FIELD TRIALS IN RETROSPECT: FLUSHING

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Summary

The work that has been done on “flushing” is reviewed in the light of the principles of field experiments with sheep outlined by Schinckel and Moule (1962).

“Flush ing” is the practice of increasing the amount of feed available to ewes just before they are mated in the hope of securing an increase in the number of eggs shed at oestrus. Flushing has been practised on the highlands of the United Kingdom for a long time, and the interest of scientists revived in the practice after Heape (1899) published the results of his survey. Subsequent workers have not been discriminating in collecting and assessing information pertaining to flushing, much of which has been obtained from surveys of farmers’ opinions. Similarly scientists have not always assessed the work of their colleagues accurately and, in consequence, the hypotheses pertaining to flushing have not been clearly defined and searching questions have not been asked of experiments designed to investigate the proposition. The designs of and execution of many experiments have been inadequate and, in consequence, conflicting conclusions have been drawn.

I. INTRODUCTION

“Flush ing” seems to be an accepted part of animal husbandry in the highlands of the United Kingdom, where ewes are commonly allowed to lose condition after their lambs are weaned.

Marshall (1904) states that the earliest experiments on flushing were conducted prior to 1827, and that the results were inconclusive. Interest in the procedure seems to have revived after Heape (1899) reported the results of his survey. He stated “there seems overwhelming evidence that flocks in good condition at tupping time have a higher subsequent fertility than flocks in poor condition at tupping”. He then refers to the “artificial stimulus to breeding, such as flushing” but he does “not gather that flushing is a wise precaution”.

Whether flushing is beneficial or not is irrelevant for the present purpose, which is to review the work that has been done on “flushing” in the light of the principles of field experiments with sheep outlined by Schinckel and Moule (1962).

The reports that were available for this review are listed in the references.

II. SOME BIOLOGICAL CONSIDERATIONS

Reeve and Robertson (1953) pointed out that the factors most likely to influence the number of multiple births are:

(1) The age and body weight of the ewe.
(2) Genetic effects.
(3) The time of mating in relation to the normal breeding season of the ewes.

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They also concluded from evidence presented by 8 other authors that “the results suggest that not only the level of nutrition at and before the time of mating, but also changes in this level may have had a considerable effect on the frequency of twins”.

Terrill and Stoehr (1942), and Johansson and Hansson (1943) produced evidence from within flock comparisons to support Heape’s (1899) original view that heavy ewes produced more lambs than light ewes. This had been confirmed by Clark (1934) and was reconfirmed by the experiments of Allen and Lamming (1961), and Wallace (1961), as well as by an analysis of data in New Zealand (Coop, personal communication). Fraser and Stamp (1957) paraphrased Clark’s (1934) conclusion in the words:

(a) A rising plane of nutrition has a beneficial influence upon fertility provided the ewes are initially in relatively thin condition.
(b) Gain in weight is not, in itself, indicative of higher ovulation rates.

Robinson (1951) quoted Clark’s (1934) statement that “the practice of flushing will lead to higher ovulation rates provided the ewes are not in a high condition to start with”. Robinson (1951) then adds “whether the absolute number of ova shed would be greater than in ewes kept in a constant good condition is a moot point”.

III. THE ASSEMBLY OF INFORMATION

The assembly and critical assessment of the relevant information is an essential prerequisite of all research. Now let us examine how those who have worked on “flushing” fulfilled these requirements. The surveys by Heape (1899), Marshall (1905), Nichols (1924, 1926a, 1926b), White and Roberts (1927), Sellars and Leech (1955), and Leech and Sellars (1959) were based on replies to questionnaires circulated among farmers. Only a small portion of the questionnaires were returned to Heape (1899), Marshall (1905), and Nichols (1924, 1926a, 1926b). The replies contained no data on liveweights, changes in liveweight or body condition, and in many instances the age composition of the flocks was not given. Similar criticisms can be levelled at the report by Bell (1912).

Marshall (1908b), and White and Roberts (1927) reported higher reproduction rates among ewes on the lowlands by comparison with those on the highlands of Scotland or Wales. This evidence was quoted by Hammond (1941) to support his suggestions that “flushing” is a worthwhile procedure. Similarly Kelley’s (1939) observation that a high incidence of twinning occurred when the mating time was preceded by rain and hence by green feed has been quoted to substantiate the practice of flushing.

McKenzie and Terrill (1937) assessed the literature relevant to their work in the words “Heape (1899) and Marshall (1903, 1905, 1908a, 1908b) believed that better feeding hastened the breeding season and also increased the number of multiple births. Nichols (1924, 1926a, b) presented further evidence in support of flushing but found no effect when the flocks were continually kept in high condition. This was confirmed by Clark (1934)”.

In referring to the work of the same authors, Allen and Lamming (1961) stated “Even relatively short periods of improved feeding prior to breeding have been found to increase the proportion of ewes bearing twins (Heape 1899;
Marshall 1905; Nichols 1924, 1926). Nichols (1926a) summarized work previous to his own in the words, “Marshall and Heape have both shown that nutritional causes affecting the ewes at tupping are probably the most important of these special causes (affecting fertility)”. These latter statements obviously infer that work by the respective authors provided experimental evidence, whereas all of their statements were based on a summary of opinions expressed by farmers. Similar discrepancies can be found scattered through otherwise accurate and appropriately qualified statements in the reviews of literature by other investigators.

IV. THE DEVELOPMENT OF HYPOTHESES

The hypotheses pertaining to flushing have not been clearly defined; rather there seems to have been an acceptance of the opinions of farmers, which in themselves were based on uncertain evidence.

Heape (1899) did not define flushing, but clearly stated that “the optimum condition of ewes for breeding was strong, healthy, vigorous breeding condition”. Nichols (1926a) qualified the term “flushed” with the words “i.e. where the ewes were brought to a high degree of nutritional activity without being too high in condition”, and subsequently (1926b) stated “flushing consists of increasing the value of food supply of the ewes for a short time before the rams are admitted to the flock”. Hammond (1941) seems to have agreed with Nichols’ former statement. More recently Williams (1954) stated that “flushing consists of causing breeding sheep to fall in condition slightly a month prior to tupping, then two weeks before tupping increasing their food so that they are rapidly improving in condition when they are mated”. This change in emphasis from the importance of the general level of body condition to rapid improvement in bodily condition is also apparent in the first experiment on flushing reported in this century by Marshall and Potts (1921).

In biological terms these hypotheses infer that the metabolic changes associated with adequate nutrition, or with rapid increases in bodily condition, stimulate the early onset of oestrus and multiple ovulations. These suggestions were first put forward in 1908, but their physiological implications were not investigated until the work of El Sheikh, Hulet, Pope and Cassida (1955), and Allen and Lamming (1961).

V. EXPERIMENTS TO INVESTIGATE FLUSHING

Generally speaking the majority of the experiments to investigate flushing have not been properly isolated, have not been analytical, and both confirmatory and negatory results have been obtained because of bad design and failure to control variables. With few exceptions any heuristic components of the results have not been exploited.

The investigations into flushing have generally failed to explore the extent to which the plane of nutrition prior to mating affects reproductive performance. A factorial design was first used to investigate flushing by Darroch, Nordskog, and Van Horn (1950). Allen and Lamming also used a factorial design, whereas Wallace (1961) made comparisons between three groups. Previous investigators had compared two groups of ewes.

McKenzie and Terrill (1937), Allen and Lamming (1961), and Wallace (1961) obtained information about ovulation rates, whereas the remaining
investigators accepted the number of lambs born as the criterion on which their results were judged, despite the findings of Quinlan and Mare (1931), and of Grant (1934).

VI. THE INTERPRETATION OF RESULTS OF FLUSHING EXPERIMENTS

In reporting the results of two surveys among British farmers, Nichols (1924, 1926a) stated *inter alia* that “the practice (of flushing) is fairly widespread, but there is little evidence of a definite nature recorded”. Despite this he “grouped data from flocks stated to be flushed, irrespective of the precise manner of flushing”, and on the basis of a difference in the overall means of 10 lambs born/100 ewes lambing in favour of the “flushed” ewes concluded that “high lambing percentages can be produced by the practice of flushing”. The mean for all the ewes was 144 lambs/100 ewes with a range of 127-181 between “breeds”; the mean for the flushed ewes was 154 lambs/100 ewes and the range was 127-194 between “flocks”.

This approach clearly disregards the three questions pertaining to the interpretation of results raised in the paper by Schinckel and Moule (1962). Marshall and Potts (1921), Anon (1932), Darlow and Hawkins (1932-1934), Underwood and Shier (1941), Gerring (1954), and Wallace (1951, 1961) handled their data simply by comparing the numbers of lambs born to groups of ewes subjected to different treatments. Only some of these authors assessed the significance of difference that were encountered. Some failed to take cognizance of the variance present in their results. Thus Marshall and Potts (1921) attempted to make their data show the point that they wished to prove by relating changes in liveweight of their experimental sheep with reproductive performance. They ignored the inconsistencies between years in their results. Briggs et al. (1942) realized that these were sufficient in their data to cast doubt on the value of flushing.

The difficulties of controlling the liveweights of grazing sheep are well known, but many authors failed to recognize that the ewes in their flushed groups may not have been producing as many lambs as they were capable of doing. Thus they did not realize that they may have been comparing the subtle differences between two levels of relative undernutrition, rather than examining the absolute benefits of a rising plane of nutrition. For instance, in the experiment conducted by Underwood and Shier (1941) the controls lost weight, whereas the “flushed” group gained weight, but Darlow and Hawkins (1932-34) either failed to weigh or omitted liveweights from their reports.

Biological implications are also important in survey work. Hunter (1959) drew his conclusions about low fertility of ewes in South Africa from the examination of abattoir material, but was generally unaware of the detailed conditions of husbandry under which the sheep had been managed, and overlooked the possible effects of stress imposed by handling and rail transportation on his material (Braden and Moule, unpublished).

Of the authors whose original papers were available, Marshall (1904, 1905, 1908a), McKenzie and Terrill (1937), Kelley (1939), Vita (1950), Hunter (1959) and Allen and Lamming (1961) were the only ones who attempted to discuss their work in terms of the biological mechanisms underlying their findings.
VII. FIELD TRIALS ON FLUSHING IN RETROSPECT

In scientific investigation “habit is heresy”. Skilled and experienced workers usually learn many procedures only after years of practice. The marshalling and assessment of the available information, discernment in developing hypotheses, care in the planning and conduct of experiments and in the interpretation of results are among the procedures every field worker must learn. Investigations into flushing have been undertaken as field studies, and the almost equal distribution of positive and negative results was inevitable because of uncritical hypotheses, inadequate design, bad execution, and superficial analysis of the experiments. Some results seem to have been interpreted in the light of what the experimenter wanted to prove, rather than in terms of the information they may have actually contained. In consequence thousands of ewe/breeding years and endless man-hours have been devoted to inefficient investigation of an inaccurately stated hypothesis. This was originally dismissed by Heape (1899), whose opinions appear to have been misquoted in order to justify much of the work that has been done this century.

VIII. REFERENCES

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