The effects of pre-breeding and post-breeding feed treatments on reproductive phenomena of ewes managed under range conditions
by Victor L Hoxsey

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Master of Science in Animal Industry
Montana State University

Abstract:
The effects of pre-breeding and post-breeding treatments on reproductive phenomena of eves managed under range condition were studied. Experimental animals (203) were from a band pf approximately 840 grade ewes, of which 36 animals were identified to be Slaughtered 3 days postbreeding . Observations were made on ovulation rate, fertilization rate, abnormal ova, and any abnormalities in the slaughter ewes which could prevent or cause the afore mentioned. The remainder of the ewes Served as a control group,and allowed to lamb using this information to compare with slaughter ewe data. Two pre-breeding treatment's were established., flushed and non-flushed (of which all ewes were on), The non-slaughter ewes Were placed on 3 post-breeding treatments.

Ovulation rate and fertilization rate were 1.31 and 82.4 percent and 1.12 and 76,9 percent for the flushed and non-flushed slaughter eweS respectively. The number of abnormal ova was the same for ,both groups, flushing resulted in a higher percent of twin births, a higher percent of ewes lambing and a higher lambing percent per eWe bred in the- un-Slaughtered group, resulting from first breeding only.

EweS On the three post-breeding treatments- showed a consistent difference in body weight and condition scope throughput the gestation period,, there was also a difference between age, where the mature eWeS, seemed mope able to cope with the environmental conditions than did the two-year-old ewes. The average pounds of lamb born per ewe bred .showed a significant difference between ages and among post-breeding treatments.

Estimated embryonic death loss in this .Study was calculated to be 12.5 percent and 7.6 percent in the flushed and non-flushed groups,, ' respectively.

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ABSTRACT

The effects of pre-breeding and post-breeding treatments on reproductive phenomena of ewes managed under range condition were studied. Experimental animals (203) were from a band of approximately 840 grade ewes, of which 36 animals were identified to be slaughtered 3 days post-breeding. Observations were made on ovulation rate, fertilization rate, abnormal ova, and any abnormalities in the slaughter ewes which could prevent or cause the afore mentioned. The remainder of the ewes served as a control group and allowed to lamb using this information to compare with slaughter ewe data. Two pre-breeding treatments were established, flushed and non-flushed (of which all ewes were on). The non-slaughter ewes were placed on 3 post-breeding treatments.

Ovulation rate and fertilization rate were 1.31 and 82.4 percent and 1.12 and 76.9 percent for the flushed and non-flushed slaughter ewes respectively. The number of abnormal ova was the same for both groups. Flushing resulted in a higher percent of twin births, a higher percent of ewes lambing and a higher lambing percent per ewe bred in the unslaughtered group, resulting from first breeding only.

Ewes on the three post-breeding treatments showed a consistent difference in body weight and condition score throughout the gestation period. There was also a difference between age, where the mature ewes seemed more able to cope with the environmental conditions than did the two-year-old ewes. The average pounds of lamb born per ewe bred showed a significant difference between ages and among post-breeding treatments.

Estimated embryonic death loss in this study was calculated to be 12.5 percent and 7.6 percent in the flushed and non-flushed groups, respectively.

INTRODUCTION

Scientists have adopted numerous methods in the study of lowered fertility in domestic animals and many contributions have been made to the over-all problem. A large amount of the work has been concentrated on the male's part in fertility and now sperm can be handled without fear of damage, and stored for almost an indefinite period of time with little or no loss of potency.

Since the mammalian ovum was first recovered, investigators have been studying methods for its isolation and techniques which will allow work with ova for more than a few hours without deterioration resulting. Greater interest has been aroused during recent years as a result of the more intensive efforts made to analyze the causes of reproductive failure. While it has been recognized that on some occasions embryonic mortality may be the result of infectious disease, that which has attracted a great deal of interest appears to arise apart from infection.

The number of living young depends on the number of ovulations, the number of eggs fertilized, the number of fertilized eggs that are capable of normal development and later implantation and survival of embyros or fetae throughout gestation. A variety of factors play a significant role in each of these critical events. It is of great economic importance that each animal should produce to the maximum of its capabilities. Efficiency of animal production may very well mean the difference between profit and loss to the stockman. One means of increasing efficiency is through increasing higher reproduction rates.

Embryonic mortality as indicated by many research workers contributes greatly to the inefficiency of reproduction. Therefore, this study was designed to investigate the effect of pre-breeding and post-breeding supplementary feeding on ovulation rate, fertilization rate, and estimated embryonic mortality of range ewes.

LITERATURE REVIEW

It has been recognized that the reproductive system of domestic animals can be influenced very materially by changes in environment. Some of the early observers and research workers (Heape, 1899; Aristotle, 1910; Darwin, 1905; and Marshall, 1908) commented on the increased fertility of sheep under favorable environmental conditions.

Ovulation and fertilization rate in general.

Clark (1934) states that Von Baer recovered sheep ova from the oviducts in the year 1828. He described the nucleus as being loose and shrunken with the yolk particle being held together on the outer surface, and referred to the zona pellucida as the "slim."

Bonnet (1884) was unable to follow the stages of development prior to the twelfth day. Assheton (1898) described the ova and embryos of sheep quite accurately and noted that the ovum reached the uterus early on the third day while in the 8 cell stage.

Allen _et al_. (1931) reported that the earliest ovulation occurred $23\frac{3}{4}$ hours after the first signs of heat and the ovum remained unsegmented up to 50 hours. By 66 to 98 hours, the 4 to 6 cell stage had been reached.

Green and Winters (1935) also stated that ovulation occurred as the animal was passing from heat. It was found that sperm reached the infundibulum of the oviduct within 5 hours after copulation with the time of travel the same in ewes that are not in heat. The life of the unfertilized sheep ovum was estimated at less than 24 hours while that of the sperm was about 24 hours.

There is evidence that all of the ova released from the follicles are not fertilized. Corner (1921) was able to recover 213 (91.8 percent) of the ova from the fallopian tubes of 26 sows whose ovaries contained a total of 220 corpora lutea. The loss of ova may be ascribed to their disappearance in the body cavity or to their incomplete recovery from the tubes. However, Corner's results substantiate the reliability of the corpora lutea count as an index of the number of ova released from the ovaries.

Squiers <u>et al</u>. (1952) working with swine, recovered 80 percent of the ova shed and found that 95 percent of these had been cleaved approximately 25 hours after coitus. They used cleavage as a criterion for fertilization. They found that 37 of the 52 sows from which cleaved ova were recovered had all of their ova fertilized. Further observations by Squiers was that 23 percent of the ova could not be accounted for 25 days after mating. Five percent of the ova were considered lost due to non-fertilization. Regressing embryos found at 25 days accounted for 7 percent of the death loss. The total loss represented an embryonic mortality of 35 percent on the 25th day after mating; the remaining 65 percent apparently represented normal embryos.

Wilson <u>et al</u>. (1948) working with swine found that 25.8 percent of the ova ovulated were either not fertilized or failed to develop into embryos.

Dutt <u>et al</u>. (1954) divided 180 crossbred yearling ewes into two groups as they came into heat and were bred. Ninety of the ewes were slaughtered three days after breeding to determine the ovulation rate, the fertilization rate and the condition of the ova. The other ninety ewes were allowed to go to lambing time. The following results were reported: All ewes slaughtered had ovulated as indicated by 132 corpora lutea present when the ovaries were examined. Recovery rate was 96 percent and of the 127 ova recovered, 70 were fertilized and 57 non-fertilized. Several abnormal conditions were also reported.

Fifty-three lambs were born of the control ewes. This represented a lambing rate of 42 percent based on 127 ova ovulated or 59 percent of the 90 ewes bred. The authors stated that failure of the ova to become fertilized was the most important factor in accounting for the low lambing rate.

The reproductive rate of the ewe varies considerably from one year to another. Van Horn et al. (1952) reported that over a four-year period the percent of live lambs recorded per ewe bred varied from a low of 98.9 percent to a high of 125.1 percent. Asker and Ragab (1954) reported lambing percentages between years in one flock as low as 106 percent and a high of 143 percent.

One could very well conclude that from the above, ovulation rate, fertilization rate and embryonic mortality may have an important role in lamb production from year to year.

Research workers in New Zealand (New Zealand Department of Agriculture, 1950) obtained the ovulation rate that occurred at various heat periods from slaughter ewes. The maxima potential lambing rate from these 5-year old Romney ewes if they had been mated at the first, second, and third heat period were 116, 180, and 170 lambs, respectively, per 100 ewes mated. The greater number of eggs released at the second or third heat periods when compared with the first heat period is of considerable interest. It suggests the possibility that mating the ewes at their second or third heat period may cause an increase in the lambing potential.

Abnormalities of fertilized bovine ova were shown by Winters <u>et al</u>. (1942), and they called attention to the possible role of such abnormalities in lowered fertility. Laing (1949) had data on 11 virgin heifers, inseminated to a single bull of known high fertility, which showed 100 percent fertilization. His observation was at least suggestive that the normal fertilization rate is high.

Evidence for the postulation that sterility may result from over fatness was presented by Asdell (1949). Reproductive tracts of 7 heifers and cows that were fat and sterile were examined. In all animals, there were fatty deposits in the ovaries, few follicles and an unusually large amount of orange pigment in the stroma. Although the ovaries were normal, they were smaller than usual and there was an absence of large follicles.

<u>Effects of nutrition on ovulation rate.</u>

Marshall and Potts (1921) reported that by flushing Southdown ewes the lambing percent at birth was increased by 18 percent. Nichols (1924) reported lambing rates of 150 and 125 lambs per 100 ewes flushed and non-flushed, respectively. Clark (1934) found that the number of eggs released from the ovary was greater from flushed ewes if they were thin at the start of the treatment. Clark (1934) found no evidence that flushing increased ovulation rate in a group of Shropshire ewes that were in good condition prior to flushing.

Marshall (1948) concluded there can be no doubt that whatever the actual condition of the animal, a rising or improving state of nutrition before service is more favorable to fertility than a stationery or falling one, indicating that the supply of additional foods given in this way has a stimulating effect upon the reproductive organs and favors follicular development and the maturation of a greater number of ova. He concluded the supply of good food raises the nutrition and increases bodily vigor and fertility, while over feeding and lack of sufficient exercise lead to excessive storage of fat and reduction of vigor and fertility.

Polovceva et al. (1938) stated that feeding a concentrate 20 days prior to breeding and continued to lambing, increased the number of multiple follicles and number of lambs born. The lamb crop was 133 percent and 119 percent for the flushed and control ewes respectively. McKenzie and Terrill (1937) reported that flushing Rambouillet ewes increased the ovulation rate from 1.06 to 1.15 per ewe.

Research workers in New Zealand (New Zealand Department of Agriculture, 1950) attributed the increased lamb crop in the flushed ewes to an increase in ovulation rate. Laing (1955) stated that flushing increased the number of follicles matured and the number of ova fertilized. Hammond (1957) quoted, "In all breeds the number of eggs shed at tupping, and hence the lambing percentage, can be increased by flushing the ewes before the rams are put in."

Hoversland et al. (1958) found ovulation rates of 1.25 and 1.20 for supplemented and control animals, respectively. Of the ova recovered, 9.1 and 17.6 percent were unfertilized in the supplemented and control groups, respectively.

These authors conclude that the results of this trial would indicate abnormal ova and lack of fertilization were the major factors in a lowered lamb drop. However, this information was based on small numbers.

El-Sheikh et al. (1954) reported ewes on high level nutrition had a significantly higher ovulation rate. Fertilization rate was also higher but not significantly for ewes on higher feeding level.

Smith (1937) indicated that the initiation of a flushing program for sows, resulting in a gain of $\frac{3}{4}$ to 1 pound daily a week before they are to be bred and until they are safely in pig, stimulates all the vital functions. It had been observed that sows, when gaining in flesh and thrift, tend to come in heat promptly and to be more susceptible to impregnation when bred. The above also applies to sows in thin condition.

Briggs et al. (1942) concluded from an eight-year study, practice of flushing was not profitable. The experiment further indicated that the economics of flushing depends upon the condition of the ewes before flushing. He stated that if the ewes are in good condition there is no significant value realized from flushing whereas if the ewes are in poor condition just prior to the breeding season there is a definite profit in flushing.

Darrock and co-workers (1950) stated that in the pre-breeding and breeding periods, the thin ewes showed greater response to feeding concentrates than ewes in good condition. During the early pregnancy period, the ewes in good condition gained the most. No important effects on birth or weaning weights were observed from the feed treatments. Flock fertility was increased by 10 and 9 percent by feeding supplement in the pre-breeding, and breeding periods, respectively. Good condition ewes produced 11 percent more lambs at birth and at weaning than the thin ewes.

Esplin and co-workers (1940) conducted an experiment on feeding ewe lambs during their first winter. Although there was only a 2 to 3 pound difference in weight as yearlings in October, there was a marked difference in breeding efficiency. The lot fed group had a 65 percent lamb crop while the range-fed had only a 45 percent lamb crop. The authors advanced the theory that there was better development of the reproductive tract while very young and also, possible storage of some essential element or elements in the body which are not available in sufficient amounts in range forage.

El-Sheikh <u>et al</u>. (1955) reported on the reproductive rate of yearling ewes which were given two different levels of feed. The ewes were started on feed in January and slaughtered in late summer or early fall. One group received hay for roughage and the other group received two pounds of a grain mixture in addition to the roughage.

They reported ovulation and fertilization rates for two consecutive years (1953-1954). The average number of ovulations per ewe for roughage plus grain was 1.81 and 1.66, whereas roughage only had rates of 1.27 and 1.04, respectively. The percentage fertilized ova was 66 and 83 for ewes on roughage plus grain, compared with 59 and 65 for ewes on roughage only.

Haines *et al.* (1956) studied effects of energy intake on reproduction of gilts. Limited fed gilts ovulated an average of 9.9 ova at first heat, compared to 12.8 ova by full fed gilts. These same gilts had mean ovulation rates of 10.8 and 13.8 in the second heat, respectively. The difference in ovulation rates between ration treatments shows the same trend as reported by Christian and Nofziger (1952), Robertson *et al.* (1951) and Self *et al.* (1955). However, Gossett and Sorensen (1956) found about the same ovulation rate under two levels of energy intake. The increased ovulation from first to second heat was apparently a normal phenomenon.

Effect of age on reproductive rate.

The ovulation rate was significantly affected by age. Marshall (1908) observed that starting with adolescent sterility, ovulation rate rose rather rapidly to its highest point then gradually fell with advancing age to senile sterility.

McKenzie and Terrill (1937) found ovulation rate increased to 3 or 4 years of age then decreased slightly. This increase is in close agreement with Goot (1951), who reported that the greatest rise in fertility takes place between age 2 and 3, gradually increasing to 5 years then declines. Terrill and Stoehr (1939) found that under range conditions there was a steady increase up to 5 years of age, in percentage of ewes lambing and percentage of live lambs born per ewe bred.

Most workers generally agree that there is a rise in reproductive rate up to the 5th or 6th year and then a gradual decline thereafter (Marshall and Potts, 1921; Hammond, 1948; Carlyle and McConnell, 1902; Nichols, 1924; Roberts, 1921; Johansson, 1932). Johansson (1932) reported about 22 percent increase in lambing rate from the first lambing to the fourth.

In swine, two separate effects of age were noted. Lush and Molln (1942) indicated that the third and fourth heats after puberty, ovulation rates were significantly higher than at the first and second. After the fourth or fifth cycle, the ovulation rate becomes stable. The second effect of aging shows up after the females have gone through one or more pregnancies.

Hoversland _et al_. (1958), studying the effect of flushing range ewes on reproductive performance, found a significant year effect as well as a significant year and treatment interaction. The combined data for the three-year period indicated that two-year-old ewes and mature ewes that gained in weight during the experimental period also reproduced at a higher rate as compared to ewes loosing weight. It also showed that flushing increased the proportion of multiple births by 9.9 percent and reduced the proportion of barren ewes by 2.2 percent. Two-year-old ewes responded quite differently to a flushing program than mature ewes under the conditions reported. The reproductive rate of two-year-old ewes was considerably lower than that of the mature ewes due to the higher rate of barren ewes.

Associated phenomena.

Marshall and Hammond (1948) reported that unfavorable weather conditions during the breeding season, such as snow-storms or drought will result in a decreased rate of twinning the following lambing season. Wallace (1907) reported that a low nutritive condition, when associated with exposure to cold wet weather, will cause temporary barrenness in cattle.

Phillips and Davies (1949) were able to show that, in West Wales, successful winter breeding of cattle was associated with areas of high winter temperature, but when other areas of Britain were examined it was not possible to demonstrate a similar clear correlation.

It is not easy to accurately apportion the incidence of lowered fertility among inherited and environmental causes, but the indication is that hereditary infertility is of low incidence. This can be inferred in cattle from the fact that most infertility is not repeated (Casida, 1950; Asdell, 1952).

Eriksson (1943) found in Swedish highland cattle that 30 percent of the cattle in these herds had hypoplasia of one, usually the left, ovary, and that 5 percent had bilateral hypoplasia. The hypoplastic ovary was significantly smaller than the normal ovary and was completely non-functional.

In a study involving 341 cows and 1,280 cow-service periods, Casida and Chapman, (1951) found that 18.8 percent of the cows had cystic ovaries. Confirming results obtained in Sweden and elsewhere, this study established the fact that the condition was inherited and that, in this particular herd, the heritability was 0.43.

Fertilization rates.

If the timing is proper and adequate quantities of viable sperm are present, the fertilization rate approaches 100 percent in polytocous females, Brambell, (1948). However, in cows and sheep, the species that have been studied most intensively, show fertilization rates varying from 60 to 85 percent (Wilson et al., 1948; Squires et al., 1952; Dutt, 1954; El-Sheikh et al., 1955).

Embryonic mortality in general.

Recognition of the importance of prenatal death in livestock production was first given special emphasis by Hammond (1914). He found on the basis of seven sows in various stages of pregnancy that the number of normal fetuses was 73 percent of the number of corpora lutea present in the ovaries. These data were increased in his 1921 report and on the basis of 22 sows the proportion of normal fetuses was 67 percent; the fetuses that were atrophic, 12 percent; and those missing entirely, 20 percent. He also presented data on 80 pregnant ewes which showed normal fetuses equal to 87 percent of the corpora lutea present. The number of atrophic fetuses and missing eggs were approximately equal.

The analysis of potential causes of embryonic death made by Hammond (1914) tended to eliminate disease as a factor. He believed this was true because dead and live embryos could exist side by side in the same uterus. Bacteria usually were not found and no particular pathology was usually present in the maternal tissues. The general nutrition of the mother did not seem to be a particular factor because much mortality occurred before embryos were large enough to be serious competitors for any restricted nutrient, and further he saw little relation between numbers of embryos in the early stages and amount of embryonic death. Hammond concluded that something inherent in the egg seemed the most likely cause. He suspected that the larger number of eggs produced by either ovary, the greater the amount of embryonic death, and interpreted it that ovarian nutrition was a limiting factor for the production of eggs capable of resulting in viable embryos. This hypothesis would at least be consistent with there being litter differences in embryonic death and also with the suspected difference between single and litter-bearing species in the amount of embryonic death.

In a later observation, Hammond (1921) found 32.6 percent fetal mortality in 22 sows. These animals had been slaughtered between the 14th and 60th day of gestation.

Corner (1921) was, in one case, able to recover 6 vesicles from a sow with 7 corpora lutea. Two of these were entirely normal, two were normal in texture but were collapsed and cup-shaped, two were abnormal, while one was unsegmented. The possible causes of early embryonic mortality were ascribed to: (a) pathological changes inherent in the germ-cells, (b) faults due to germ-cells, and (c) injuries which might affect the ovum during passage from the ovary to the uterus. Concerning the last cause cited, he mentioned the possiblility of chemically abnormal secretions from apparently normal uteri.

Corner (1923) studied the problem in swine and gave some recognition to the importance of stage of gestation in connection with the estimation of the embryonic death. He was puzzled by an apparent loss in his packing-house material of 40 percent of the embryos in the first few days of gestation whereas in later stages only 20 to 30 percent of the embryos appeared to be degenerate or missing. His explanation assumed that some sows which would appear at earlier stages as having both normal and abnormal embryos would finally lose all their embryos and thus would not be recognized as having been pregnant in later stages.

Warwick (1928) calculated the percent of ova lost at various stages of gestation. He concluded that the loss tended to increase as gestation advanced. Uteri from sows in the 20th to 40th-day period of gestation had from 20 to 25 percent of the ova missing. Degenerating embryos were found to be most common in the earlier stages.

Henning (1939) estimated the incidence of fetal mortality in sheep from the discrepancy between the number of corpora lutea in the ovaries and the number of live fetuses in the uteri. He pointed out the fact in his material that early embryonic death with complete absorption could not be detected. Over-all, he found 16 percent of the corpora lutea were not accounted for by live fetuses, a figure which is but slightly higher than that noted earlier by Hammond (1921).

Henning also called attention to the increase in the mortality of the fetuses with the increase in number of ova shed; 8 percent with one ovum, 26 percent with two, and 43 percent with three.

The authors reported that embryonic death appeared to be greater during the first 18 days following service (20%) than during the remainder of gestation (9%).

Nutrition.

Robertson et al. (1951) investigated pasture, protein level, and feeding level as factors that possibly affect variation in the embryonic death of swine. Limited effects only were noted for pasture and for level of protein. The most general effect was from full feeding. The percentage of eggs resulting in normal embryos at 25 days gestation was less by 25 percent in those animals that were full fed.

Christian et al. (1952) obtained similar results. They compared gilts that were on high and low planes of nutrition. The estimated prenatal death rate in the high plane animals was greater by 27 percent than in the low plane animals. They found that even though a higher ovulation rate was obtained by full feeding, the greater embryonic death resulted in smaller litters than from the gilts on the low plane of nutrition.

El-Sheikh et al. (1954) reported that the embryonic survival rate was lower in the ewes on the higher level of feeding. The difference in embryonic survival rate between the two groups of ewes was highly significant. Also there was a significant interaction between year and level of feeding on embryo survival.

Ova classification.

Hart (1956) examined over 1,000 ova and made certain classifications. He stated that a fertilized sheep's ovum may always be identified by the numerous surplus sperms which can be found adhering to or embedded in the zona pellucida. A single cell ovum was deemed to be normal, up to its present stage of development, if it was fertilized or able to be fertilized, when recovered. It was accepted that all dividing ova recovered had been and were normal up to their present stage of development unless obvious signs of abnormalities were then appearing.

Other workers have used cleavage as the critera for fertilization of the ova recovered (Dutt, 1954; El-Sheikh et al., 1955; Squires et al., 1952; Wilson et al., 1948).

CONDITIONS OF THE EXPERIMENT

Experimental animals.

The sheep used in this study were from a band of approximately 840 grade ewes, owned by the Montana Agricultural Experiment Station. They were Rambouillet, Targhee and Columbia ewes bred and managed at the Red Bluff Ranch near Norris, Montana. The ages varied from long yearlings to seven-year-olds. The entire band had previously been culled, eliminating all ewes of unsound condition.

Description and location of the range.

The ranges grazed by the experimental band were on the Red Bluff Ranch. The elevation varies on the portion of the range grazed from approximately 4650 feet up to 5400 feet. Most of the range was characterized by relatively steep slopes dissected by deep drainages. Slopes vary from approximately 0 to 34 percent. Portions of the winter range were largely on south-facing slopes, whereas much of the fall range was on gentle north-facing slopes. Much of the spring range was on relatively steep, south-facing slopes.

Soils on the range grazed by the experimental band were largely light-textured with heavier textures occurring at the lower elevations and more gently sloping portions of the range. The higher portions of area grazed were characterized by rockiness and uneven topography.

Water was available from springs and Hot Springs Creek. In general, the water is of good quality and was plentiful for the sheep. In addition, snow water was available during portions of the late fall and winter months.

The sheep were not forced to trail excessive distances to secure water.

The vegetation on the ranch grazed by the experimental band is dominated by bluebunch wheatgrass (Agropyron spicatum). Other grasses of considerable importance on the winter range were needle and thread (Stipa comata), junegrass (Koeleria cristata), western wheatgrass (Agropyron smithii), bluegrasses (Poa spp.), and sedges (Carex spp.). Forbs on the winter range were unimportant as a source of feed. The only forbs grazed to any extent were the dried twigs, leaves, and pods of several of the locos (Oxytropis spp.), lupines (Lupinus spp.), and milkvetches (Astragalus spp.). An important halfshrub common on the winter range and highly palatable to the sheep was fringed sagewort (Artemisia frigida). Shrubs of importance included bitterbrush (Purshia tridentata), rabbitbrushes (Chrysothamnus spp.), and scattered plants of big sagebrush and silver sagebrush (Artemisia tridentata and Artemisia cana).

The spring range is characterized by essentially the same species as the winter range, with the exception of bitterbrush. Spring ranges are perhaps steeper with sharper draws. Along the bottom of the draws and the slopes there are extensive stands of various browse plants, including shunkbrush sumac (Rhus trilobata), ninebark (Physocarpus malvaceus), squaw current (Ribes cereum).

Most of the fall range is comparatively free of browse plants. It is dominated by the grasses common on the winter and spring ranges and, in addition, at the higher elevations there are considerable stands of Idaho fescue (Festuca idahoensis). The forbs common on the winter range are present on the fall range with extensive stands in certain locations of white pointloco (<u>Oxtyropis serecia</u>) and prairie milkvetch (<u>Astragalus straiatus</u>).

These ranges are open to grazing during most of the winter except when there is extreme accumulation of snow. Even during heavy snow periods, the south-facing slopes of the winter range are available for grazing.

METHODS AND PROCEDURE

Three wintering regimes and two pre-breeding treatments were established. All ewes (203) were assigned at random, within breed, age and pre-breeding groupings.

Eighteen ewes from each of the pre-breeding treatments were identified with a red ear tag to be slaughtered 3 days post-breeding to determine ovulation and fertilization rates. The remainder of the ewes were allowed to lamb and lambing data were collected to compare with slaughter data.

Throughout the experimental period all ewes were individually weighed with approximately 16 hours shrink previous to weighing.

Pre-breeding.

All ewes were weighed November 5, 1958 and half of the ewes assigned to each wintering regime were fed one pound of a 30 percent protein pellet per head per day 14 days prior to breeding and continued until they were bred. The ingredients of this protein pellet are shown in Table I.

TABLE I. Feed composition of the supplement fed.

Ingredients:	%
Barley	11.8
Cane molasses	6.0
Cottonseed meal	20.3
Linseed meal	20.3
Soybean meal	20.4
Dehydrated alfalfa meal	20.0
Salt	1.0
Trace mineral	0.15
AD-SEAL-IN	0.05
	100.00
Percent crude protein	31.1

The flushing period started November 8. Each morning the ewes were divided into two groups and the flushed ewes were group fed one pound of supplemental pellet per head. After supplemental feeding, which took only a short time, all ewes were herded on the range together. All ewes were individually weighed on November 19.

Breeding.

Breeding began November 22. Each night the ewes were brought in from the range and by means of a cutting chute, they were separated into three breeding pens. Rams of the three breeds were turned into their respective breeding pens at the rate of 3 rams per 100 ewes. All rams were ochred on the brisket to facilitate detection of ewes bred during the night. The following morning the rams were taken out and put into a day holding area with available feed and water. Each morning ewes marked by the ram and designated for slaughter were identified and breeding dates recorded. On the third day post-breeding they were transported to the meats laboratory at Montana State College and slaughtered the same day. Upon slaughter, the reproductive tract was removed and trimmed of all excess connective tissue and recent ovulation points observed and recorded. The oviduct was severed from the mesosalpinx leaving one inch of the cornu attached. A small hypodermic needle with 3 cc. of physiological saline solution was used to flush the ova down the oviduct. Flushing was initiated by inserting the needle into the infundibulum end of the oviduct. The ova and saline solution were recovered in a watch glass. If the ova were not recovered from the oviducts after several flushings, the uterus was then flushed. With the aid of a dissecting microscope the ova were located and transferred to a hanging drop slide by means of a capillary tube. The ova were then examined under a high power microscope for normality and cleavage.

The critera for fertilization in this study was cleavage, however ruptured ova where only the zona pellucida was recovered were classified as fertilized if sperm were present. This method of classification was based on work of Hart (1956). All uncleaved ova were classified as non-fertilized.

Post-breeding.

The Montana Agricultural Experiment Station nutrition band was on nine winter feed treatments. The ewes in this study were part of the band and in feed treatments 0, 7 and 8. Treatment (0) consisted of range forage with no supplementation and treatment (7) consisted of range forage plus one pound per head per day of the pellet used for flushing (Table I). Ewes in treatment (8) were separated from the band three days after being marked by the ram and placed in dry lot. They were fed grass hay at the rate of $4\frac{1}{2}$ pounds per head per day.

Throughout the gestation period all ewes on the above post-breeding treatments were weighed periodically. Individual condition scores were recorded during the December and April weighing dates. The last period for weight records was prior to lambing. Ten days before lambing the entire band was managed under the same conditions. They were lambed under shed conditions equipped with individual jugs. The drop area was located adjacent to the shed and as the ewes dropped their lambs they were transferred to the shed. Each morning lambing data were recorded for the previous days drop. Under these conditions all lambs were weighed within 24 hours from the time of birth.