

Sheep research stresses management, nutrition, and breeding

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Goals of the Hopland Field Station's sheep research program have been to increase production by increasing the number of lambs born, improving lamb survival, increasing weaning weights, economically meeting the nutritional needs of sheep, and developing more productive strains of sheep.

Early surveys of problems facing sheepmen in the North Coast area, where conditions are similar to those at the station, revealed that lamb production varied greatly. An average of 110 lambs were born per 100 ewes, but an average of only 75 lambs were weaned. Average survival varied from 90 to 95 lambs per 100 ewes in years with mild winters to only 50 to 60 lambs per 100 ewes during severe winters. Some ranchers reported survival of as few as 10 lambs per 100 ewes.

Weaning weights also varied, averaging 72 to 76 pounds. Twenty-five to 35 percent were large enough and fat enough to go directly to slaughter. The others, after replacement ewes were selected, were sold as feeders.

Shelter

Based on this information, the first research programs at the station were designed to increase weaning weights and improve weaning percentages by protecting ewes and lambs from adverse weather.

Rain and wind rapidly deplete the energy of lambs, causing many deaths from exposure or pneumonia. Because ewes always select a high point for their

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Low-cost sheep shelters give range ewes and their lambs protection from harsh winter weather.

bedding grounds, where winds can be especially strong, inexpensive plastic shelters were designed and placed on the bedding grounds to protect the ewes and lambs. These shelters had three sides enclosed, were framed with small-dimension lumber costing 7 to 10 cents per square foot of shelter, and were covered with plastic costing 3/4 to 2 cents per square foot.

The plastic deteriorated rapidly in sunlight but, when the framework was covered in the fall, the plastic survived two and sometimes three lambing seasons. Re-covering the framework was time-consuming (8 man-hours for a

20-foot x 100-foot shelter), so a plywood-covered arch-truss was designed as a more permanent structure. This type of shelter costs two to three times as much as the plastic shelter but lasts considerably longer and is still much less expensive to build than a pole barn.

In addition to providing shelter for ewes and lambs on the range, studies were conducted to develop an economical barn-lambing system. Barn lambing makes it easier to assist ewes that are having lambing difficulties and protects lambs from rain and cold for 1 to 3 days, allowing time for development of a strong mother-infant bond.

Nutrition

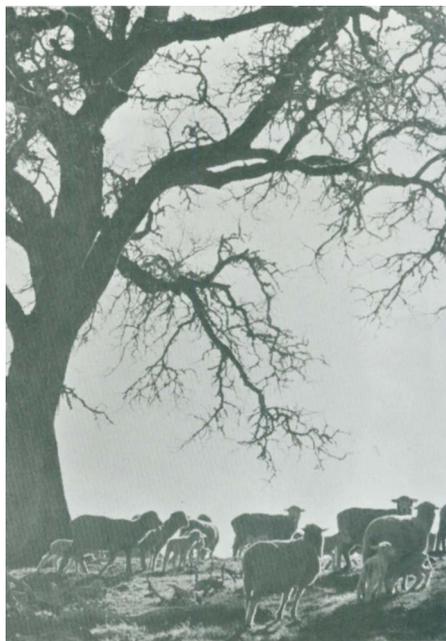
Range nutrition is another factor that affects the weaning percentage and weight of lambs. The sheep nutrition research has emphasized making maximum use of available vegetative growth without limiting the nutrient intake. Methods of assessing what the sheep graze have been developed, intake samples have been analyzed, and ways to provide animals with needed nutrients have been explored.

Weanling lambs experience considerable stress during the dry season and the following winter. Early supplemental-feeding trials concentrated on this problem. In early experiments, the treatment groups were rotated between the pastures, but then a system was developed in which the experimental animals grazed in a common flock and were separated into treatment groups only for feeding the supplement. Eventually, the system was further refined so that the animals were individually supplemented.

Results from 7 years of these trials showed that small amounts of protein meal or alfalfa moderated weight losses, improved wool production, and reduced death losses sufficiently to make supplementation economical.

Since the number of lambs produced per breeding ewe in the flock is the most important variable affecting net income from a sheep operation, the effect of the nutritional status of the ewe at breeding time on her subsequent lamb production also was studied. It was found that supplemental feeding with protein and, sometimes, energy 14 to 17 days before introducing rams to the flock and during the first 17 days of breeding often increased lambing percentages. Response was more certain when the ewes received their whole ration in drylot (a 30 to 60 percent lambing percentage increase in several seasons) than when supplemented on the range (a 10 to 15 percent lambing percentage increase in some seasons). When available, improved pasture also was effective in increasing lambing percentage.

It was discovered that there is a very good correlation between the protein available in the pasture and the urea nitrogen level in the blood of the sheep. Because of this correlation, ranchers can take representative blood samples to their



local hospital laboratory for analysis, and feeding practices can be regulated according to the need as determined by the analysis.

It also was found that, with adequate nutrition from weaning to early fall, a high proportion of ewe lambs will breed to lamb as yearlings. In this project, 54 percent of the ewes that produced twins as yearlings also produced twins as two-year-olds. Among the ewes that did not breed as yearlings or that produced single lambs, only 18 percent had twins as

two-year-olds. Since twinning appears repeatable, this should be a useful tool in selecting ewes for multiple births.

Studies on the effect that nutrition during the first year of life has on a replacement ewe's lifetime performance showed that replacement ewes raised on a good plane of nutrition at Davis were considerably heavier than those raised on the range at Hopland. However, lifetime wool and lamb production favored the range-raised ewes.

In evaluating the feeding value of shrubs and trees for livestock and wildlife, little difference was found between sheep and deer in their ability to digest alfalfa, chamise, and live oak. The chamise and live oak were fair sources of energy, but both were low in digestible protein. Further study comparing the feeding value of shrub species with that of grasses indicated that the brush species studied have limited feed value for sheep.

Algae grown on sewage, rice straw, chicken litter, apple pulp, and other economical sources of nutrients also have been experimentally fed to sheep.

Not all feeding trials have produced positive results. For example, cobalt supplementation was of no value, and additional vitamin D actually gave negative responses. The station's flock also has contributed to lamb feeding trials on the UC Davis campus by providing experimental animals of known background and breeding.

Esophageal fistula aids researchers

To provide a truly representative sample of what animals were grazing, an esophageal fistula was developed at the station. This technique utilizes a fistula (hole) prepared surgically in the esophagus, which allows all feed consumed to be collected in a bag around the sheep's neck during the sampling period. When not being used for collection, a plastic plug caps the fistula, allowing the animal to eat and drink normally.

The esophageal fistula technique--used to demonstrate the selectivity of grazing animals, the inaccuracy of hand-clipped or plucked samples, and the effect of prior grazing on intake of nutrients--has been the basis for much of the animal feeding research at the Hopland Field Station and is now used throughout the world for similar studies.

Feeding Interval

To see if labor costs could be reduced, researchers fed ewes at less frequent than daily intervals. When a week's ration of alfalfa cubes was fed all at once, the ewes cleaned up the feed in 3 to 3 1/2 days. They then went hungry for the next 3 1/2 to 4 days. Surprisingly, these ewes produced more lambs than those given the same weekly total of feed as a daily ration. It appears that, with daily feeding, the stronger ewes intimidate the weaker ones and consume more than their share of the feed. Only when the stronger ewes have been satisfied are the weaker ones allowed to eat. When the entire week's ration is fed, feed is available to all the ewes over a longer period so that all have the opportunity to get to the feeders.

Several other management techniques also have been tested. Spring or summer shearing used to be an established practice among sheepmen. However, tests showed that fall or winter shearing had several advantages--wool fibers were stronger, the ewes produced more twins, and there were fewer dry ewes. The only disadvantage to fall or winter shearing seemed to be extra seeds in the fleece. Comfort of the ewes did not appear to be a factor because wool is a good insulator for both cold and heat, and full-fleeced ewes are comfortable in the summer if they are not forced into strenuous exercise.

Station researchers also discovered that mastitis is prevalent in sheep. Approximately 10 percent of the ewes in the station flock had a positive CMT test in 1975. Forty-two percent of the single lambs from mastitic ewes died before weaning, compared with a 14 percent loss from nonmastitic ewes. Of the lambs that lived, those from mastitic ewes weighed less at weaning.

Breeding

A series of experiments has been conducted to identify and develop strains of sheep that are well adapted and productive under the annual grassland range conditions of the North Coast area. The emphasis has been on lamb production, but wool production also has been measured.

An early trial compared crossbred ewes sired by Columbia, Corriedale, Border Leicester, and Romeldale rams, out of Merino dams. The first two of these groups were similar in performance, but the latter two lacked adequate longevity for this environment.

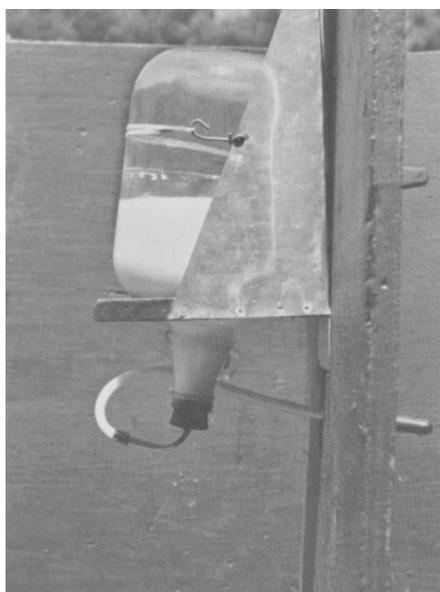
A comparison of growth rates of Suffolk- and Corriedale-sired lambs confirmed the advantages in the growth and finishing ability of Suffolks as sires of market lambs. Suffolks have been used in the Hopland flock continuously since the mid-1950's as a terminal sire breed in all evaluations of market-lamb producing

ability of different ewe types, and as the reference breed in comparisons of different terminal sire types.

Since the North Coast counties are predominantly a feeder-lamb producing area, an experiment was conducted to determine if a higher fat lamb percentage and higher returns could be obtained using Southdown rams. The first of these objectives was achieved, but not the second; the lighter weight of Southdown-cross lambs, as compared with Suffolk-cross lambs, more than offset the advantages of the Southdowns in terms of readiness for slaughter at weaning off the range. The Southdown crosses had a higher survival rate, but the difference was not enough to result in equal returns from ewes bred to Southdowns.

Other terminal sire breeds tested included Dorsets, which sired more fat lambs than Suffolks, but with slightly lower weights, resulting in no significant difference in net returns. A comparison of lambs by Hampshire, Suffolk, and F₁ Hamp x Suffolk rams showed a slight overall advantage for the F₁ sires over those of both parent breeds, and a follow-up study in Glenn County showed advantages of these crossbred rams in longevity as well.

In 1960 researchers began a long-term evaluation of selection for rapid growth from birth to weaning, and of the effect of the environment in which such selection is practiced. The question posed



Self-feeder reduces labor

Almost every sheep operation has orphan lambs to contend with, but nursing these lambs takes a lot of time, and many die because feeding equipment is not properly cleaned.

Two practical approaches to overcoming these problems were developed at the Hopland Field Station. A self-feeder, consisting of a gallon jug inverted into a holder with a tube and nipple attached, was developed to reduce feeding labor. The lambs quickly learn to nurse from the nipple and can drink at will. The only labor required is a periodic refilling of the jugs with milk or a milk replacer.

To further reduce feeding labor and eliminate the need for daily cleanup, it was found that bacteria growth in milk can be prevented for up to 10 days by adding 1 ml of Formalin (a 37 percent solution of formaldehyde, which serves as a bactericide and a preservative) per gallon of milk. Studies showed that a weekly cleaning of feeding equipment was sufficient to prevent scours and any decrease in rate of gain.

These same techniques have been applied by wildlife workers at the station who raise fawns in captivity for research or other purposes.

was: Is it preferable to select for growth rate under favorable nutritional conditions and introduce males of the improved strain into the range flock (the common approach in much of the world, for cattle as well as sheep) or to select for the desired performance in the range environment?

A base population of 300 Targhee-type ewes was divided at random between Davis, representing a more favorable nutritional environment, and the Hopland station, representing a range environment. Closed lines selected for heavy 120-day weight (after adjustment for twin or single birth) and unselected control lines have been carried continuously in each

location since 1960. In addition, a third line has been maintained at Hopland by mating ewes selected at Hopland to the rams from the line selected at Davis, to compare the benefits of using locally selected and introduced sires.

The results to date are interesting and somewhat unexpected. Weaning weight has improved in the selected lines at both locations, but much more at Davis than at Hopland (15 to 25 percent vs. 8 to 13 percent above the control line, in recent years). This is due to greater selection pressure permitted by higher reproduction at Davis, which was expected, and to a higher heritability in the better environment, which was not pre-

viously known. Also, response to selection at Hopland is expressed more by single than by twin lambs, and more in good feed years than in poor. The pattern, therefore, seems to be that an environment favorable to growth is necessary for expression of genetic differences in growth potential and, hence, for effective selection.

A consequence is that the line at Hopland bred from rams selected at Davis is equal or superior to the line selected at Hopland. Whether this will remain so in the long run is yet to be seen, but it has been true now for 16 years, or about 8 sheep generations. This experiment represents, in terms of generations, one of



the longest evaluations ever conducted on the effects of selection for a production trait in a livestock species. The relatively large number of generations in the time involved has been achieved by the routine use of ram lambs for breeding, a practice usually considered unfeasible but which has been used successfully in this project.

Prolificacy

Because of the importance the number of lambs weaned has on net returns from a sheep enterprise, research to make genetic improvement in prolificacy was initiated in 1963. Ewes with a consistent record of multiple births from the weight and control lines of the weaning weight experiment formed the nucleus of a line which has been selected for multiple births continuously since 1963. Progress has been encouraging. In 1975, for example, the number of lambs born per ewe lambing was 1.24, 1.32, and 1.50 for the control, weight, and twin lines of Targhees, respectively, with the twin line having the highest weight of lamb weaned per ewe and per hundredweight of ewe. As was described for weaning weight, there appears to be an environmental (nutritional) threshold below which genetic potential for multiple births is not expressed.

The importation into the United States in the late 1960's of the highly prolific Finnish Landrace breed suggested a means of even more rapid improvement of multiple birth potential. Station ewes of mixed Corriedale and Targhee breeding were mated in 1970 to Finn, Finn-Targhee, Finn-Suffolk, selected Targhees, Corriedale, and Suffolk rams, and the productivity of the ewe progeny is being assessed.

Based on the average of the first three lamb crops, all crossbred groups (by Finn, Finn-Targhee, Finn-Suffolk, and Suffolk rams) are significantly more productive, in number and weight of lambs weaned, than all of the Whiteface (Corriedale and Targhee) combinations. The four crossbred groups are similar in weight of lamb weaned per ewe. In terms of lamb per unit of ewe weight, the Finn groups are superior to the Suffolk cross because of the heavier ewe weight of the latter. In overall performance, ewes carrying 25 percent Finnish Landrace and 75 percent Targhee-Corriedale inheritance appear to be the most productive of all

breeds or crosses tested.

Overall, the sheep research program at the Hopland Field Station has made a significant contribution to the sheep industry. Management techniques have increased lamb survival rates and weaning weights. Feeding research has provided a sound basis for supplementing ewes, demonstrated an economical supplementation for weaning ewe lambs, and established the feeding value of by-product feeds. Breeding research has identified more productive sire and dam strains and crosses. Many of the research projects also have led to developments that will facilitate future research programs at the Hopland Field Station and throughout the world.

Selected bibliography

AN ESOPHAGEAL FISTULA FOR ANIMAL NUTRITION STUDIES

Torell, D.T. 1953. *J. Anim. Sci.* 13(4):878-884.

SELECTIVE GRAZING BY SHEEP AS SHOWN BY A COMPARISON OF THE CHEMICAL COMPOSITION OF RANGE AND PASTURE FORAGE OBTAINED BY HAND CLIPPING AND THAT COLLECTED BY ESOPHAGEAL-FISTULATED SHEEP

Weir, W.C., and D.T. Torell. 1959. *J. Anim. Sci.* 18(2):641-649.

A PLASTIC-ROOF SHEEP SHELTER

Cleaver, T., D.T. Torell, and R. Parks. 1959. *Calif. Agric. Exp. Stn. Leaf.* 118.

THE EFFECT OF ENVIRONMENT FROM WEANING TO FIRST BREEDING IN LIFETIME PRODUCTION OF EWES

Bradford, G.E., W.C. Weir, and D.T. Torell. 1961. *J. Anim. Sci.* 20(2):281-287.

EFFECTS OF ENVIRONMENT ON PHENOTYPIC AND GENETIC VARIATION IN SHEEP

Osman, A.H., and G.E. Bradford. 1964. *J. Anim. Sci.* 24(3):766-774.

FORAGE INTAKE BY CATTLE AND SHEEP ON DRY ANNUAL RANGE

Van Dyne, G.M., and J.H. Meyer. 1964. *J. Anim. Sci.* 23(4):1108-1115.

BOTANICAL COMPOSITION OF SHEEP AND CATTLE DIETS ON A MATURE ANNUAL RANGE

Van Dyne, G.M., and H.F. Heady. 1965. *Hilgardia* 36:13.

SUPPLEMENTAL FEEDING OF SHEEP GRAZING ON DRY RANGE

Weir, W.C., and D.T. Torell. 1967. *Calif. Agric. Exp. Stn. Bull.* 832.

COMPARISON OF METHODS OF ESTIMATING THE DIGESTIBILITY OF RANGE FORAGE AND BROWSE

Wilson, A.D., W.C. Weir, and D.T. Torell. 1971. *J. Anim. Sci.* 32(5):1046-1050.

EFFECT OF LEVEL OF PROTEIN AND ENERGY DURING FLUSHING ON LAMBING PERFORMANCE OF RANGE EWES

Torell, D.T., I.D. Hume, and W.C. Weir. 1972. *J. Anim. Sci.* 34(3):479-482.