production. The Department is studying the importance of placental size on lamb survival and growth. Preliminary studies indicate that it may be possible to achieve marked increases in lamb birth weights through feeding to increase the size of the placenta.

During the final 50 days of pregnancy the foetus grows from about 0.5 kg to 3 to 5 kg. The ewe’s own feed intake during this period is critical to lamb survival because it influences birth weight, the amount of energy reserves in the lamb and milk production. Recent research into feeding ewes during late pregnancy and subsequent lactation will be described in a later issue of the Journal of Agriculture.

**Lamb survival**

Starvation, exposure to extreme heat or cold, difficult births, the size of the lamb at birth and mothering ability of the ewe all influence lamb survival, and they are often interrelated. Small lambs not only have lower energy reserves but also larger surface areas per unit of body mass. They are less vigorous and more susceptible to bad weather, and perhaps predators, than are larger lambs. On the other hand lambs can be too big at birth, leading to dystokia (difficult births).

Death rates are lowest for lambs between three and five kilograms birth weight (Figure 4). Extreme lamb losses are usually associated with a single major problem, such as bad weather. There is also a core level of 10 to 15 per cent mortality which cannot be reduced unless farmers are prepared to put in more labour and capital to save lambs.

![Newborn lamb—a rewarding sight for the sheep farmer, but losses from birth to marking can sometimes be unacceptably high.](image)
Table 2. Average performance of 100 ewes from joining to lamb tailing

<table>
<thead>
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<th>Ewes joined Shedding 1 or 2 eggs</th>
<th>Maximum potential lambs</th>
<th>Losses up to lambing</th>
<th>Lambs born</th>
<th>Lamb deaths</th>
<th>Lambs tailed</th>
</tr>
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<tr>
<td>One egg lost</td>
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<td>0</td>
<td>23 ewes - 23 eggs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No losses</td>
<td>62</td>
<td>7</td>
<td>62 ewes</td>
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<tr>
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<td>5</td>
<td>8 ewes</td>
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<td>Total</td>
<td>115</td>
<td>32</td>
<td>83</td>
<td>13</td>
<td>70</td>
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</table>

Extent of reproductive wastage in flocks

The relative importance of all these sources of reproductive wastage in Western Australia’s commercial sheep flocks was studied extensively in the early 1970s by the Department of Agriculture and the University of Western Australia. The average performance of 100 ewes from joining to tailing is shown in Table 2, which highlights several reasons for the low performance of the State’s sheep flocks.

- Low ovulation rates. For every 100 ewes mated, 85 ewes shed one egg and 15 ewes two eggs. At best, therefore, this ‘state flock’ could only produce 115 lambs if all eggs survived.
- High percentage of dry (barren) ewes. Twenty-three of the ewes shedding one egg failed to lamb. Only two of the ewes shedding two eggs failed to lamb (representing a loss of four potential lambs), but five of the remaining 13 ewes had only a single lamb. Thirty-two potential lambs were lost.
- Lamb deaths. On average 13 lambs died. Of the 67 single-born lambs, eight died (12 per cent) and five of the 16 twin-born lambs died (31 per cent).

Low ovulation rates and the high percentages of dry ewes are the main contributors to the low performance of many sheep flocks. About half of the differences between flocks in numbers of lambs tailed was due to differences in ovulation rate.

As a consequence, the establishment of techniques to increase ewe ovulation rate have been the aims of considerable research over the past decade. The following articles by Drs K. P. Croker, E. Teleni and J. B. Rowe describe some of the results of more recent studies within the Department of Agriculture. Mr M. A. Johns describes techniques that are available to detect dry ewes before lambing starts.

Further reading