

Third Edition

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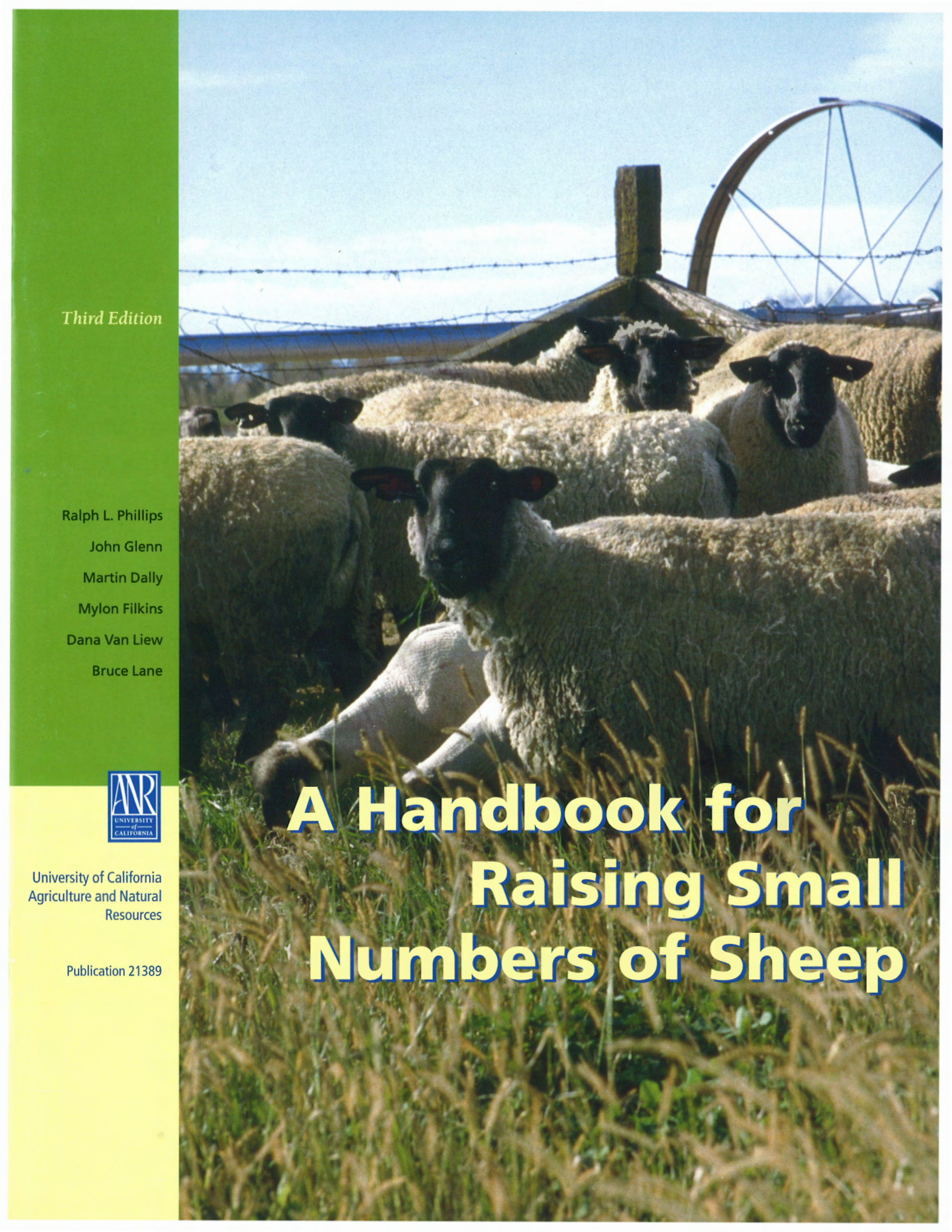
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A photograph of a flock of sheep in a field. The sheep are white with black faces and are grazing on tall grass. In the background, there is a wooden fence and a large wooden wheel structure. The sky is blue with some clouds.

A Handbook for Raising Small Numbers of Sheep

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Third Edition

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PREFACE

California's sheep industry is changing. Many newcomers are interested in raising small numbers of sheep on small acreages, and they are often not familiar with the principles of raising sheep.

This publication offers basic information on breeds, breeding, feeding, diseases, parasites, general management, and management equipment for sheep. It also contains a glossary, a bibliography for additional reading, and an index. The information in this publication has been developed from many sources, including the authors' personal experiences.

The responsibility for the welfare of sheep lies with owners and managers. Acceptable welfare for sheep can be maintained through proper health care, living conditions, and handling practices. The information furnished in the following pages should help owners and managers provide a comfortable and healthy environment for their flocks.

SUMMARY OF MANAGEMENT ACTIVITIES

PREBREEDING MANAGEMENT FOR EWES AND RAMS

- Vaccinate ewes for abortion-causing diseases.
- Deworm ewes and rams.
- Flush ewes 2 to 3 weeks before breeding.
- Check condition of rams; provide extra feed if in poor condition.
- Trim hooves.
- Semen-test rams and palpate testicles.

BREEDING MANAGEMENT

- Tag ewes (if dirty).
- Turn rams in with ewes.
- Use color marking methods for rams.
- Take rams out 90 days after first exposure to ewes.

PRELAMING MANAGEMENT

- Deworm ewes.
- Examine condition of ewes.
- Increase feed to ewes.
- Tag ewes for lambing.
- Prepare barn and equipment for lambing.
- Vaccinate ewes for enterotoxemia and tetanus.

LAMBING MANAGEMENT

- Watch ewes carefully, BE THERE!
- Vaccinate lambs for enterotoxemia and tetanus.
- Trim hooves as ewes lamb or shortly after lambing season.
- Wean lambs at proper weight.

GENERAL MANAGEMENT

- Trim hooves.
- Shear ewes and rams.
- Shear lambs.
- Plan feed supply for winter.
- Consult with veterinarian for vaccination needs, worming schedule, and drugs.

BREEDS OF SHEEP

Sheep have been bred to fit almost every environmental condition in the world. This chapter discusses the more popular breeds in the United States (see figure 1). Excellent pictures and descriptions of the various breeds can also be found at Oklahoma State University's "Breeds of Livestock" website (www.ansi.okstate.edu/breeds/sheep/) or at the American Sheep Industry Association's website "Directory of U.S. Sheep Breeds" (www.sheepusa.org/). A list of breed associations can be found at the Breeder's World website (www.breedersworld.com).

Generally, breeds can be divided into five groups: fine wool, medium wool, long wool, meat, and other breeds.

FINE WOOL

The most widely used fine wool breeds, Rambouillet and Merino, originated in the dry, arid regions of Spain and thrive in western range conditions.

ADVANTAGES

- Rugged; adapt well to extreme heat and cold; do well under poor feed conditions.
- Produce high-quality fine wool.
- Excellent herding instincts; band together.
- Long breeding season: April through July, for lambing early in the fall.
- Long-lived; ewes may live 10 to 12 years.

DISADVANTAGES

- Not heavily muscled; poor body conformation.
- With high rainfall and on irrigated pasture, hoof growth is more rapid than in most breeds, requiring frequent trimming.
- Not a breed of choice in high-rainfall areas because of wool rot and fly strike.

MEDIUM WOOL

Medium wool breeds were bred for both wool and meat. They were developed by crossing fine wool breeds with long wool breeds: fine wool breeds were used for wool quality, and long wool breeds were used for growth and body conformation (shape). Medium wool breeds are used mainly in the range sheep industry. About 35 percent of the sheep in the United States are medium wool breeds. The most common of these in the west are Columbia, Corriedale, and Targhee. Panama is less numerous.

ADVANTAGES

- Compared with fine wool breeds, lambs grow faster, reach market at a younger age, and have better body conformation.
- Produce more pounds of wool and cleaner wool than fine wool breeds; wool is not as fine as that of fine wool breeds but is fine enough to receive a top price.
- Ewes are good milkers with adequate feed.
- Good herding instincts.

DISADVANTAGES

- Do not produce meat or wool well in extremely warm climates.
- Require more feed and are not as rugged as fine wool breeds.
- Shorter breeding season than fine wool breeds.

LONG WOOL

Long wool breeds were developed in the British Isles under cold, moist conditions with an abundant feed supply. They are less popular in the United States and do not adapt well to most California conditions. The most popular long wool breeds are Romney, Lincoln, Cotswold, Leicester, and Border Leicester.

ADVANTAGES

- Grow to large size as adults.
- Lambs grow fast but mature late.
- Ewes are heavy milkers.
- Adapt well to heavy rainfall areas.
- Produce a lot of coarse wool.

DISADVANTAGES

- Low demand for coarse wool.
- Mature late and are very seasonal in their breeding habits.
- Lack herding instincts.
- Lambs do not produce as desirable a carcass as meat breeds.

MEAT BREEDS

Meat breeds were developed primarily for lamb production and are usually produced under farm flock management. Meat breed rams, particularly Suffolk, Hampshire, and Suffolk-Hampshire crossbreeds, are often bred to range ewes to increase lamb production. The crossbred ewe lambs produced are usually sold as market lambs. The most popular meat breeds are Suffolk and Hampshire. Dorset, Cheviot, and Montadale are not as popular; Shropshire, Oxford, and Southdown are other less-popular breeds.

ADVANTAGES

- Lambs have excellent body conformation and grow quickly.
- Ewes are prolific, good milkers, and good mothers.

DISADVANTAGES

- Ewes are later breeders compared with fine wool breeds.
- Produce a light clip of wool.
- Herding instincts are poor.

OTHER BREEDS

The Finnish Landrace (Finn) breed was introduced to the United States in the late 1960s. Finn lambs are very hardy. Purebred ewes can have from three to seven live, healthy lambs, and the lambs appear to have the ability to absorb a great deal of antibodies from colostrum during the first 24 hours of life, increasing their survival rate. This breed, however, has poor body conformation and grows slowly, and the wool is of very poor quality. Finn sheep have been used very successfully in crossbreeding to increase the number of lambs born. One-half-blood Finn ewes can produce about a 250 percent lamb crop. A one-fourth-blood, or quarter-blood, ewe can produce up to 200 percent lamb crops. When Finn is crossed with the proper breed, conformation and wool quality can be improved.

Specialty cheese made from sheep milk is in high demand in many metropolitan areas of the United States, and it sells for a premium price. Although any sheep can be milked, specialized milk breeds such as East Friesian and Rideau Arcott excel in milk yield and provide a better return on investment in facilities and labor. Making cheese from sheep milk is both an art and a science and requires the proper equipment and attention to detail.

Hair sheep are descended from the hair sheep of Africa, which do not produce a fleece (the whole coat of wool shorn from a sheep) and therefore do not require shearing. Katahdin is an American breed of hair sheep developed in Maine from a base of an African hair-type sheep and wool breeds. In cold weather, Katahdins grow a very thick winter coat, which generally consists of coarse outer hair fibers and an undercoat of fine woolly fibers. This winter coat becomes very thick and long with cold weather and decreasing day length. It is shed as temperature and day length increase, leaving a shorter summer coat.

Hair sheep are fertile in crosses with other breeds. The first crosses between wool sheep and hair sheep result in individuals that shed only part of their wool, such as on the belly, lower neck, face, and sides. It takes about three generations to produce hair sheep that breed true. For example, crossing a wool sheep and a hair sheep produces a sheep with one-half wool and one-half hair. Mating the one-half hair sheep to a purebred hair sheep

produces a sheep with three-quarters hair and one-quarter wool. Mating the three-quarter hair sheep to a purebred hair sheep produces a sheep with seven-eighths hair and one-eighth wool. Mating the seven-eighths hair sheep with a purebred hair sheep produces a hair sheep that produces pure hair sheep offspring when mated with other purebred hair sheep.

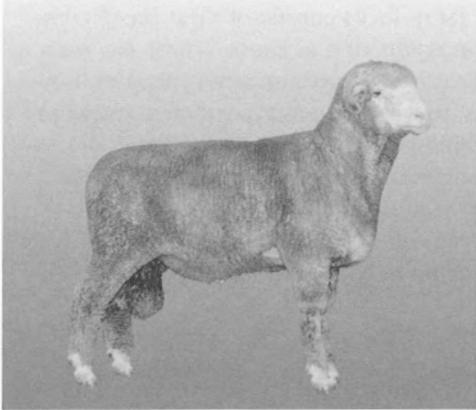
Other breeds of sheep include Dorper and White Dorper from South Africa; St. Croix from the United States and British Virgin Islands; Barbados Blackbelly, a polled hair sheep from the island of Barbados; and Barbadillo, a horned breed that originated in Texas from crossing Barbados Blackbelly with Rambouillet and Mouflon.

The Polypay breed was developed at the U.S. Department of Agriculture Science and Education Administration Sheep Experiment Station at DuBois, Idaho, using Finn, Dorset, Rambouillet, and Targhee to incorporate the advantages of these breeds. Polypay ewes can produce a 175 to 200 percent lamb crop.

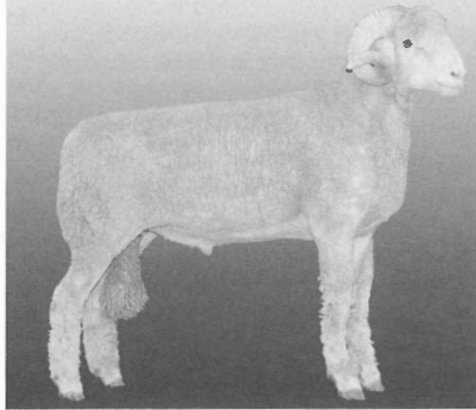
CROSSBREEDING

Most farm flocks consist of meat breed ewes for the production of lambs. There has been a bias against the medium wool sheep in farm flocks; however, a good meat-medium wool crossbred ewe can be very productive. Crossbreeding can increase lamb numbers. The use of medium wool sheep in crossbreeding can increase returns from wool with little or no reduction in lamb growth.

Fine Wool

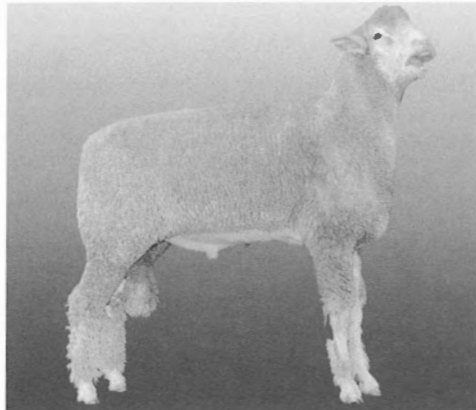


Merino



Rambouillet

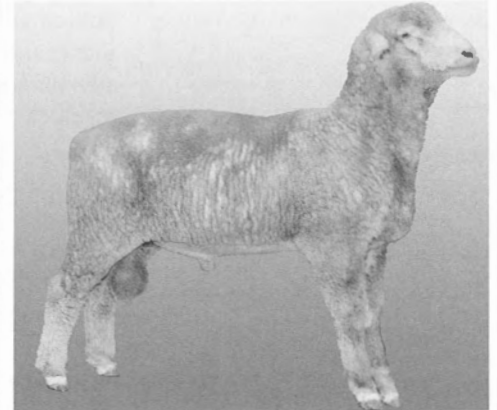
Medium Wool



Columbia

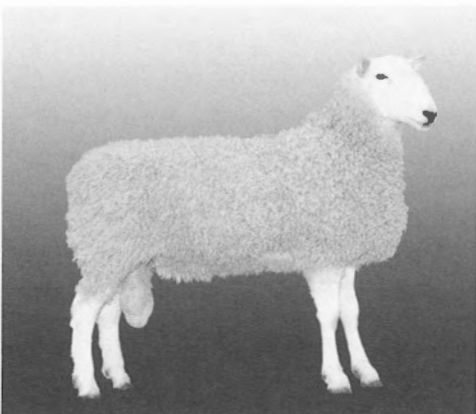


Corriedale

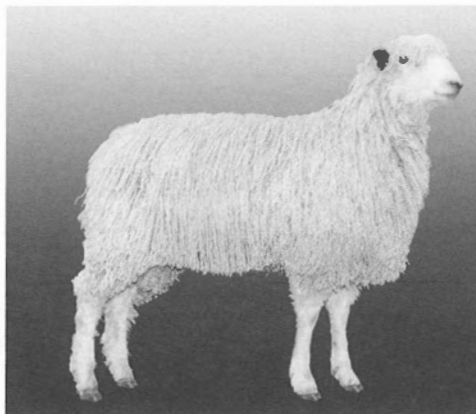


Targhee

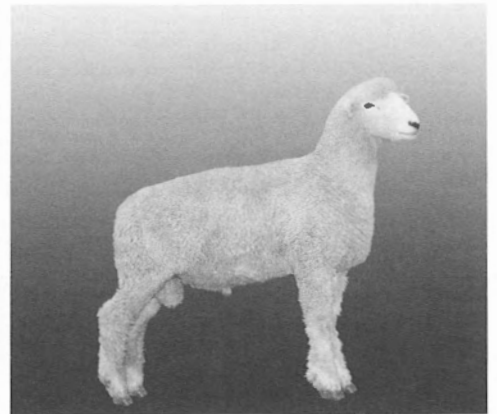
Long Wool



Border Leicester



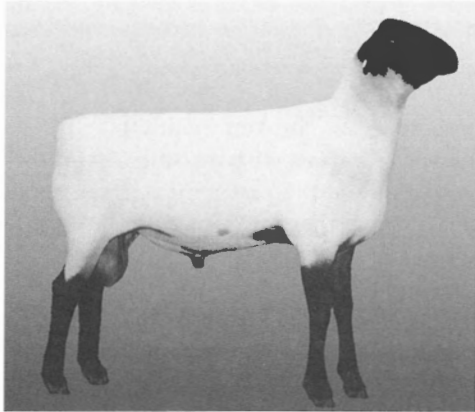
Lincoln



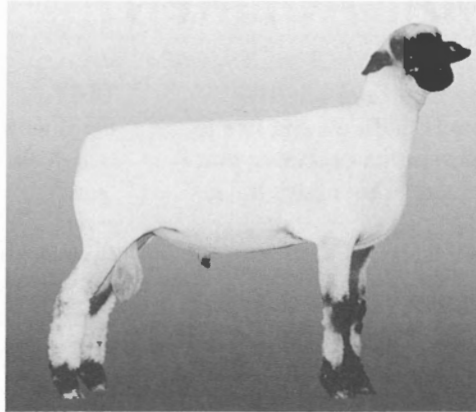
Romney

Figure 1. Major breeds of sheep.

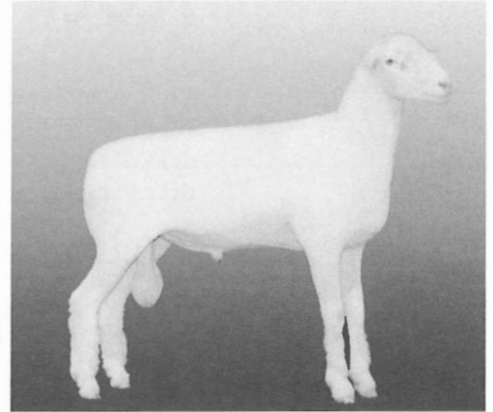
Meat Breeds



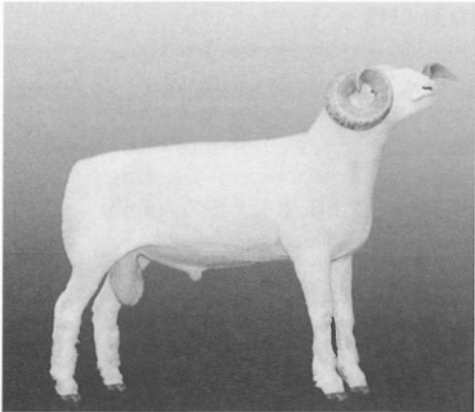
Suffolk



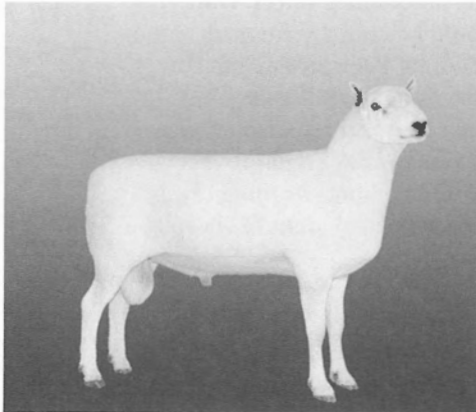
Hampshire



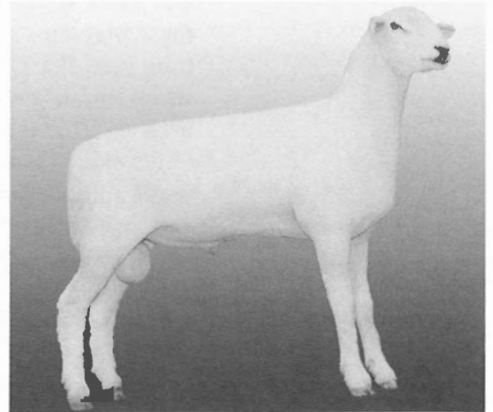
Polled Dorset



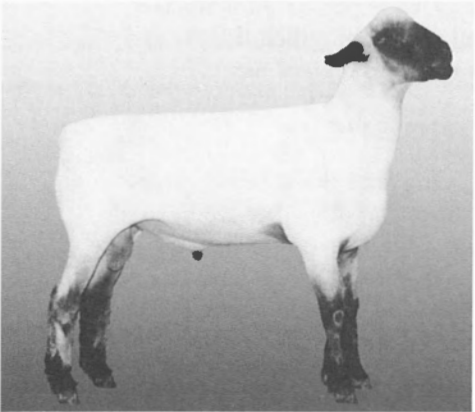
Horned Dorset



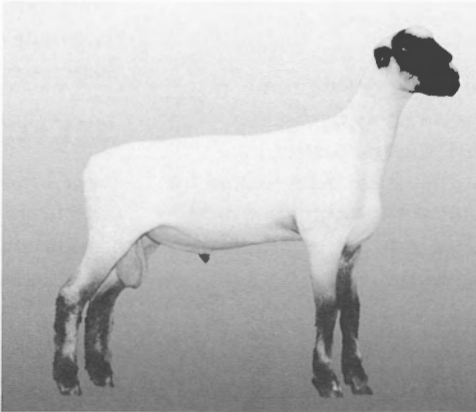
Cheviot



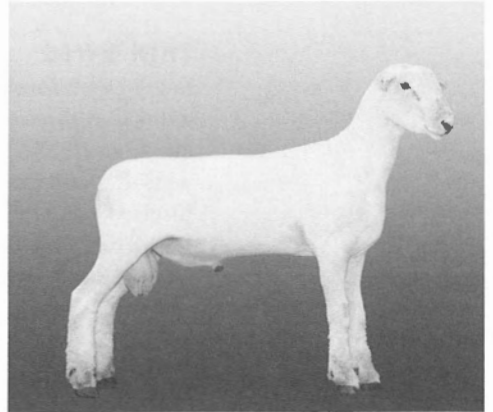
Montadale



Oxford

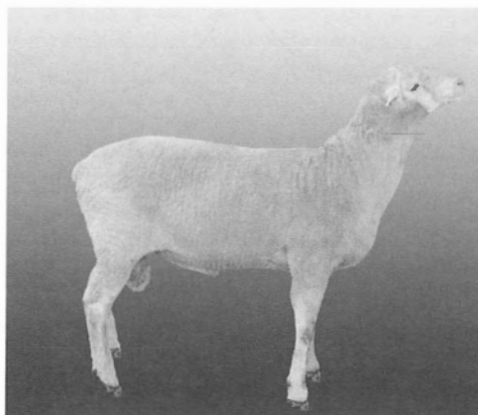


Shropshire



Southdown

Other Breeds



Polypay

FLOCK MANAGEMENT

Culling poor-quality sheep and selecting sheep that are in good condition and free of defects are two important management practices that help maintain a productive flock.

CULLING SHEEP

Watch your flock carefully for the following problems. Some of the problems are heritable (can be passed from one generation to the next), and they will weaken your flock over time. All of the problems reduce production and waste your time and money. Sheep with these problems should be culled (removed from your flock). Culling poor-producing sheep can be a problem in small flocks because there is often sentimental attachment to the sheep, but it is necessary to improve profit and production. Lambing, weaning, and breeding are good times to identify sheep for culling.

LOW FERTILITY AND BAD UDDER

Ewes that do not produce and raise at least one lamb per year should be culled. Ewes with bad (lumpy) udders should be culled, since they cannot raise twins.

THIN EWES

Some ewes develop thin ewe syndrome, a condition caused by a variety of diseases. The ewes usually are very thin no matter how well they are fed. If they have been treated for internal parasites and are still thin, it would be wise to cull them because they will be poor producers or may die.

TEETH

Ewes with missing teeth ("broken mouth") may have to be culled. Ewes with missing teeth can graze pasture if the pasture is not too coarse or mature. If they are kept, their front teeth should be pulled. Ewes with no teeth ("smooth mouth") can graze better than ewes that have some of their teeth missing. Cull sheep that have overshot or undershot jaw (see "Genetic Defects" in the section "Selecting Sheep," below).

OTHER PROBLEMS

A good ewe should produce good, healthy lambs for the first 6 to 7 years of her life. Some continue to be good producers beyond this age. (Figure 2 provides guidelines on how to determine the age of ewes.) Ewes that produce inferior or deformed lambs or lambs with poor breeding characteristics should be culled. Ewes or lambs with wool blindness (wool growing too close to the eyes), black wool fibers mixed with white wool, large amounts of kemp (white, coarse fibers), crooked legs, and weak pastern joints should be culled from the flock. A small ewe does not produce as many pounds of lamb as a large one and should be culled if there is a large ewe available to replace her.

SELECTING SHEEP

When developing your flock, select thrifty and healthy ewes and rams that are in good condition (see table 1, p. 35, for how to score the condition of sheep). Ewes should be neither too thin nor too fat (score 2 or 3). Replacement ewes and lambs that are too fat

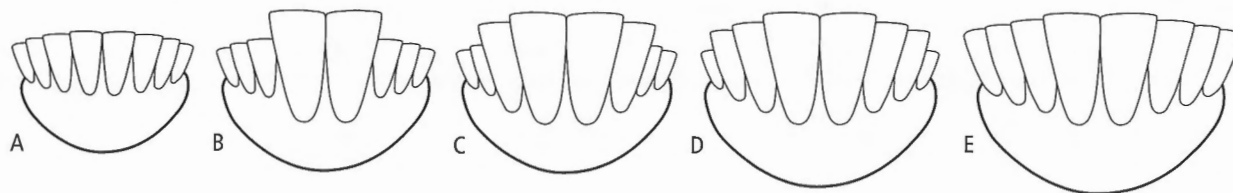


Figure 2. Front view of the lower jaw of sheep of various ages. The upper jaw has no incisor teeth in the front. (A) Lamb. All of the lamb's teeth are small. These temporary teeth will be shed to make way for permanent teeth. (B) Yearling. The two large teeth in the center are permanent incisors that come in immediately after the loss of the temporary central pair. (C) 2-year-old. Note the two pairs of permanent incisors. (D) 3-year-old. There are three pairs of permanent incisors; note that the temporary teeth on each side are much smaller by contrast. (E) 4-year-old. The mouth is full of developed teeth. At 5 or 6 years of age, permanent teeth wear down and appear more slender with flatter grinding surfaces. At variable ages, depending on the breed, teeth begin to spread and loosen through the "spreader," "broken mouth," and "gummer" (sheep that have no teeth at all) stages. Fast-growing, large sheep often replace temporary incisors with permanent incisors earlier than ages given above.



Figure 3. Sheep with overshot jaw (upper jaw longer than lower jaw) do not do well and should be culled from the breeding stock. This characteristic can be passed from one generation to the next.

(score 5) may not breed. Also, rams that are too fat may be poor breeders. Avoid animals that have genetic defects (see below).

Although the animals may be good producers, their defects may be difficult to eliminate from your flock.

When establishing a small flock, select ewes of different ages. If ewes are all the same age, they will leave the flock at about the same time. It is best to plan for a relatively steady turnover of ewes.

Demand the health records (especially the kinds of vaccinations) of purchased animals. New sheep should be given the vaccinations used in your own health program if they have not received them and quarantined for 3 to 4 weeks (see the chapter "Maintaining Flock Health").

OLDER EWES

A relatively inexpensive way to start a flock is to buy older ewes rather than buying only young ones. Older ewes usually produce more lambs than yearling ewes. A flock of high-quality sheep can be assembled at less cost when some older ewes are included. Care must be taken in selecting older ewes: they should have good udders and be in good health. The condition of their teeth may not be a concern, for ewes fed in drylot or by grazing good pasture do not need excellent teeth to be productive.

STRONG FEET AND LEGS

The front legs should be set wide apart when viewed from the front. Feet should be sound, and toes should be short. Strong feet and legs are essential. There should be no sign of weak pastern joints or foot rot, since severe foot rot can deform the foot (see "Foot Rot" in the chapter "Diseases").

BODY

The best-conformed (shaped) sheep is long, heavily muscled, and has long legs. The back should be broad and straight, indicating good muscling. A wide chest, deep heart girth, and well-sprung ribs show the capacity to convert feed into pounds of lamb.

FERTILITY AND BIRTH RATE

Ewes that reach puberty at a young age have a greater lifetime lamb production; ewe lambs born early in the season reach puberty at an early age. These are very important criteria for ewe selection. Also, the number of lambs born (birth rate) is a heritable characteristic. When possible, select ewes and rams that were twins or triplets. Over time, this kind of selection results in a larger lamb crop.

WOOL QUALITY

Select sheep that have a uniform coat of wool fiber over the entire body, particularly on the shoulders, sides, and thighs. A sheep can have coarse or fine wool, yet the wool can still be of good quality: the key is uniformity. One general indication of whether wool is coarse or fine is the number of waves (crimp) per inch along the length of the wool fiber. The more crimp per inch, the finer the wool. For more information on grades of wool, see "Grades" in the chapter "Wool."

GENETIC DEFECTS

Do not select lambs that have genetic defects. Inverted eyelid, for example, is a heritable trait that should be avoided; if it appears in the flock, cull it. Jaw defects can be found in all breeds. In undershot jaw, the upper jaw is shorter than the lower jaw, causing the lower teeth to extend beyond the dental pad. In overshot jaw, the upper jaw is longer than the lower jaw, causing the lower teeth to hit behind the dental pad (fig. 3). These conditions decrease the growth rate of lambs.

RECTAL PROLAPSE

Rectal prolapse (a rectum protruding several inches past the anus) is common among meat breeds and lambs on high-concentrate rations. Affected animals are usually culled before they are ready for market, with great economic loss. Do not select sheep with this trait; if the trait appears in any sheep, they should be culled.

CRYPTORCHIDISM

This condition, in which one or both testicles of a ram remain in the body cavity rather than descending into the scrotum, is heritable. It has been associated with the polled characteristics in Merino and Rambouillet. Cryptorchidism does not affect the growth rate, and it is of little concern to the commercial sheep producer. However, producers of registered sheep should eliminate this trait from their flocks.

SKIN FOLDS

Avoid sheep that have excessive folds of skin on the neck. Sheep with Rambouillet or Merino blood are the most likely to have this condition. Sheep with heavy folds are hard to shear and do not produce more wool.

WOOL BLIND

Wool blind, or excessive wool covering the face, is a heritable trait that should be avoided. Experience and research have shown that open face (without wool covering the face) (fig. 4) ewes raise more lambs and wean more pounds of lamb than wool blind ewes. Also, wool blind sheep tend to get foreign material in their eyes, which can cause permanent blindness. This problem is most common in wool breeds, but it is also found in some of the meat breeds and some crossbred sheep.

BREED STANDARDS

Producers of purebred sheep should select sheep that meet minimum breed characteristics. Ewe lambs that do not meet these standards should be sold for meat or as commercial ewes. Only outstanding male lambs should be saved for rams. Because producers of small numbers of sheep work with a small number of animals, it is more difficult to improve their flocks rapidly through ewe selection. However, they can buy superior rams or ewes to improve their flocks.



Figure 4. Open faced ewes (ewes without wool on the face) produce more lambs and more pounds of lamb per ewe per year than closed face, or wool blind, ewes. This remains true even when wool blind ewes have had their faces shorn periodically throughout the year.

REPRODUCTION

A successful breeding program is the key to successful sheep production. In order to develop an effective breeding program, the owner or manager must understand the breeding season, estrus cycles, gestation, puberty, and fertility.

BREEDING SEASON

In most sheep, the breeding season is restricted to certain months (sheep are seasonally polyestrous). However, the length of the breeding season is influenced by the breed of sheep. Rambouillet, Merino, and Dorset have long breeding seasons, and many individuals among these breeds breed at any time of the year. Breeding may start in April and continue into late fall. Romney and Leicester (long wool breeds), as well as Southdown, Cheviot, and Shropshire, have a short breeding season, August through January. By comparison, Suffolk-Hampshire, Columbia, and Corriedale have a longer season, July through January.

ESTRUS, OR HEAT CYCLE

Estrus, or the heat period, is the time during which the ewe will mate with the ram and can become pregnant. The length of estrus in sheep is 20 to 42 hours; the average is 30 hours. Ovulation (release of the egg from the ovary) usually occurs toward the end of the heat period. The ovulation rate (number of eggs released per heat period) changes during the breeding season. It is low during the first part of the breeding season, high in the middle, and decreases at the end. In sheep, the length of the estrus cycle (days between heat periods) is 14 to 19 days, with an average of 16.5 days.

GESTATION

Gestation (pregnancy) in sheep is 144 to 152 days; the average is 147 days. Meat breeds tend to have shorter gestations, and fine wool breeds have slightly longer gestations. High temperatures can shorten gestation by 2 to 3 days. Also, multiple births may shorten gestation by a few days.

PUBERTY

A ewe reaches puberty (has her first heat cycle) at 5 to 12 months of age. Heredity and nutrition strongly influence the age at which ewes reach puberty. Most ewe lambs weigh 85 to 100 pounds (39 to 45 kg) before they start to cycle. Fine wool and Finnish Landrace (Finn) breeds reach puberty at lighter weights, while the larger meat breeds reach puberty at heavier weights.

FERTILITY

Fertility (ease of getting pregnant) in ewes can be influenced by

- heredity
- age of ewe
- light, temperature, humidity, and season of year
- association with a ram
- nutrition
- diseases and parasites

Because so many factors influence fertility, it is difficult to increase fertility in a ewe flock through breeding. Culling ewes that do not bear lambs is the fastest way to increase flock fertility.

HEREDITY

Heredity can influence fertility and fertility rates (the number of lambs per lambing). Highly fertile ewes reach puberty at an early age; replacement ewe lambs and ram lambs should be selected from twin or triplet births. Over many years, this type of selection increases a flock's fertility rate. Also, certain breeds naturally produce more lambs; for example, Finnish Landrace has many lambs (as many as 3 to 7 per lambing). Under good management, 85 to 95 percent of ewes with one-fourth Finnish Landrace blood will produce twins.

AGE OF EWE

The average pregnancy rate in ewe lambs is about 65 percent in most farm flocks. However, with good management and nutri-

tion, this rate can increase to 70 or 80 percent. Ewes that lamb as yearlings usually do not give birth to more than one lamb. As ewes reach 8 or more years of age, fewer of them become pregnant, but those that do usually produce multiple lambs.

LIGHT, TEMPERATURE, AND HUMIDITY

Day length, temperature, and humidity influence the start of a ewe's seasonal cycle. While these factors cannot be changed, understanding how the cycle works may help increase the number of lambs born. Because of differences between individuals and among breeds, breeding activity in a flock can occur in all months of the year. However, fertility is highest in the black face breeds (Hampshire or Suffolk) in September, October, and November, when light exposure is 10 to 12 hours per day. The cooler temperatures at this time increase embryo survival in all breeds.

The ovulation rate (number of eggs released) is closely related to the amount of light in a day as well as to temperature. High temperatures (90°F [32°C] or higher) and high humidity can reduce fertility. Hot weather also influences the growth rate of the fetus. Heat stress during gestation results in small lambs at birth. Shade should be provided when possible, especially early in gestation.

ASSOCIATION WITH A RAM

Turning a ram in with a group of ewes (known as "associating" a ram) helps ewes start their estrus cycle earlier in the season. Producers wanting early lambs should turn a vasectomized ram (a surgically altered ram that cannot ejaculate sperm) in with ewes 2 to 3 weeks before the breeding season. This practice ensures that more ewes will be in their second or third heat period when they are bred. It also tends to bunch the ewes in estrus: more ewes will be in heat at one time,

shortening the lambing period and the breeding season. However, ewes exposed to a ram year-round may breed later in the season.

NUTRITION

Nutrition, more than any other factor, influences fertility and the fertility rate. (To determine the amount of fat and muscling a sheep has, see figure 16, p. 34; to score the fat and muscling condition of sheep, see table 1, p. 35, and figure 16). A sheep's condition affects its breeding time and nutritional needs. Ewes that are too thin (score 1) do not cycle normally, and if they do conceive, they do not conceive at a normal rate. The same is true of ewes that are too fat (score 5). Fat ewes are usually more common than thin ewes in producers with small flocks, as there is a temptation to become attached to the sheep and overfeed them.

FLUSHING

Flushing is a nutritional practice that can increase the fertility of ewes and the number of lambs born. It involves increasing the nutrition level of ewes 2 to 3 weeks before and during the breeding season. Flushing includes increasing dietary energy as well as increasing protein. Most authorities believe that flushing increases the ovulation rate. Flushing thin (score 1 or 2) ewes tends to cause them to start cycling sooner and may increase the number of lambs born; extremely thin ewes gain weight from flushing but may have trouble becoming pregnant. Ewes with condition score of 2 or 3 respond best to flushing. Fat ewes (score 4 or 5) do not respond to flushing; they only get fatter, and their reproductive rate declines. Ewes grazing poor-quality pasture from weaning to flushing time may be flushed by placing them on high-quality pasture. Ewes should not graze pure clover pastures at breeding time because

many clovers contain estrogens that can interfere with the normal heat cycle.

An alternative flushing practice is to supplement ewes that are on poor-quality pasture with 1 pound (454 g) of high-quality alfalfa hay. This should provide enough additional energy and protein to ensure good breeding performance. Another alternative is to provide $\frac{1}{2}$ to 1 pound (227 to 454 g) of a grain supplement that contains at least 60 percent total digestible nutrients (TDN) and 10 percent crude protein. Do not feed the full amount on the first day; start with $\frac{1}{4}$ pound (114 g) per day and increase the feed gradually, about $\frac{1}{4}$ pound per ewe per day. Allow enough feeder space for all ewes to get their share of the supplement; otherwise, dominant ewes will get too much feed and less-aggressive ones will get too little (see appendix B).

DISEASES AND PARASITES

Diseases and parasites can reduce the fertility of ewes and rams. If a ewe becomes sick, she may not start cycling at the proper time, or if she has been cycling, she may stop. Heavy parasite populations in sheep reduce their condition and general health. If parasites are present, ewes should be wormed before breeding (see the chapters "Diseases" and "Parasites").

BREEDING

An effective breeding program begins before the breeding season starts and continues until the lambing date. Ewes must be in good health before breeding. They must be bred at the right time, and rams must be fertile in order to produce a good lamb crop.

PREPARING EWES

At least 1 month before breeding, ewes should be given vaccinations necessary to prevent abortion and any other treatments needed in your area for a good health program (see “Maintaining Flock Health” and consult your local veterinarian). Occasionally, vaccines may make ewes sick for a few days and may interrupt the heat cycle. Also, it takes a period of time for the vaccine to provide protection or immunity.

DEWORMING

Deworm ewes before breeding (see “Internal Parasites” in the chapter “Parasites”).

KEEPING EWES COOL

In hot climates, shearing ewes 4 to 5 weeks before the breeding season helps them start cycling early. About ½ inch (1.3 cm) of wool insulates sheep from direct sunlight and still allows body heat to escape. Shearing, in combination with shade, keeps ewes cooler and reduces heat stress; however, shearing ewes immediately before breeding season can cause heat stress because the wool insulates ewes against sunlight. Embryos of heat-stressed ewes are very likely to die.

WEIGHT GAIN

Ewes should be gaining weight before they are bred. Ewe lambs to be bred should gain at a faster rate than mature ewes, and they should weigh 100 pounds (45 kg) or more at breeding.

VACCINATION

Ewes should be vaccinated against overeating disease (enterotoxemia) and tetanus about 3 to 4 weeks before lambing. This management practice protects the lamb until it is old enough to be vaccinated. (For more information, see the chapters “Maintaining Flock Health” and “Diseases”.)

TAGGING

Tags (wool around the vulva that is soiled with manure or urine) should be removed before breeding. Tagging improves breeding efficiency and reduces the incidence of fly strike (maggot infestation). Ewes should be tagged again or shorn 4 to 6 weeks before lambing.

SHEARING

Many large sheep operators in the Pacific Northwest who lamb in sheds shear ewes 3 to 4 weeks before lambing (“lambing out of the wool”) using a “rake” comb that leaves ¼ to ⅜ inch (6.5 to 9.5 mm) of wool. Fall shearing is becoming more common in certain parts of California. In cold or wet climates, ewes should be protected from the weather for several days following shearing. “Lambing out of the wool” keeps the lambing shed cleaner and drier for the ewes and does not bring in as much dirt and moisture. Also, a shorn ewe does not take up as much space in the shed and at the feeders. Another advantage to shearing before lambing for new producers with a few sheep is that producers can watch the ewe’s development in the later stages of pregnancy.

PREPARING RAMS

CONDITION

Rams in good condition (score 2 or 3 in table 1) have the energy to breed ewes. Overconditioned (score 4 or 5) rams usually are more sensitive to high temperature, and their sexual activity and fertility are reduced.

COOLING

In hot weather, shear rams before breeding. They should have about ½ inch (1.3 cm) of wool. In hot weather, separate rams from ewes during the day. Place rams in a shaded or cool area and turn them back in with the ewes at night. If rams are not heat stressed, they will be more sexually aggressive, making it likely that more lambs will be born in the first part of the lambing season. Rams can be sterile for 6 weeks following exposure to high temperatures and heat stress. Also, high fever (above 104°F or 40°C) for a relatively short time can cause temporary sterility in rams.

SOUNDNESS

Rams must be physically sound. The feet should be checked for foot rot and excess hoof length. Long hooves should be trimmed several weeks before the start of breeding so that the ram will recover from any lameness that may occur as the result of too-close trimming. A lame ram will not be an effective breeder.

Rams should be checked for sores (pizzle rot) on the penis sheath, and any infection observed should be healed before breeding. The scrotum should be checked for abnormal swellings or misshapen testicles (see "Epididymitis" in the chapter "Diseases"). Scrotal circumference is an excellent indication of a ram's ability to make ewes pregnant. Ram lambs should have a scrotal circumference of at least 28 cm (11 in), and a mature ram should have a scrotal circumference of 30 cm (11¹³/₁₆ in). Generally, bigger is better when it comes to a ram's scrotal circumference. The only time large testicles become a problem is if they interfere with the ram's movement. Also, when possible, rams should be semen-tested by a veterinarian. A sterile ram cannot produce lambs, and a ram with low fertility produces few lambs, extending the lambing season. Semen testing is especially important if only one or two rams are used. If either is infertile, the lamb crop will be severely reduced. If a single ram is used and it is sterile, no lambs will be born.

Under normal conditions, one sexually active ram can serve 30 to 50 ewes. In confinement or close breeding conditions, one ram can breed up to 100 ewes. A well-developed ram lamb (6 to 10 months old) can

serve 20 to 25 ewes. The breeding activity of a young ram should be observed closely. An inexperienced ram may devote too much attention to one ewe and ignore other ewes in estrus. If this occurs, the favored ewe should be taken away from the ram after she has been bred once or twice.

RECORDING BREEDING DATES

Knowing the date when ewes have been bred is important to determine when the lambing season will begin. To obtain accurate breeding dates, equip rams with a marking device. Special marking harnesses are commercially available. As the ram mounts a ewe, the harness leaves a colored mark on her rump. These marks can be recorded daily. Producers can use the record of breeding dates to estimate the beginning date of the lambing season and have the necessary equipment ready when the first lambs are born. To check for repeat breeding, start with a light-colored dye; use a darker color every 14 days. Excessive dye can stain the wool, reducing the value of the fleece. Scourable (washable) dye should be used.

Ewes that conceive do not come back into heat until after the lamb is born. During the breeding season, check the flock at least once daily to make sure the ram is healthy and not lame. When possible, have a backup ram available in case the working ram becomes sick or lame.

LAMBING

Lambing time is probably the most satisfying part of sheep raising. A good lamb crop is a measure of the success of your breeding program and overall management.

PREPARING EWES FOR LAMBING

Ewes should be tagged before lambing. Tagging is shearing or clipping the tags (soiled wool) from the ewe's flanks, udder, and vulva area so that the signs of lambing can be more easily observed. A bare vulva is more sanitary during lambing; bare flanks and udder make it easier for the lamb to find the ewe's nipple, and the person taking care of the ewes can observe more easily whether the lamb is nursing.

PREPARING THE LAMBING SHED

The lambing shed or area should be cleaned and disinfected several weeks before the first lamb is born. Remove old bedding and allow the area to dry. A layer of "slake" lime (usually available at building material yards) on the ground helps sanitize the soil. In lambing sheds that have a history of disease, disinfect walls and feeders with a strong disinfectant. Consult a veterinarian for a good product to use. A good layer of clean bedding—cereal or grass straw—should be applied to the entire shed. Although wood shavings may also be used for bedding, sawdust used as bedding may cause problems: small slivers of wood from the sawdust may work into the gland opening between sheep's toes and into the soft tissues of the foot, causing boils and abscesses.

PROTECTION FOR NEWBORNS

During lambing in cooler climates, ewes and lambs should be protected with a shelter that is dry and free of draft at ground level. A newborn lamb is very susceptible to chill, since it comes from a 101°F (38°C) environment in its mother's uterus and is wet. Also, the lamb's body mass is small, which allows the entire body to become chilled quickly. Wind, rain, and cold can cause rapid deaths.

Newborn lambs need protection until they are dry, warm, and have received colostrum.

The lambing shed should have adequate ventilation to remove the excess moisture and ammonia that is created when the ewes are confined. Also, if the ewes are not shorn and are confined in a poorly ventilated area, they can become overheated (heat stressed). This heat stress could trigger pregnancy toxemia (see "Pregnancy Toxemia" in the chapter "Diseases").

LAMBING JUGS, OR JAILS

As soon after lambing as possible, the ewe and her lamb should be placed in a small pen, called a jug or jail, that is at least 5 feet wide by 5 feet long (1.5 m by 1.5 m). As a rule of thumb, there should be one jug for every 10 ewes. For small flocks, one or two jugs should be adequate. The smaller the jug, the greater the chance that the ewe will lie on her lamb and crush it. To protect the lamb when small jugs are used, place a railing about 6 inches (15 cm) above the bedding. This will help prevent ewes from crushing lambs.

Each jug should be equipped with a hay feeder, grain trough, and water. Ideally, all feeding and watering equipment should be portable so it can be removed from the jug. Also, the waterer and feeder should be high enough off the ground so that lambs cannot get trapped in them. Low, shallow water buckets are very dangerous for newborn lambs. These lambs are not very stable on their feet and can fall in the water and drown. In larger flocks it is best to separate ewes with twins from ewes with one lamb (singles). Ewes nursing twin lambs need more feed in order not to lose excess weight. Ewes with singles require less feed; they become over-conditioned (score 4 to 5 in table 1) if fed as much as ewes nursing twins. In small flocks it is not practical to separate ewes based on the number of lambs they are nursing. For information on space required for sheep feeding facilities, see appendix B.

CHECKING EWES AT LAMBING

The ewe flock should be checked several times a day for 2 weeks before the estimated start of lambing. Ewes carrying two or more lambs usually deliver several days early, so it is better to be prepared rather than to suffer a surprise.

SIGNS OF LAMBING

Several signs indicate how close a ewe is to lambing (see fig. 5). The ewe's udder should begin to fill 2 to 4 weeks before lambing, and in some cases, the skin may become very red. The vulva takes on a soft, shiny appearance and becomes enlarged (fig. 5A). Many ewes make grunting sounds as they move around or while they are lying down. They move slowly and should be handled gently.

Most ewes have a mucous discharge from the vulva during the 24 hours before lambing and usually stop eating several hours before

delivery. Ewes that do not eat should be watched closely, as they are either getting ready to lamb or may be coming down with pregnancy disease (see "Pregnancy Toxemia" in the chapter "Diseases"). As delivery nears, a ewe usually lies down and gets up often and walks around in a small area. Ewes lambing for the first time usually lie down, strain once or twice, and get up to see if the lamb is there, unaware that lambing takes more effort. A hollow usually appears high on the ewe's flank (fig. 5B).

A sure sign that the birth process has begun is the appearance of the embryonic, or water, sac (fig. 5C). Once it has appeared, let the ewe work at having the lamb by herself—do not try to help her at this time. In most cases she will not need help. If a ewe has the lamb by herself, it strengthens the bond between them.

The next sign should be the lamb's two front feet (fig. 5D). If the tops of the feet are showing, the lamb is coming properly. If the bottoms of the feet are showing, the lamb is coming breach, or backward (see "Helping the Ewe," below). The nose should appear after the feet. For the ewe, pushing the head out is usually one of the most difficult parts of the delivery (fig. 5E). After the head is completely exposed, the shoulders appear next; once the head and shoulders appear, the rest of the lamb is born very easily (fig. 5F).

HELPING THE EWES

Once the water sac has appeared, the birth should be completed within an hour. If it is not, the ewe needs help. An inexperienced person should not assist a difficult delivery alone. Get experienced help if possible—a local veterinarian or an experienced sheep producer. If no one is available, follow these basic instructions.

Put on an obstetrical sleeve that reaches above the elbows. Cover your hands and the ewe's vulva with liquid soap (a disinfectant soap is best). If the water sac has broken and the lamb is dry, apply liberal amounts of soap to the lamb and ewe. The soap acts as a good lubricant during delivery.

Before attempting to help the ewe, determine how the lamb is being presented (coming out). Figure 6 shows several abnormal ways in which lambs can be presented.

A lamb with a large head is a common problem in lambing. To help the ewe that has

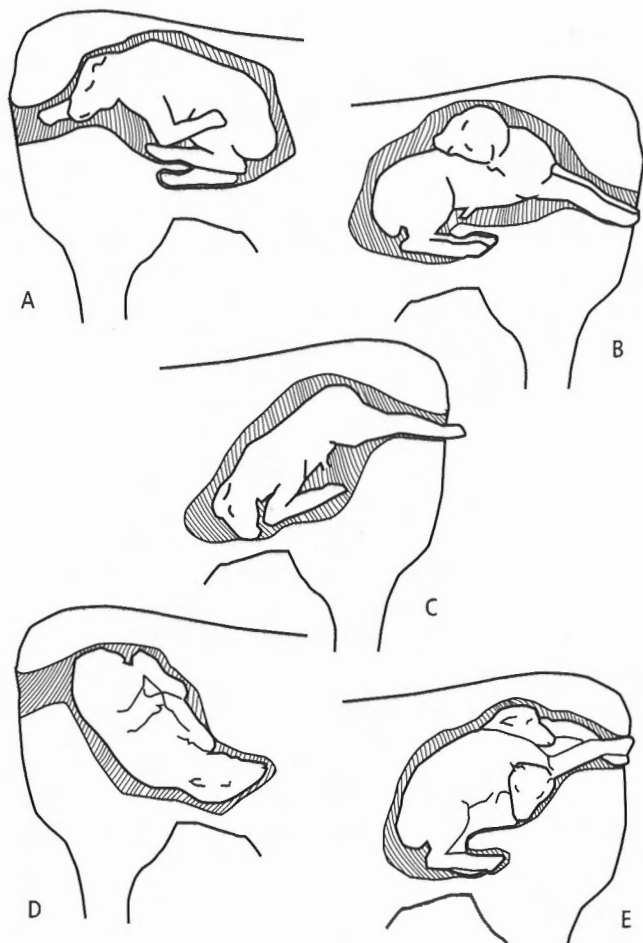


Figure 6. Abnormal presentations of the lamb at birth. (A) Leg back. (B) Head back. (C) Breech (hind end first). (D) Crosswise (upside down). (E) Twins coming at the same time.



Figure 5. The birth of a lamb. (A) Ewes in late pregnancy have enlarged abdomens and filled udders. They are sedate in their actions and should be handled gently.

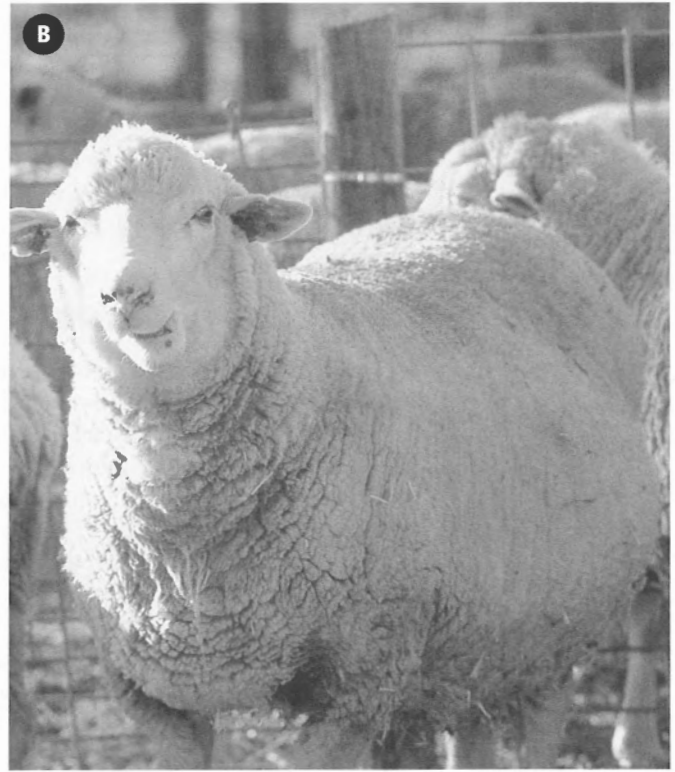


Figure 5B. As the time of birth approaches, a ewe develops a hollow high in her flank.

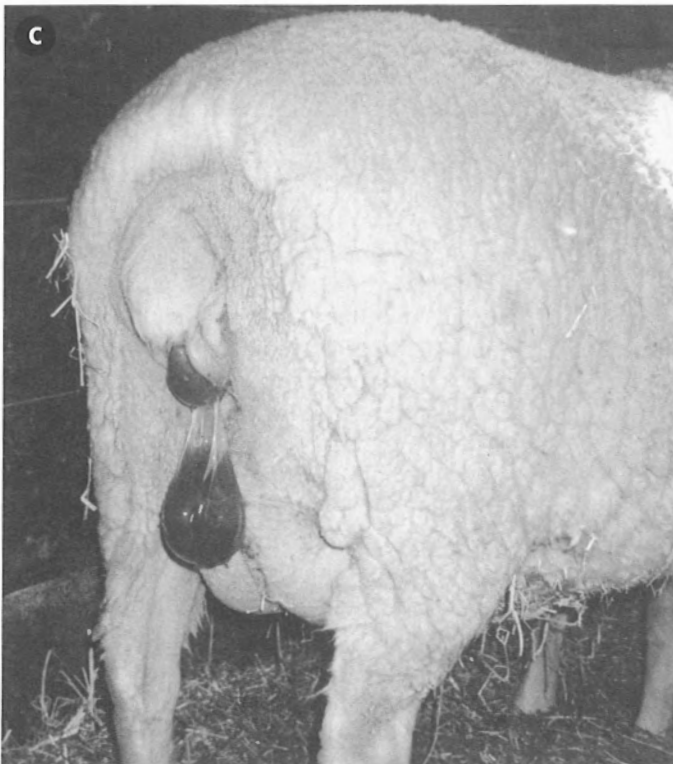


Figure 5C. The embryonic sac, or water sac, appears first when the birthing process has begun.



Figure 5D. The front feet appear shortly after the water sac. This photograph shows one foot; the other foot will appear shortly. Note that the top of the hoof is showing; this means that the lamb is coming out front feet first (the normal manner of birth).



Figure 5E. The head and front legs have appeared. The water sac has not broken yet. Once the head is out, the rest of the delivery is fast and easy.



Figure 5F. The lamb is delivered up to its hips; the birth is nearly complete. The water sac is still unbroken.



Figure 5G. The ewe cleans the embryonic sac from the lamb's head. Although the lamb may appear to be dead, the ewe's licking will stimulate it.

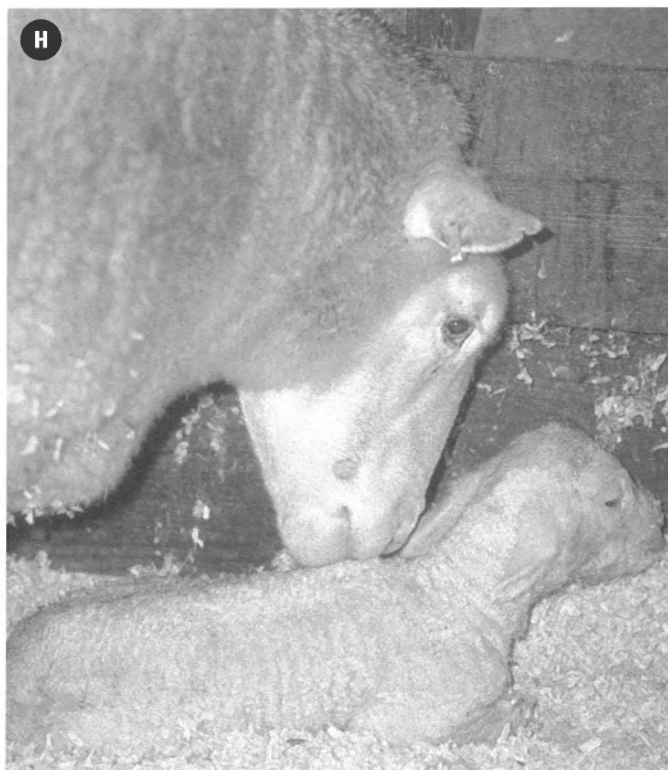


Figure 5H. The lamb has responded to the ewe's licking and has lifted its head.



Figure 5I. Awake and alert, the lamb tries to get to its feet.



Figure 5J. The ewe continues to clean the lamb after it gets to its feet.



Figure 5K. The lamb searches for the ewe's udder.



Figure 5L. Twin lambs. One lamb is nursing, and the other lamb has not yet gotten to its feet. Make sure all lambs find the udder and receive colostrum.



Figure 5M. The lamb has found the udder and begun to nurse.



Figure 5N. This ewe has not shed the afterbirth. Ewes can shed the afterbirth during birth or several hours later without suffering any ill effects.

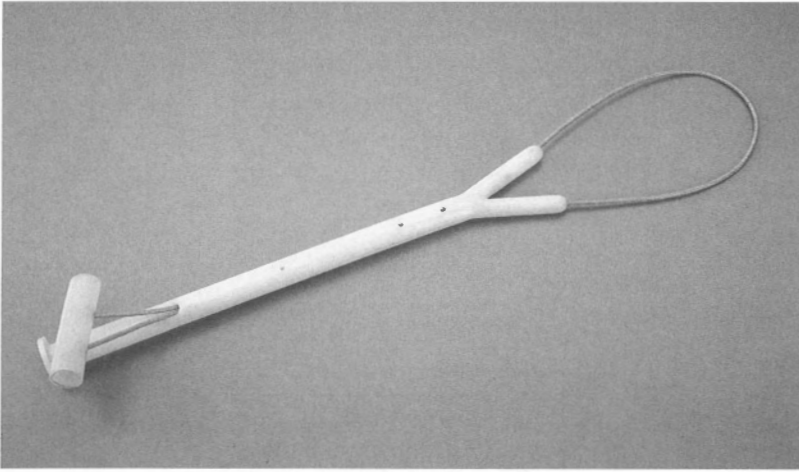


Figure 7. Lamb saver, a tool often used in delivering lambs.

a lamb with a large head, lay her on her side and grasp the front legs of the lamb with one hand, sliding the fingers of the other hand up over the forehead of the lamb. Next, use both hands to pull the lamb slightly down (toward the ewe's feet) and out. Continue to pull firmly and slowly until the lamb is completely delivered. Delivering the lamb with too much force or too quickly could cause the ewe to prolapse (the uterus turns inside out). This condition may occur following a difficult delivery. If a ewe prolapses, contact a veterinarian, who can put the uterus back in its proper place. A ewe should not be used for breeding again if she has prolapsed.

A commercially available device that is useful in helping ewes deliver is a lamb saver (fig. 7). It is made of a hollow tube with a looped cable attached to it. The loop is passed behind the lamb's head and the tube is inserted under the lamb's chin. The cable and tube are pulled to help move the head as the feet are being pulled.

Another common type of delivery occurs when the head and one front foot are in view, and the other leg is inside the ewe. In most cases, it is not necessary to get the other front leg out before attempting delivery. The lamb can be delivered by pulling on the head and the leg that is showing. However, in some cases, the lamb cannot be delivered when the head and one leg is exposed. In this case, the lamb's head must be pushed back far enough to insert your hand and pick up the leg that is back. Pushing the lamb back may be difficult because the ewe is trying to push the lamb out. To stop the ewe from pushing, ask some-

one to open the ewe's mouth and pull her tongue forward. Pulling on the ewe's tongue should temporarily stop the birth contractions. When both legs are out, the lamb can be delivered normally.

Sometimes only the head is showing and both front legs are inside the ewe. The head must be pushed back far enough to insert a hand and grasp the front legs with an index finger. In this case, a person with a small hand is very useful. Once one or both front legs are forward, the lamb can be delivered.

The lamb's head can swell to a very large size if the ewe has been trying to deliver for some time and the head has been exposed. At this point, check to see if the lamb is alive by inserting a finger into the lamb's mouth—if there is a sucking reflex, the lamb is still alive. The lamb's head may be so large that it is difficult to push the lamb back far enough to get a hand in the ewe; however, if pressure is applied slowly to the head, pushing the head back into the ewe between contractions, normal delivery can be accomplished. If the lamb cannot be delivered at this time, it will die. If that happens, the head must be cut off and the lamb's body removed to save the ewe's life.

Another situation that may occur is when there are three feet and one head showing from the ewe, indicating the presence of two lambs. To correct this situation, make one lamb wait its turn by inserting a hand and finding out which leg belongs to which lamb. Push back the leg that doesn't belong to the lamb whose head is showing. Once the "extra" leg is out of the way, the first lamb can be delivered. The second lamb can then be delivered by finding the front legs and head and pulling the lamb out.

If a ewe has shown signs of lambing for 1 or 2 hours and the lamb has not appeared, check to see whether the lamb is entering the birth canal properly. First, lay the ewe on her side and insert a hand to see if the opening (cervix) of the uterus is enlarged (dilated) enough for delivery. Always make sure your arm is covered with a clean obstetrical sleeve. If the cervix is not dilated enough so that you can feel the lamb, give the ewe another hour. When the cervix is dilated enough, make sure the lamb is lying properly for a normal delivery, and then give her about 30 minutes. If delivery has not progressed, the ewe needs help. Contact a veterinarian for assistance.

If the ewe has had difficulty giving birth, you may wish to insert a hand (covered with an obstetrical glove) into the uterus after the lamb has been delivered to check for additional lambs. Triplets or even quadruplets are not uncommon. The size of a lamb does not indicate how many lambs a ewe may have; sometimes a ewe may have one large lamb and one small lamb. If the large lamb is delivered first, you might think the ewe has only one lamb and stop checking her. The second lamb may not be lying properly for a normal delivery, and both the ewe and lamb could be lost.

CARE OF EWE AND LAMB AFTER BIRTH

The ewe will lose, or shed, her afterbirth within a few hours of the birth. If she does not shed the afterbirth during this time, contact a veterinarian for assistance.

CLEARING LAMB'S AIRWAY

After helping a ewe deliver, clear the lamb's airway. Hold the lamb by its hind legs and allow the birth fluids to drain from the air passages while placing a finger in the mouth to help remove mucous. Sometimes this may not completely clear the airways and the lamb may still have trouble breathing. If so, hold the lamb by its hind legs and swing it in a circle. The faster you swing it, the better the airways will be cleared, but be careful. This technique requires a lot of space. In small areas the lamb's head could be bumped on a solid object, resulting in death or serious injury.

Once the airway is clear, some new lambs need encouragement to breathe. One way to get them to breathe is to take a small straw or stem of hay and push it gently about 1 inch (2.5 cm) into the nose. Usually, the lamb will sneeze and take a breath of air. If this does not work, give the lamb artificial respiration by raising a front leg to help expand the chest cavity and draw air into the lungs. Push the leg down and repeat until the lamb starts to breathe. Mouth-to-nose resuscitation works well; a lamb's lungs can be filled with air by blowing hard into the lamb's nose. However, some people do not like placing their mouth on a newborn lamb's nose.

STILLBIRTH

Occasionally a lamb may die in the uterus and the ewe will show no signs of lambing. In this case, there may be a chocolate-brown discharge as the lamb starts to decompose. A veterinarian should be contacted so the ewe's life can be saved.

ewe's CARE OF LAMB

Although serious problems may occur during lambing, most ewes deliver lambs without assistance. The lambing season demands a lot of time, but a lot of personal satisfaction can be gained. The best policy at lambing is to **BE THERE**—spending extra time with your ewes will mean saving more lambs.

Once a ewe has delivered, she usually gets up and licks her new arrival (see fig. 5G–J). Licking removes the slime and afterbirth and also stimulates the lamb to get to its feet and nurse. Some ewes do a poor job of cleaning their lambs. Others do a good job—in fact, some ewes get so carried away with the cleansing process that they chew the lamb's tail and navel cord. If this occurs, remove the tail, clip the navel cord, and treat the wounds with iodine immediately. This reduces the chances of infection, loss of blood, and other trauma to the lamb.

If possible, do not disturb a ewe while she is delivering and cleaning her lambs. Prevent other ewes from interfering with her. If a lambing ewe is disturbed, she may leave her lambs, or, if she has twins, she may accept one lamb and reject the other. Ewes need time to recognize their lambs.

A ewe that has had a hard, long delivery may be too tired to clean her lamb. In this case, clean the afterbirth from the lamb's nose and mouth so the lamb won't suffocate and present the lamb to the ewe. Avoid excessive handling, however.

Another problem that can occur is that an older ewe may "granny" another ewe. The granny ewe, usually very near to lambing herself, may see another ewe giving birth. When the lamb is born, the granny may try to take the lamb away from its mother. This is a particular problem with young ewes who give multiple births. A young ewe may deliver and clean the first lamb, and while she is lying down to have the next one, the granny ewe will claim the first lamb. When the new mother gets through delivering, she will think she has had only one lamb. Although the

granny ewe will have no milk, she will encourage “her” lamb to nurse. If this situation is not corrected, the lamb will starve to death. To prevent this problem, keep potential granny ewes separated from ewes that are lambing. If two ewes claim the same lamb, look for blood and birth fluid on the rump of one of the ewes: the clean ewe is the granny.

Once a ewe has lambed, move her to a jug by getting her to follow her lamb or lambs into the jug rather than driving her into the jug. Pick up the lamb by the front legs with the hind legs almost touching the ground. Hold it until the ewe sees it; if she comes up, let her smell the lamb. Walk slowly toward the pen, making sure the ewe sees the lamb at all times. If the ewe moves away, stand still and make the sound of a lamb to get her attention—she will usually come back to the lamb. If she does not, set the lamb on the ground, step back, and let the ewe come up to her lamb. This process may need to be repeated several times before the ewe reaches the pen with her young.

CARE OF EWES AND LAMBS IN THE JUG

Once the ewe and her lamb are in the jug, take the following steps.

Remove the waxy plug in the end of each teat of the ewe by stripping a couple of squirts of milk from each teat. Small or weak lambs cannot remove this plug and may starve even though they are nursing. If the plug is not removed, the ewe’s udder can become so enlarged and so sore that she will not permit nursing. The ewe’s udder can be spoiled to the point that she cannot raise any future lambs.

Check the ewe’s udder for hard lumps that indicate earlier udder damage such as mastitis (see “Mastitis” in the chapter “Diseases”). These lumps reduce her milk production. If the lumps are large and the ewe has twins, consider removing one lamb to be raised as an orphan, or “bummer,” lamb (see “Raising Orphan, or Bummer, Lambs,” below). Another option is to leave both lambs with their mother and give the lambs additional milk to supplement their mother’s supply. A spoiled or mastic udder condition is often called “blue bag.” Many producers take a sample of the ewe’s milk and test it for mastitis, but this is not a necessary step in caring for lambs. Mastitis testing kits used by dairy

producers can be used on sheep. A ewe with mastitis can be treated with antibiotics; consult your local veterinarian. Some ewes produce thick, yellow milk that is okay for the lamb to drink, but her milk should look like normal milk within 2 days. If this change does not occur, the ewe should be checked for an udder infection.

Trim the lamb’s navel cord to about 1 inch (2.5 cm) in length and treat with a 7 percent solution of iodine. This step should be completed as soon after birth as possible. Re-treat in an hour, if possible. Treating a navel cord that is already dried is not effective. Keeping the navel cord short prevents the lamb or ewe from stepping on it, which could pull it off, causing severe bleeding. However, cutting the navel cord too short can also cause excessive bleeding.

A lamb’s navel is easily treated. Put $\frac{1}{2}$ to 1 inch (1.3 to 2.5 cm) of 7 percent iodine solution in a wide-mouthed glass jar. Pick up the lamb by the front legs and place the jar over the navel area. Tip the jar up so the navel is saturated with the iodine solution. This process is more effective than swabbing or spraying the navel. Treating the navel with iodine prevents bacteria from entering the navel cord and moving into the body, where infection usually settles in the joints, causing lameness. This condition is called navel ill (see “Navel Ill” in the chapter “Diseases”). The infection is difficult to cure because the joints receive a low blood supply. Curing a lamb that has navel ill is very expensive, and success is doubtful. The sick lamb may live, but it will grow poorly and will probably have deformed joints.

Make sure the lamb gets colostrum. Within a few hours after birth a lamb must get colostrum, or “first milk” (see fig. 5K–N). This milk contains a wide range of antibodies that help protect the lamb against disease. Colostrum is high in protein, fat, and fat-soluble vitamins, and it also acts as a laxative, which helps the lamb’s digestive system. A newborn lamb can absorb antibodies very well, but its ability to absorb antibodies declines rapidly: absorption is reduced by one-half at 12 hours of age and is near zero at 24 hours, so the sooner the lamb gets colostrum after birth, the better. *Colostrum is critical for survival of the lamb!*

The best source of colostrum is a ewe, but if ewe colostrum is not available, cow or goat

colostrum can be substituted. Some producers collect colostrum from ewes and freeze it for future use. Freezing it in ice cube trays or plastic sandwich bags allows part of the colostrum to be used at a time. One or two cubes of colostrum should be enough for a feeding. Once frozen, cubes should be transferred to an airtight plastic bag or container for storage. Thaw frozen colostrum at room temperature or in warm water. High temperatures may destroy the antibodies. Do not thaw colostrum in a microwave.

NURSING

Get the lamb up and introduce it to its mother's udder. A lamb usually wiggles its tail when nursing, but some lambs wiggle their

tails whenever their heads are next to the mother's udder. Make sure the lamb has found the mother's teat and has nursed.

Some ewes will not stand still while you are trying to get the lamb to nurse. To overcome this, set the uncooperative ewe on her tail, stand behind her, and hold her head up next to your chest. With the ewe in this position, lay the lamb between her hind legs and put the teat in the lamb's mouth. In this position you can force milk into the lamb's mouth. Once the lamb tastes milk, it should start nursing. Let the lamb nurse until it is full. It may be hard to tell whether the lamb has gotten any milk; baby lambs nurse very often and do not take much milk at one time. With experience you will be able to tell if the lamb has received milk by how tight its stomach feels. Another way to tell if the lamb has nursed is to shake it gently and listen for the milk splashing in its stomach.

When trying to get an uncooperative lamb to nurse its mother when the mother is standing, push the lamb into the nursing position and hold it there with your knee. Then open the lamb's mouth, put the teat in its mouth, and hold the lamb until it nurses by itself. Do not put your hand on the back of the lamb's head; it will pull back and fight to get away as long as it feels pressure there. Massaging a lamb's tail stimulates the lamb to nurse. This is similar to what a ewe does to a lamb while it is nursing.

Some lambs may be too weak to nurse. Do not give up; in most cases the lamb can be saved by feeding it with an esophageal probe (fig. 8). A small, soft tube $\frac{1}{4}$ inch (6.5 mm) or less in diameter can also be used to pass milk down the lamb's esophagus into its stomach. Once the tube is in place, give the lamb 4 ounces (118 ml) of colostrum. Be careful: if you insert the tube into the lamb's lungs and force milk into them, the lamb will die. When passing the tube down the lamb's throat, be gentle and work slowly. Tilt the lamb's head back so that the mouth is in a straight line with the esophagus. Lay the tube along the outside of the head and neck to the last rib. Mark the tube at the lamb's mouth so you have an idea how far the tube should be passed. Place one hand on the lamb's throat and pass the tube. You should be able to feel the tube pass down the esophagus. If the tube stops, do not force it—you may puncture the esophagus or lungs. The lamb should respond

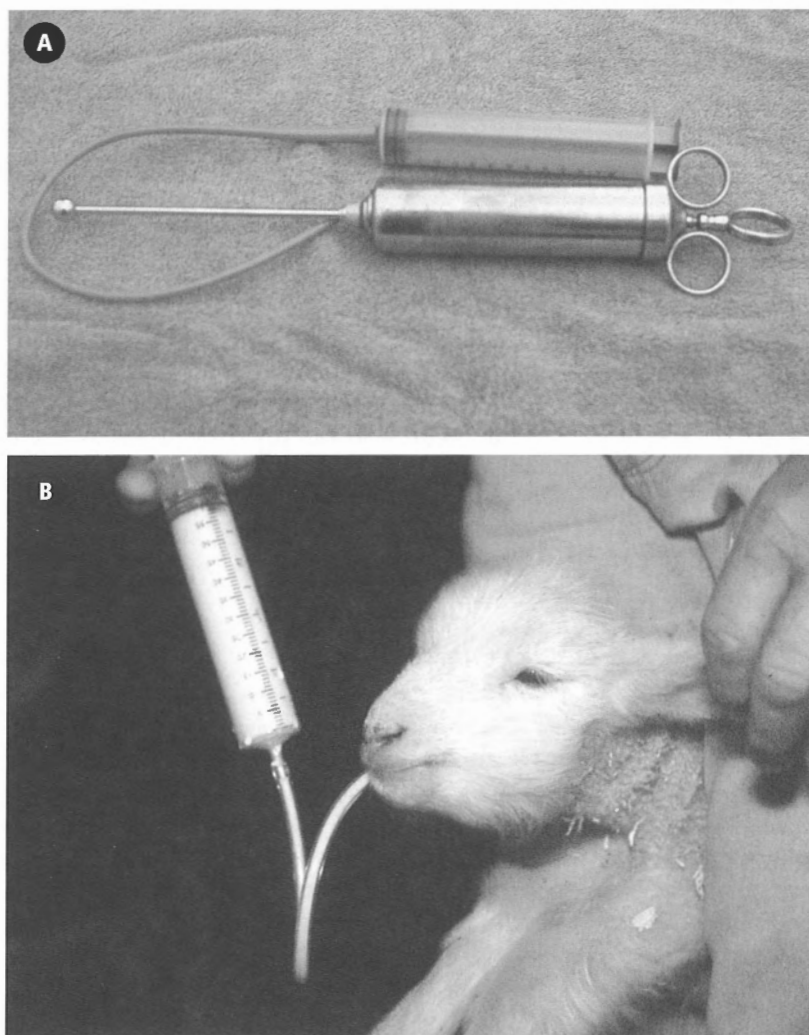


Figure 8. (A) Two types of esophageal probes used to force-feed weak lambs. These items can be purchased from livestock supply stores. (B) An esophageal probe has been passed down the lamb's esophagus into its stomach. Holding the lamb between your legs helps keep the esophagus in line with the lamb's mouth.



Figure 9. Ewe in stationary stanchion used in grafting lambs.

to feeding within 30 minutes to 1 hour. When the lamb gets to its feet, take it back to its mother. Watch the lamb closely for the next few days to make sure it is nursing.

If a small tube is not available, the lamb can be fed with a bottle and a small lamb nipple. Tip the lamb's head up and force a few drops of colostrum into its mouth. Then rub its throat gently to stimulate swallowing. Continue until the lamb has consumed at least 4 ounces (118 ml) of milk. This process is slow and requires patience. Always avoid getting milk in the lamb's lungs.

IDENTIFYING LAMBS

Soon after birth, identify or mark each lamb with a permanent ear tag or ear tattoo. Identification is important for matching ewes and lambs, and it is a must if flock production records are to be kept. Tagging the right ear of males and the left ear of females helps when separating lambs in a corral.

In larger flocks, ewes and lambs are often paint-branded on their backs or sides with the same number. (Always use washable branding paint to avoid contaminating the wool.) This helps keep track of ewe-lamb pairs to see how well ewes are feeding their lambs during the first weeks after birth. Ewes and their twin lambs can be branded on the right side, and ewes and single lambs can be branded on the left side. This helps identify ewes that are not raising their twins properly. If you see a lamb with a number on its right side that is doing poorly, find its mate to see whether it is doing well. If one twin is doing

well and the other is not, care for the weaker lamb as a bummer (see "Raising Orphan, or Bummer, Lambs," below) or provide supplemental milk using a bottle and a lamb nipple.

GRAFTING

Grafting is the process of convincing a ewe that has lost her lamb to adopt an orphan, or "bummer," lamb. Grafted lambs can come from ewes that have died, ewes that have had triplets or quadruplets, or ewes with twins that are able to raise only one lamb. Although lambs can be grafted in several ways, this section discusses some of the more successful methods. A graft is considered successful when a ewe allows the grafted lamb to nurse without being restrained or coerced.

SLIME GRAFT

The easiest graft is the slime graft, which can be done only shortly after a ewe has given birth to a dead lamb. Before grafting, remove the dead lamb from the pen. Cover the bummer lamb with the birth fluid, or slime. The fluid gives the bummer the scent of the ewe's own lamb. Slime grafting must be done before the ewe has realized that her own lamb is dead. Also, it works best with younger bummer lambs. An older, aggressive bummer lamb may overwhelm the ewe, causing her to reject it even though it smells like her own lamb. A double graft is possible if the ewe has enough milk. Both lambs must be covered with the birth fluid and both should be about the same size. If one lamb is too large it may take most of the milk, weakening the smaller lamb.

STANCHION GRAFT

Restraining a ewe in a special head gate, or stanchion, can be effective in grafting (fig. 9). Keep the ewe in the stanchion for several days, if necessary, until the odor from the urine, feces, and bedding that cover the lamb cause the ewe to accept it. The gate allows the ewe to stand, lie down, and move around for comfort. Provide the ewe with clean water and feed and change the bedding as needed.

HIDE GRAFT

In hide grafting, the dead lamb is skinned so that its hide can be slipped over the bummer lamb (figs. 10, 11). It is best to leave the tail on the hide so the ewe can smell it when the lamb nurses. The tail also covers the rear end

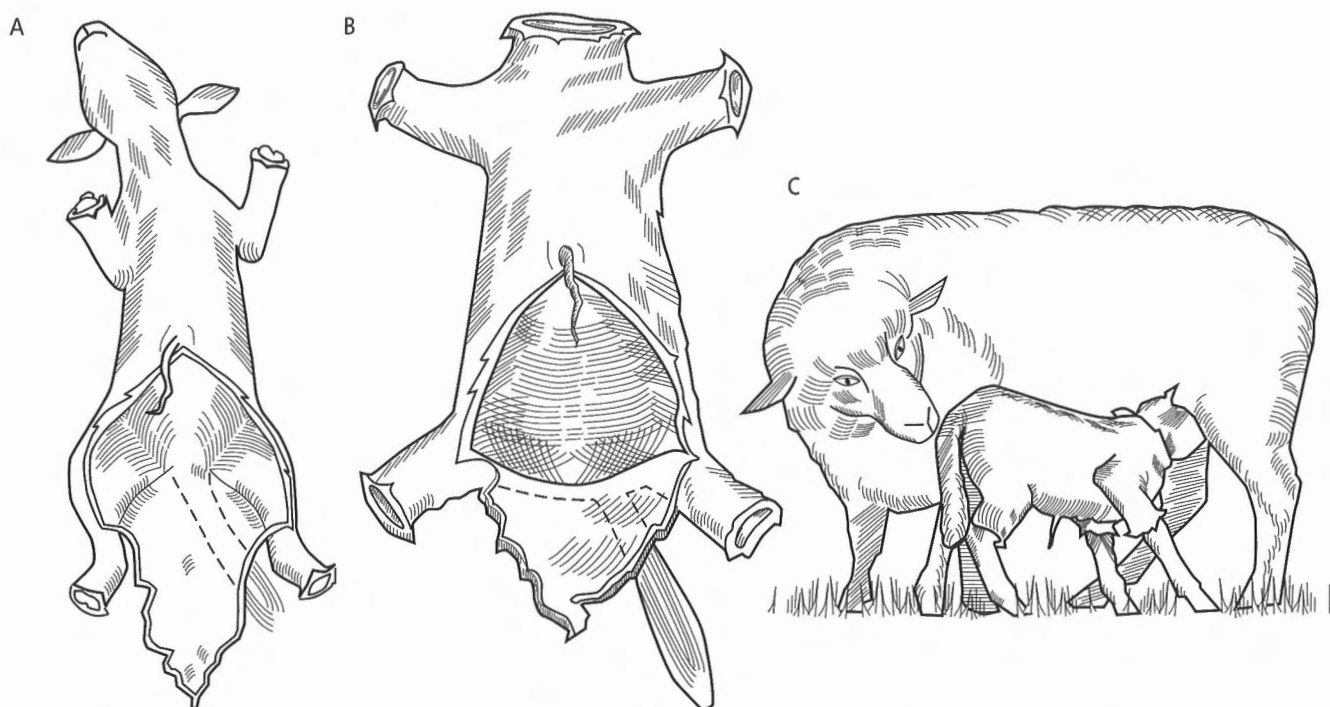


Figure 10. Hide grafting. (A) Skin the dead lamb so that a triangular flap of skin is loosened. Cut off the fore and hind legs at the knee and hock joints. Double the hind leg at the stifle joint and slip the cuff on the hock over the end of the leg. Cut the tail at the base. Pull the hide up over the head so that the hide has the flesh side out (as in taking off a pullover sweater). (B) Cut the hide from around the neck of the dead lamb and turn the hide so that the flesh side is in. The hide is now ready to be put on the bummer, or orphan lamb. (C) The hide of the dead lamb should completely cover the bummer; the triangular opening of skin is hidden on the lamb's belly.

of the bummer, masking its odor. After 3 or 4 days, remove the hide. By this time the ewe can identify the lamb by sight, sound, and smell. A double graft is possible if the dead lamb's hide is divided between two bummers. More risk is involved in a double hide graft, since each lamb is not covered as well. In double grafting, the two bummers should be about the same size.

STOCKINETTE GRAFT

The stockinette graft is also based on odor transfer. The procedure requires a 4-inch-diameter (10-cm) Stretchtex nylon orthopedic stockinette (fig. 12) with holes cut to make a jacket for the lamb. To use the stockinette, transfer odor from the foster ewe's dead lamb by passing the dead lamb through the stockinette several times. Turn the stockinette inside out and place it on the lamb to be grafted. Once the stockinette is in place, introduce the lamb to its new mother. At this time, the lamb should be tied down for 10 to 15 minutes. This gives the foster mother time to become familiar with the lamb. An overaggressive lamb can cause the ewe to reject it.

After the ewe and lamb become acquainted, untie the lamb and encourage it to nurse.

OTHER TYPES OF GRAFTING

Varying degrees of success can be obtained with other methods of grafting, depending on your patience and the ewe's temperament. One technique to encourage an ewe to accept a grafted lamb is to tie the ewe's body so she cannot move and tie one hind leg so she cannot kick. This allows the lamb to nurse as it wishes. After several days, the ewe may accept the lamb. Strong-smelling materials, such as salves or lemon extract, can be rubbed on a lamb and in the ewe's nose to prevent the ewe from identifying the grafted lamb's odor, increasing the chance that she will accept it. Commercially prepared lamb grafting products are also available. Many experienced sheep producers say that commercially prepared grafting products work best with experience. The slime and stockinette grafts are probably best for less-experienced sheep producers.

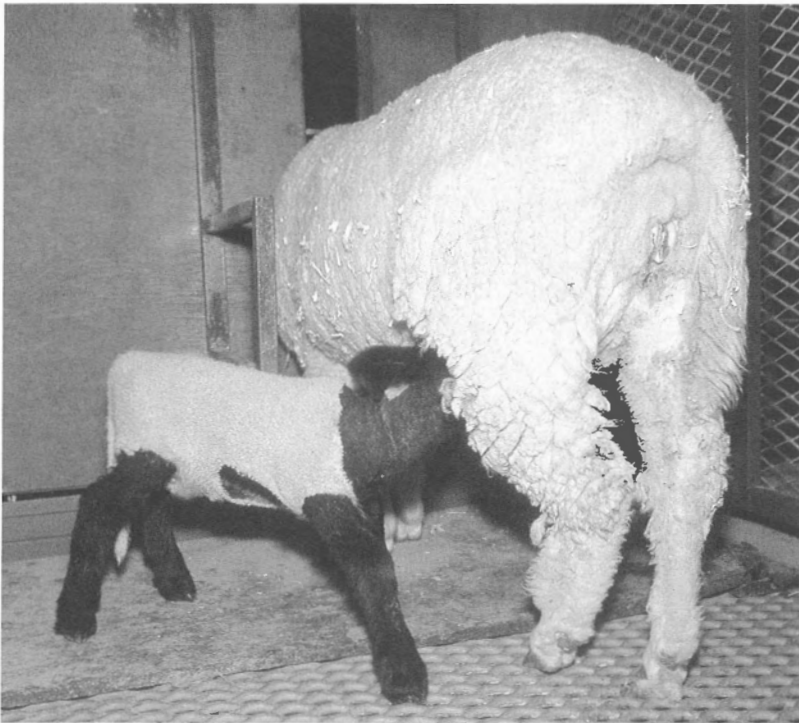


Figure 11. Hide grafting: lamb fitted with hide.

RAISING ORPHAN, OR BUMMER, LAMBS

If grafting fails, bummer lambs can be saved by raising them on warm or cold milk. Lambs tend to overeat when fed warm milk, and warm milk feeding requires extra time and effort. Cold milk feeding requires more equipment, but it is faster and easier if more than three to five bummers are being raised at one time. For more information on cold milk feeding, contact your local UC Cooperative Extension farm advisor.

Warm milk feeding requires a soda or beer bottle and a lamb nipple, which can be purchased at a livestock supply store. Bummer lambs can be raised on cow's milk, but they grow much faster if they are raised on a commercial lamb milk replacer. This supplemen-

tal milk is higher in fat and solids than cow's milk or calf milk replacers. (Ewe's milk is higher in fat and total solids than cow's milk.) The lamb milk replacer may be more expensive than the calf milk replacer, but the added expense will be worth it. The lambs grow faster, will be healthier, and have less tendency to get diarrhea.

A bummer lamb should receive at least one feeding of colostrum during the first 12 hours after birth. The first day, the lamb should take up to 4 ounces (118 ml) of milk and at least four feedings. The second day, increase the feeding to 5 to 7 ounces (148 to 207 ml) and still feed four times a day. By the time the lamb is 1 week old it should be consuming 16 to 24 ounces (473 to 710 ml) of milk in three or four feedings. Gradually increase the milk intake until at 2 weeks of age the lamb is drinking 16 ounces three times a day. The lamb should be fed at this level until it is about 45 days old or weighs about 30 pounds (13.6 kg). At this time the amount of milk fed per feeding can be reduced gradually, provided the lamb is eating dry feed.

Fresh water should be available at all times. In the first week, high-quality dry feed should be available. At 1 to 2 weeks of age, lambs will eat a few alfalfa leaves and some rolled or cracked grains. During the nursing period, they should have high-quality feed available to them at all times. As their intake of dry feed increases (after 45 days or 30 pounds [13.6 kg] of weight), milk intake can be reduced.

If a ewe has triplets or cannot raise twins because of a poor udder, an alternative to grafting or raising bummers is to leave the lambs with their mother and train the lambs to nurse the bottle. The training must start within a couple of days of birth. It will take several days to train the lambs. Have patience!

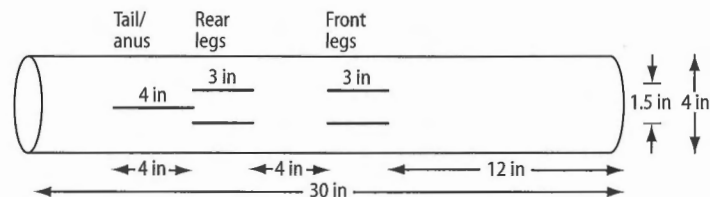


Figure 12. Stockinette, showing the position and dimensions of slits for the legs and anal area. The openings for the umbilical cord and the male genitals are made after the stockinette has been fitted.

LAMB MANAGEMENT

CASTRATION AND DOCKING

To keep the rump area free of feces and moisture, lambs must be docked (have the tail removed); otherwise, flies can lay eggs in the wet manure on the rump and tail. Fly strike, or maggot infestation, can kill the animal. Lambs can be docked at 1 to 2 days of age. Castration of male lambs not needed for breeding purposes is necessary to prevent indiscriminate breeding with their mothers or other ewes before weaning. Also, young ewe lambs and ram lambs can breed, resulting in difficult deliveries of lambs and stunted growth in the ewe lambs. Castration should be done as soon as both testicles have dropped down into the scrotum, which should be within 1 week after birth. If flies are present during castration or docking, fly

repellent should be applied around the wounds, and lambs should be closely watched for fly strike. Castration and docking wounds generally heal within 3 weeks. When castrating and docking are to be done at the same time, castration should be done first. Several types of tools can be used to dock and castrate lambs (see fig. 13).

HOLDING LAMBS FOR CASTRATION AND DOCKING

Castration and docking can be done more easily by two people than one: one holds the lamb and the other carries out the procedures. It is much easier if the lamb is set on its tail with its back to the person holding it. The front legs should be locked under the hocks of the hind legs (see fig. 14A). The tail

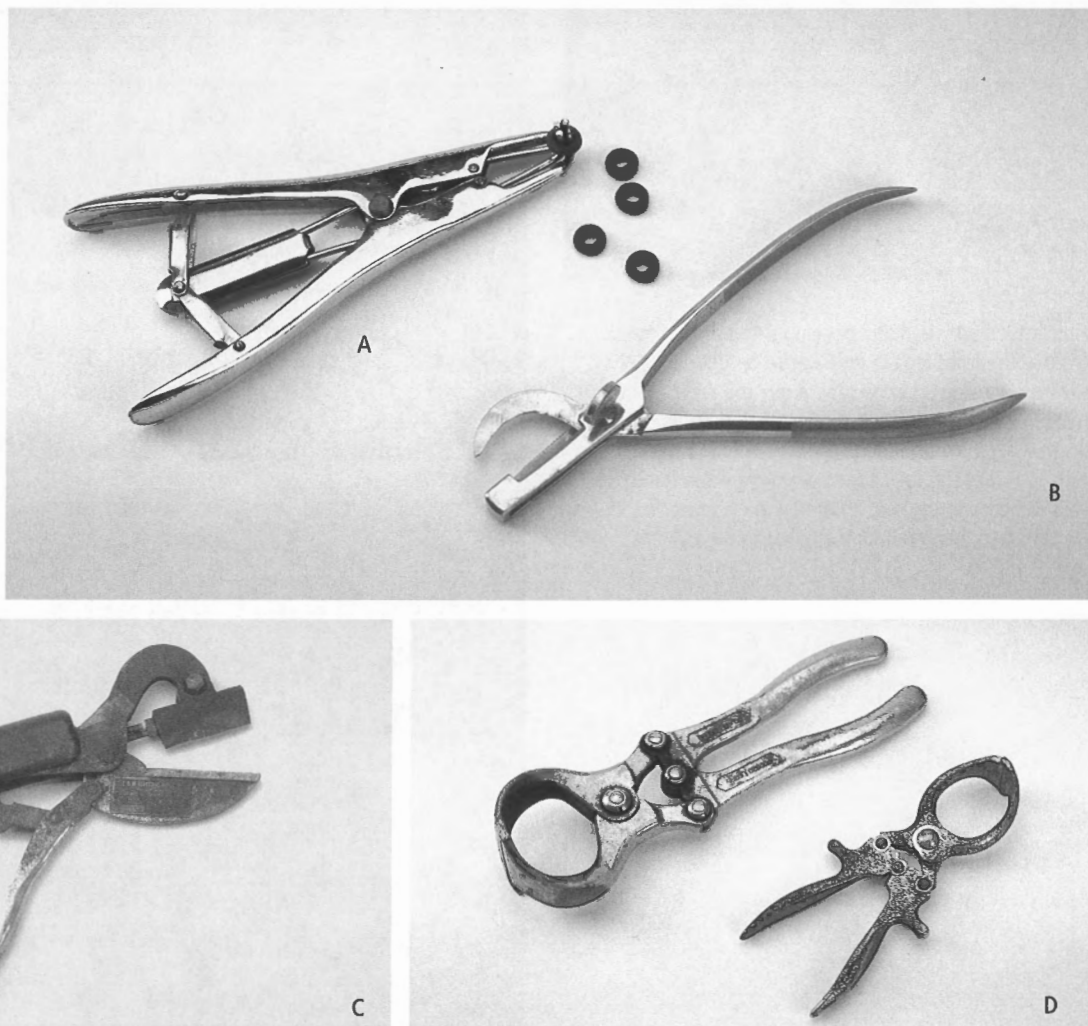
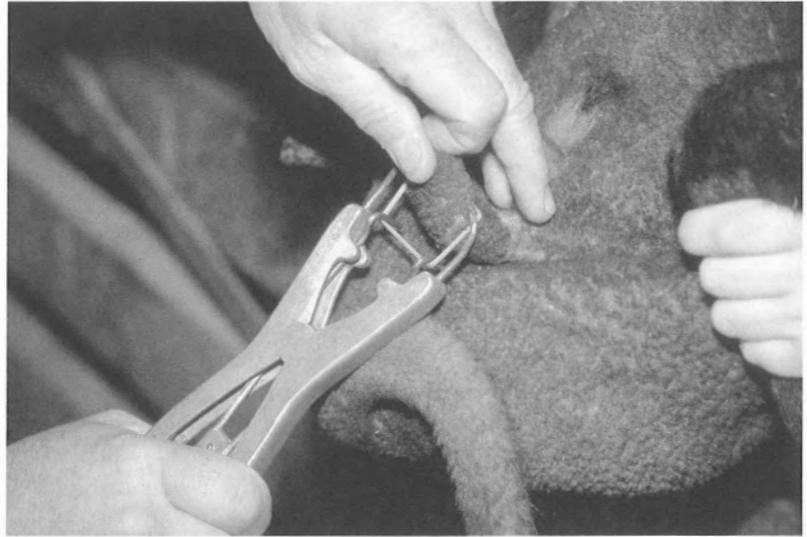


Figure 13. Tools used to castrate and dock lambs. (A) Elastrator. (B) Emasculator. (C) Hot knife. (D) Burdizzoes.



A



B



C



D

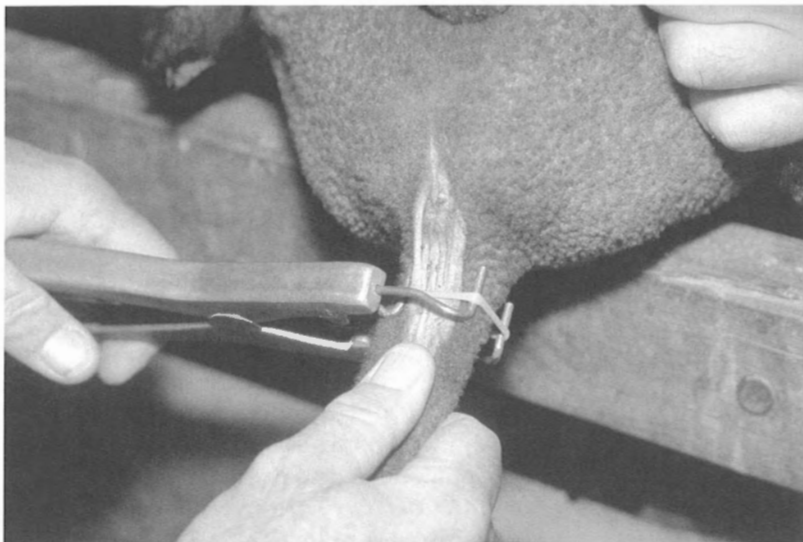
Figure 14. Castration and docking using an elastrator. (A) Use the front legs to hold back the hind legs. (B) Castration using an elastrator: apply the elastrator band between the testicles in the scrotum and the lamb's body. (C) Elastrator band properly applied to the scrotum. (D) Dock the tail at the point where the fold of skin attaches to the tail. (E) Applying elastrator band. (F) Elastrator band properly applied to the tail.

and scrotum are easy to reach with the lamb in this position.

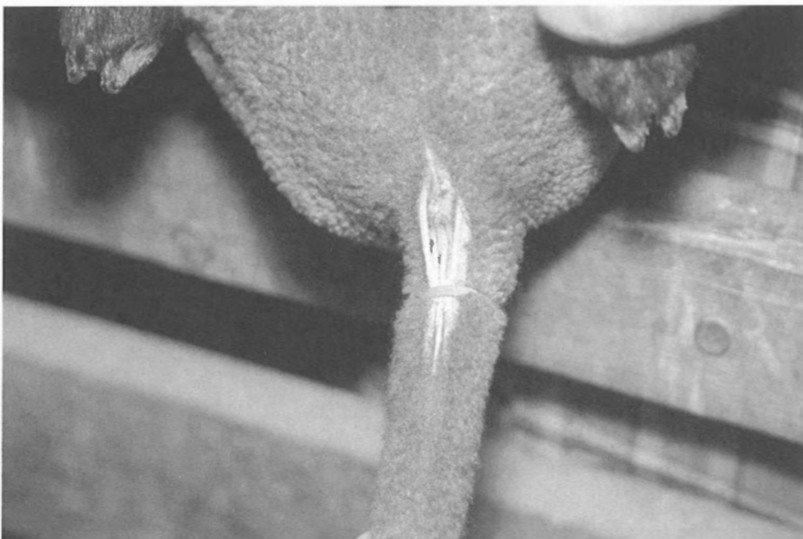
ELASTRATOR

Using the elastrator is probably the cleanest and easiest method of castration and docking. An elastrator is a tool that applies a special type of rubber band (see fig. 13A). Both items can be purchased from a local livestock product supplier or veterinarian. The elastrator works by cutting off the blood supply to the testicles and scrotum or tail, causing them to wither and drop off. A tetanus anti-toxin vaccination must be given when the elastrator is used.

When castrating and docking, first place the rubber band on the elastrator. Position the lamb so that you have clear access to the scrotum; then force both testicles well into it.



E



F

With the testicles in the scrotum, place the rubber band on the scrotum between the testicles and the body (fig. 14B). Release the elastrator, allowing the rubber band to tighten around the scrotum. Check to make sure both testicles are below the rubber band. If they are, remove the elastrator. Check the rubber band again to ensure that it is intact and in the proper location (fig. 14C).

Opinions vary as to where to dock the tail and how long the tail stub should be after docking. The following location is acceptable to most sheep producers: There is a fold of skin on each side of the rectum under the lamb's tail. This fold goes from the rectum area to the tail. The point where this fold connects to the tail is a good place to dock the tail (fig. 14D–F). To dock lambs without assistance, place the rubber band on the elastrator; kneel on one knee and place the lamb over the other knee; pick up the lamb's tail and slide the rubber band down the tail to the desired area; release the rubber band and remove the elastrator.

Do not become alarmed if the lamb being castrated and docked lies on its side and pants after these operations. Within 10 to 15 minutes, it will be up and moving around, free of any reaction.

The elastrator method works best on small lambs. With this technique there is some danger of tetanus infection and fly strike in warmer climates, but there is no danger from excessive bleeding. The tail and scrotum should drop off in 2 to 4 weeks. Always check for unhealed areas when the tail and scrotum drop off. If any are present, treat with fly repellent. An alternative option to prevent infection is to cut off the tails behind the band (away from the lamb's body) about 1 week after the band was applied. Treat the cut area with iodine or fly repellent. This practice helps reduce fly strike.

KNIFE OR EMASCULATOR METHOD

Another way to castrate lambs is to cut off the bottom half of the scrotum and then pull out the testicles with your teeth, fingers, forceps, or special pliers with serrations on them. The testicles may also be cut off with an emasculator (see fig. 13B). Cutting the testicles should be done only on very young lambs (less than 1 month old)—it may be too stressful on older lambs. Sanitation is important; all equipment must be kept clean and

disinfected to reduce the chance of infection. Check to be sure that both testicles are removed. Occasionally one testicle may remain in the body cavity and cannot be reached. Such male lambs, called cryptorchids, may be capable of impregnating ewes.

HOT KNIFE OR CHISEL DOCKING

Tails can be removed by using a hot knife (see fig. 13C) or chisel. It is best to set up a board with a hole through which the tail can be pulled. One side of the board should be covered with metal to prevent the hot iron from burning the board. The board is to protect the lamb's rectum from the hot iron. This method requires two people and a heat source for heating the tool (or electricity for the hot knife). Properly done, there should be little bleeding, because the hot iron cauterizes the blood vessels. There could be problems if the scab is knocked off before the tail is healed. Lambs docked with this method at an early age show little pain or reaction.

BURDIZZO CASTRATION AND DOCKING

Lambs can be castrated with a burdizzo (see fig. 13D), a tool that crushes the spermatic cord above the testicles. If castration is done properly, the testicles are reabsorbed and the scrotum remains intact. Occasionally, a cord is missed and the testicle redevelops. In this case, the lamb will probably produce sperm cells at sexual maturity and develop the characteristics of a ram.

The burdizzo can also be used to dock lambs by clamping it on the tail and using a sharp knife to cut off the tail behind the tool. The tool's crushing action reduces bleeding and reduces blood-clotting time. The end of the tail should be disinfected to prevent infection. Care should be taken that the cut end of the tail is not bumped after docking to avoid bleeding.

It is not recommended to use a burdizzo for docking and an elastrator for castration at the same time. When the elastrator is on the

testicles, the lamb could thrash around, bump the tail, and open the wound. This could cause excessive bleeding that could weaken or kill the lamb.

INVERTED EYELID

Inverted eyelid (entropion) can occur in one or both eyes. The lower eyelid (and occasionally the upper eyelid) turns in, and the hair on the lid irritates the eyeball, causing the eye to water. In severe cases, inverted eyelid can cause blindness. Lambs with inverted eyelid should not be kept for breeding purposes because this condition is heritable. Inverted eyelid should be corrected for the comfort of the animal as well as to ensure a good rate of growth. In severe cases, lambs grow poorly because of the constant irritation. Several methods can be used to correct this condition.

An effective bloodless method employs surgical wound clips. One end of the clip is attached to the lower eyelid next to the eyelashes, and the other end is attached lower down on the eyelid. After the clip is fastened, the lower eyelid is rolled out and down. After several weeks, the clips can be removed. This method requires specialized, expensive equipment that is not readily available.

Inverted eyelid can often be corrected by stretching the eyelid and pulling it down and away from the eye several times a day. In mild cases, no further treatment is needed. One other method uses several small injections of an antibiotic under the skin of the inverted eyelid. Consult your local veterinarian for advice on this technique.

CREEP FEEDING LAMBS

A lamb's most efficient growth takes place during its first 2 to 3 months of life. To take advantage of this, lambs should be fed a high-quality creep feed to maximize growth. A "creep" is a feeding area for lambs only; ewes are excluded. The creep fence or gates have one or two areas through which lambs can enter (see appendix A). These entry areas

should have vertical slots about 10 to 12 inches (25.5 to 30.5 cm) wide, which is wide enough to let lambs in and keep ewes out. It is best to start with narrow slots and increase the width as the lambs get larger.

The creep should be located near where ewes spend most of their time, preferably in the pasture where sheep tend to congregate, such as near shade, water, or feeding areas. During their first few weeks, lambs will want to be near their mothers. The creep should be kept clean, dry, and protected from wind, which makes it attractive to lambs. Creep feeders should be a convenient height for young lambs and should not be near the entry areas. If feeders are close to entry areas, ewes will spend too much effort trying to get into the creep and may break down the creep fence. Also, if a ewe blocks the entry, lambs will not be able to enter.

It takes several days for the lambs to start using the creep. Older lambs begin to use it first; younger ones soon follow the older ones. Once the lambs have started using it, they will spend more time there, eating and socializing. The creep feed should be available until they are weaned.

CREEP FEEDS

Lambs are able to eat small amounts of high-quality feed at 2 to 3 weeks old. High-quality, leafy alfalfa hay is a good starter creep feed for lambs. A concentrated grain mix containing 12 to 16 percent crude protein should also be available. Fresh, clean feed should be available at all times. Do not allow feed to become stale in the creep feeder. Stale creep feed can be fed to ewes.

ADVANTAGES OF CREEP FEEDING

Creep-fed lambs wean more easily than non-creep-fed lambs. The creep becomes a mother substitute, and the ewe's main function by weaning time will be social, not a source of milk. A weight gain advantage for creep-fed lambs can be realized when the ewes and lambs are grazing high-quality pasture. The additional gain by lambs before weaning is

important for future management. Wether and ewe lambs to be sold reach market weight sooner, and less feed is needed to finish them. Also, replacement ewe lambs weigh more at breeding time, improving their pregnancy rate.

CREEP FEEDING AND OVEREATING DISEASE

Creep feeding increases the likelihood that lambs will get overeating disease (pulpy kidney, or enterotoxemia). Creep-fed lambs must be given enterotoxemia injections. (It is a good practice to give all lambs enterotoxemia injections under any type of management; see "Enterotoxemia" in the chapter "Diseases.")

WEANING LAMBS

Lambs can be weaned at 60 to 90 days old. During weaning, the ewes should be moved to a different pasture and the lambs should be left in a familiar environment for several days. Creep-fed lambs should continue to have creep feed during weaning to reduce stress. In heavy-milking flocks, ewes should be placed on poor-quality feed or reduced feed for about 2 weeks after weaning so that their milk flow will decrease.

In an accelerated lambing program (a lamb crop every 6 to 8 months), lambs are weaned at about 60 days. These lambs must be fed high-quality feed before, during, and after weaning. Early-weaned ewes should be held off feed and water for 48 hours to reduce milk production. In hot weather, provide water to the ewes after 12 hours.

After weaning, lambs should be placed on the best pasture or feed available to maximize their growth. Ewes should be placed on the poorest pasture. After weaning, the ewe needs only to maintain body weight and does not require high-quality feed until just before breeding. Ewes carrying excess fat at weaning time should be managed to lose weight between weaning and breeding.

NUTRITION

Sheep should be fed enough to meet their productive needs. For example, lactating ewes need more feed than ewes in early pregnancy, and a growing ewe needs a different kind of feed than a mature, dry ewe. The kinds and amounts of feeds must be adjusted to meet the nutrient requirements for each stage of production. To maintain good health, sheep require

- water
- energy sources, expressed as total digestible nutrients (TDN) or digestible energy (DE)
- protein, expressed as crude or digestible protein
- minerals, most importantly salt, calcium, and phosphorus
- vitamins, most importantly vitamins A, D, and E

WATER

A clean, ample supply of water should be available at all times. Sheep need more water during hot weather than during cold weather; lactating ewes require more water than do nonlactating sheep; and sheep eating dry feed require more water than sheep grazing green forage or eating silage. Sheep will not drink enough water if the water is dirty or stagnant. Low water intake reduces feed intake, reducing performance and affecting health.

ENERGY SOURCES

Hay, pasture, or silage are common sources of energy. Mature forages are often too low in energy to meet the needs of ewes, especially in the last 6 weeks of pregnancy, or to meet the needs of lactating or young ewes. Additional corn, milo, barley, or wheat

should be fed to meet their energy requirements.

PROTEIN

Adequate protein can usually be supplied by high-quality forages. Diets containing poor-quality pastures or hay should be supplemented with a high-protein feed such as cottonseed or soybean meal.

MINERALS

Salt should be provided at $\frac{1}{4}$ to $\frac{1}{2}$ ounce (7 to 14 g) per head daily. Sheep deprived of salt do not eat or drink enough. Loose or ground salt is better than block salt: sheep bite block salt rather than lick it, increasing the likelihood that they will break teeth. Sheep can satisfy their salt need faster when fed loose salt and will be able to spend more time eating.

Sheep must have very small amounts of copper in their diet, yet they are extremely sensitive to too much copper. Most rations naturally contain adequate amounts of copper. Never give supplemental copper to sheep unless a test of the copper level in the liver confirms a deficiency. Common sources of toxic levels of copper in sheep include swine concentrate feed mixes, cattle concentrate feed mixes, and trace mineral mixes containing copper.

The feed in many areas can be selenium-deficient; sheep in these areas require supplemental selenium by injection or in feed. Check with your local veterinarian or UC Cooperative Extension farm advisor for more information.

Forages usually contain adequate amounts of calcium, but they are often low in phosphorus. Grains usually contain adequate phosphorus but are low in calcium. Because

sheep consume mostly forages, their diets can be low in phosphorus. Phosphorus and calcium dietary needs can be supplied by providing a mix containing 75 percent salt and 25 percent dicalcium phosphate. Instead of dicalcium phosphate, trace mineral salt (without copper), or monosodium phosphate can be used. This mix can be offered as a free choice (as opposed to being force-fed).

VITAMINS

Sheep require vitamins A, D, E, and K; they do not require vitamin C or the B-complex vitamins, which are produced in the sheep's rumen (stomach) by bacteria and protozoa. The diet consumed by most ewes contains an

adequate supply of vitamins A, D, E, and K. Diets consisting largely of mature dry forages that are not green are low in vitamin A. However, under most conditions, sheep do not require supplemental vitamin A. Vitamin D deficiency is not a problem unless ewes are fed a diet low in sun-cured forages or are kept out of the sunlight. Many times, white muscle disease (usually associated with selenium deficiency) can be prevented with supplemental vitamin E. In selenium-deficient areas, it is a good practice to give lambs vitamin E at birth. Check with your local veterinarian or UC Cooperative Extension farm advisor for more information.

FEEDING

A sheep's nutrient requirements depend on its age, sex, and production stage. For information on feeding facilities, see appendix B.

EWES

A ewe's feed requirements change throughout the year (see fig. 15).

EVALUATING EWE'S CONDITION

Each ewe's condition (amount and ratio of muscle to fat) should be evaluated to help determine her nutritional needs. Weighing a

ewe gives the best indication as to whether she is underweight or overweight, since most of the time, sheep have too much wool to evaluate their weight accurately by looking at them.

The best way to check a ewe's condition is to feel the degree of muscling and fat over and around the vertebrae in the loin regions (body condition scoring). Look for three landmarks: the spinous process, which is the vertical portion of the backbone; the transverse process, which is the horizontal portion of the backbone; and the eye loin muscle, which lies between the spinous process and the transverse process (see fig. 16 and table 1).

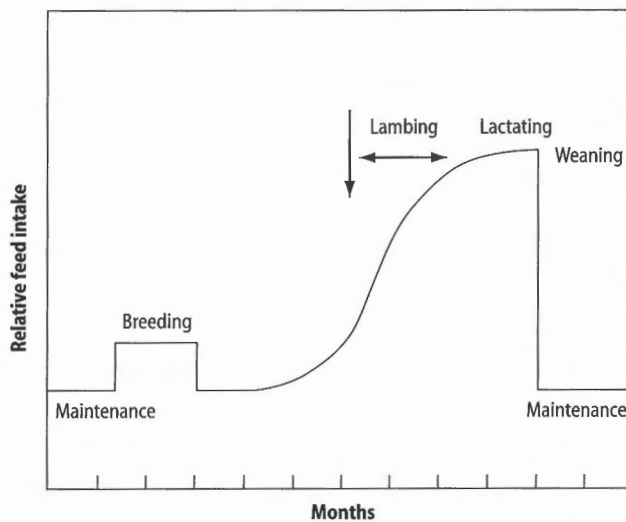


Figure 15. Relative intake of feed needed by a ewe during various stages of production over a 12-month period.

EWES' CONDITION AND FEED REQUIREMENT

From the end of breeding to 6 weeks before lambing (early gestation), ewes in good condition (score 3 in table 1) should maintain their weight. Thin ewes (score 1 or 2) should gain weight slowly ($\frac{1}{16}$ to $\frac{1}{8}$ pound [28 to 56 g] per day). Ewes that are too thin produce smaller lambs that have a higher death rate, and they also produce less milk. Lambing paralysis (pregnancy toxemia, or pregnancy disease) is also a threat.

Ewes that are too fat (score 5) during early gestation should lose excess fat, since they may develop pregnancy disease during the 4 weeks before lambing, particularly if they are

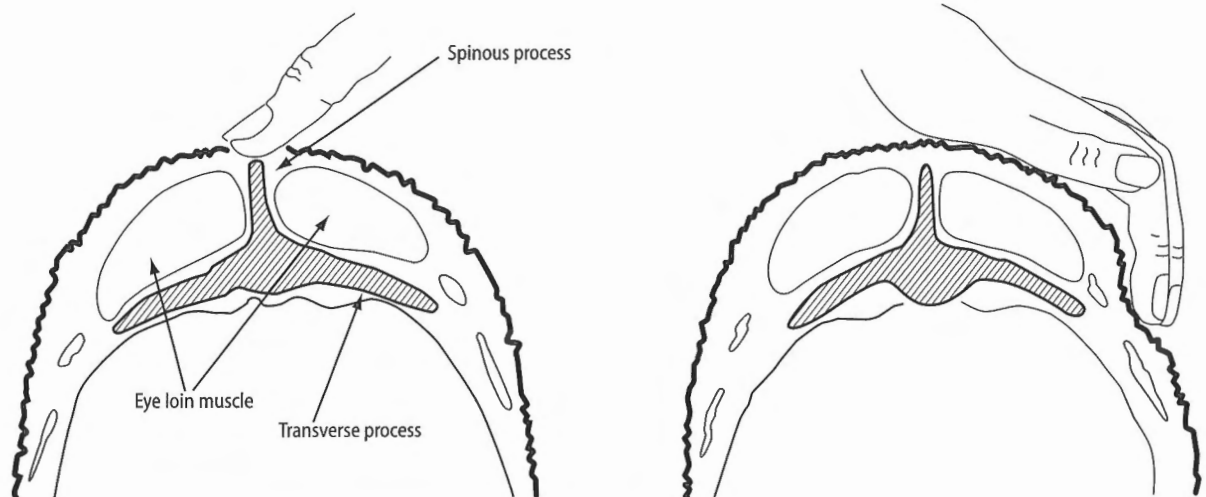


Figure 16. Cross-section of a sheep's loin area showing the spinous process, transverse process, and eye loin muscle.

Table 1. Scoring sheep muscling and fat condition

Score	Area of sheep*	Condition
1 Very thin	spinous transverse eye muscle	prominent and sharp sharp; can feel underneath them and feel each process shallow; no fat covering
2 Thin	spinous transverse eye muscle	prominent but smooth (individually felt only as corrugation) smooth, rounded; can feel each with a little pressure full; moderate fat covering
3 Good condition	spinous transverse eye muscle	only small elevation; smooth, rounded (individually felt only with pressure) smooth; firm pressure required to feel over ends moderate; little fat covering
4 Fat	spinous transverse eye muscle	can be detected with pressure as a hard line cannot be felt full; thick fat covering
5 Very fat	spinous transverse eye muscle	cannot be felt but is hollow in back cannot be felt very full; very thick fat covering; may be lumpy over tail and rump

Note: *See figure 16 for location of spinous process, transverse process, and eye loin muscle.

carrying twins or triplets. Prevention through good management and avoiding underfeeding and overfeeding is best for controlling this problem. Lack of exercise by ewes in late pregnancy can contribute to pregnancy disease (see "Pregnancy Toxemia" in the chapter "Diseases").

MAINTENANCE DIET

Maintaining a 150-pound (68-kg) ewe requires 3 to 3½ pounds (1.4 to 1.6 kg) of good-quality hay per day. Ewes grazing medium- to poor-quality pasture should maintain their weight. Ewes on short, poor-quality pasture may need a hay or grain supplement.

LATE PREGNANCY

During the last 4 to 6 weeks of gestation, when rapid fetal growth occurs, the ewe's ration should be increased to meet the needs of the developing fetus. Without increased energy intake to meet her needs and those of the developing lamb, the ewe may develop pregnancy disease (see "Pregnancy Toxemia" in the chapter "Diseases").

LAST 6 WEEKS OF PREGNANCY

Ewes should gain from ¼ to ½ pound (114 to 227 g) a day during the last 6 weeks of pregnancy. Thinner ewes and ewes carrying more than one lamb should gain at the faster rate. Fat ewes should gain at the slower rate.

Eating 4½ pounds (2 kg) of high-quality alfalfa hay daily should provide a ewe with enough energy. The quality of the pasture determines whether additional feed is needed; most pasture is too poor for a ewe to gain ½ pound (227 g) per day. If the pasture is too poor, additional energy must be supplied with ½ to ¾ pound (227 to 341 g) of grain.

FIRST 8 TO 10 WEEKS OF LACTATION

Nursing ewes need twice as much energy as ewes without lambs (see fig. 15). Ewes nursing twins need more energy than ewes with a single lamb; if possible, separate these two groups of ewes to make feeding more efficient. Ewes with twins require a daily ration of about 5½ pounds (2.5 kg) of good-quality alfalfa hay, plus ½ to ¾ pound (227 to 341 g) of grain. Ewes with single lambs can be fed the same amount of hay but only ¼ pound (114 g) of grain. Ewes that nurse lambs and graze poor-quality pasture or eat poor-quality hay need supplemental feed for energy and protein.

WEANING

A ewe's nutritional needs change drastically at weaning time (see fig. 15). Ewes should be held off water for 6 to 18 hours (depending on air temperature—hold off less time during hot weather) and held off feed for about 24 hours after weaning to reduce milkflow.

During hot weather, ewes should not go longer than 6 hours without water. Breaking the milkflow also apparently helps reduce damage to the udder. A ewe's body condition at weaning determines her subsequent nutritional needs. Very thin (score 1) ewes should gain at a slow rate, about ½ pound (227 g) a day. Ewes in good flesh should maintain their weight, and overweight ewes (score 5) should lose weight. Poor-quality pasture is adequate for most ewes at weaning time; the best pasture and feed should be used for lambs. A ration of 3 to 3½ pounds (1.4 to 1.6 kg) of medium-quality hay per ewe per day should be adequate if pasture is not available.

BEFORE BREEDING

A ewe's nutrition should be improved by flushing 2 to 3 weeks before breeding (see "Flushing" in the chapter "Reproduction"). A change from poor-quality to good-quality pasture may be adequate to get a good flush. When pasture is not available, ½ pound (227 g) of additional grain should provide a good flush.

REPLACEMENT EWE LAMBS

Replacement ewe lambs should be managed differently than mature ewes. Ewe lambs should gain from ⅛ to ½ pound (57 to 227 g) a day from weaning to lambing. They should be also fed to gain some weight during lactation. These young ewes are still growing and must have enough feed for milk production and growth if they are to reach mature weight by their second breeding season.

From weaning to breeding, ewe lambs should gain at a rate that ensures a weight of 100 pounds (45 kg) or more at breeding. High-quality pasture can provide the necessary nutrients to reach this weight. Ewe lambs grazing poor-quality pasture need additional grain to achieve desired gains. Ewe lambs in drylot require 3½ pounds (1.6 kg) of good-quality hay and ½ pound (227 g) of grain per head daily to reach the desired weight at breeding time.

The level of feed for fat ewe lambs should be reduced slightly at the end of the breeding season. Ewe lambs in good condition should

remain on the high level of feed through lambing and lactation. After lambing, ewe lambs should be fed separately from mature ewes and given all the high-quality hay they can eat plus ¼ to ½ pound (114 to 227 g) of grain.

FEEDER LAMBS

The amount of feed and crude protein a lamb requires increases as the lamb gains weight. Early-weaned lambs and lambs weighing less than 70 pounds (32 kg) should receive a ration high in grain and low in forage. However, the forage should be high quality and contain at least 16 percent crude protein. A ration for lightweight lambs should be about 35 percent roughage (hay) and 65 percent grain and protein supplement. Even lush pasture does not contain enough nutrients for small lambs to grow at a reasonable rate and should be supplemented with feed containing protein and energy sources.

Lambs weighing from 70 to 100 pounds (32 to 45 kg) should receive a ration of 60 percent roughage and 40 percent grain that contains at least 12 percent crude protein. Lambs in this weight range can consume rations higher in grain, but high-grain rations can cause digestive problems such as scours, founder, and overeating disease. Lambs in drylot consume 2½ to 4 pounds (1.1 to 1.8 kg) of feed per head per day, depending on size. High-quality pastures are usually adequate to meet the weight-gain needs of older lambs.

Finishing lambs should gain ½ pound (227 g) or more per day; most lambs should have a good fat cover and be of good grade choice by the time they reach 100 to 110 pounds (45 to 50 kg). However, lambs of larger breeds may not finish until they weigh 120 pounds (54 kg) or more.

RAMS

Most mature rams should be maintained in a good, thrifty condition (score 3 in table 1). Hard-working rams may require additional energy-source supplement during or after breeding season. Rams fed in drylot eat about 1½ to 1¾ percent of their body weight on an as-fed-basis and remain in good condition when fed medium-quality hay.

MAINTAINING FLOCK HEALTH

Maintaining a flock in a healthy condition involves many factors. Some of these factors, such as the weather or exposure to certain diseases, cannot be controlled. Yet many others can be controlled through proper management practices such as breed selection, herd management, breeding, nutrition, and feeding, as discussed earlier in this publication. This chapter discusses practices that can help your sheep remain healthy even if they are exposed to diseases. These practices include managing stress, administering medication properly, and general disease-control practices such as sanitation, quarantine, and vaccination. A sample flock health program is given in table 2.

STRESS

Stress, more closely related to disease than to any other factor, comes in many forms and is not always associated with underfeeding or neglect. Watch your flock closely for sickness during periods of stress. Consult your local veterinarian at the first sign of sickness; prompt treatment could prevent the disease from spreading.

Although we cannot control the climate, we can provide conditions to overcome stress caused by climate. Providing shade during hot weather can reduce heat stress. The shade should be well ventilated. Also, plenty of clean, cool water helps reduce heat stress. Timing shearing so that the sheep have short wool during hot weather is also helpful (see the chapter "Shearing"). Mature sheep need protection from moisture more than they need protection from the cold: poorly ventilated barns can create many respiratory health problems in sheep.

Diseases often appear shortly after animals have been moved or worked. Stress from hunger and lack of water should be minimized when hauling sheep long distances. Also, do not work sheep during extremely hot, cold, or wet weather or in dry, dusty corrals. Work sheep on a cool day or during a cool part of the day and keep handling of the animals at a minimum. When sheep require a lot of handling, spread it over 2 days rather than a single long, stressful day. Avoid sudden changes in feed or care and try to avoid work-

ing sheep during changes in nutrition or management.

ADMINISTERING MEDICATION

Administer only drugs that are approved for sheep and always follow label directions for dosage, route, timing, and withdrawal times. Using unapproved drugs, or using approved drugs at doses, routes, or times other than those listed on the label, is considered to be "extra-label use" of the drugs. This can be done legally only under the supervision of a licensed veterinarian who is familiar with the animals and recommends an appropriate withdrawal time. If an illegal residue is found in an animal you sell, the carcass will be condemned and you will be subject to legal action.

There is increasing concern over consumer complaints about injection site reactions in cuts of meat. Whenever possible, give injections by the subcutaneous route and at sites in the neck rather than in the leg or loin. A ½-inch 20-gauge needle can be used for subcutaneous injections, and a 1-inch 19 or 20 gauge needle can be used for intramuscular injections.

BASIC DISEASE CONTROL MEASURES

SANITATION

The number of disease organisms in the environment can be reduced with good sanitation. Attention to cleanliness of feed, water, air, and housing will go a long way toward preventing disease in the flock.

Illness can be caused by bacteria or algae growing in watering troughs. Feeding and watering equipment should be designed so that the animals cannot contaminate the feed or water with urine or feces. Equipment should also be designed for easy cleaning. Contaminated feed can spread disease and internal parasites; spoiled feed that contains mold can cause abortion. Sheep in confinement should not be fed on the ground.

Grazing pasture too closely can create serious internal parasite problems in sheep. As pastures are grazed closer, the number of

Table 2. Sample sheep flock health program

Period or activity	Disease or condition	Control
Prelambing		
Ewes	white muscle disease enterotoxemia tetanus pregnancy toxemia abortion	supplemental selenium in feed or by injection vaccination with type C and D bacterin/toxoid vaccination maintain good body condition and adequate nutrition preventive vaccination sanitation
Lambing		
Ewes	mastitis scours	sanitation check udder antibiotics sanitation isolation prompt treatment
Lambs	pneumonia navel ill scours white muscle disease	adequate nutrition reduce stress give adequate colostrum ventilation disinfect umbilical cord and navel with iodine sanitation sanitation isolation prompt treatment adequate nutrition selenium injection
Marking		
Lambs	soremouth enterotoxemia tetanus	vaccination vaccination vaccination
Shearing		
Lambs and ewes	boils	shear younger lambs first sanitation
Prebreeding		
Ewes	vibriosis enzootic abortion bluetongue foot rot	vaccination vaccination vaccination inspect and trim hooves foot bath
Rams	epididymitis foot rot	palpation blood testing inspect and trim hooves foot bath vaccination
Postbreeding		
Ewes	vibriosis	vaccination

internal parasites that are eaten increases. If grazing cannot be controlled and the pastures are short, the flock should have a good deworming program.

Barns and corrals should be cleaned in the fall and spring, and more often if needed. Bedding and manure should be disposed of so as to prevent the spread of disease. Bedding material from lambing and mixing pens should not be placed where expectant ewes can come in contact with it. Lambs with scours (diarrhea) can contaminate the bedding, and the scour fecal material can get on the udder of a ewe ready to lamb. After birth, her lamb will be exposed to scours-causing organisms at the first nursing.

Health management is critical at shearing. Insist on clean equipment before starting (see "Boils" in the chapter "Diseases").

QUARANTINE OF NEW SHEEP

Fewer new disease organisms are introduced into a flock if new sheep are quarantined. Sheep that appear normal may be incubating disease; quarantined, they can be watched closely, and if no disease develops within 3 to 4 weeks, they can be mixed with the other sheep. Obtain the health and vaccination records of new sheep, if available.

ISOLATION OF SICK SHEEP

The spread of disease organisms from infected to noninfected sheep is reduced and the seriousness of infection is kept at a low level if sick sheep are isolated from noninfected ones. In most illnesses, sick sheep are the major source of infection for other sheep through breath, body secretions, and abnormal discharges.

TESTING

By identifying the diseases sheep have or have had in the past, decisions can be made about whether they should be culled and the types of control programs that should be put in place.

CULLING INFECTED ANIMALS

The spread of disease-causing organisms to healthy animals can be reduced by culling infected animals. Some sheep may be incurable or chronically infected, and unless they are eliminated from the flock, they will be a constant source of infection for healthy sheep.

VACCINATION

Vaccination increases an animal's resistance to specific diseases. However, the protection provided by vaccination can be overwhelmed by disease, and some animals may not be able to respond to the vaccination. As a result, vaccination cannot be relied upon as the sole method of disease control in a flock. Instructions supplied with vaccines about handling, dosage, frequency of administration, and withdrawal time before slaughter must be closely followed to assure success and maintain the quality of the carcasses.

Most vaccinations or injections should be given subcutaneously (under the skin) in the neck region unless the drug label states that injection must be intravenous or intramuscular. The "tenting technique" works best for giving subcutaneous injections. This technique involves picking up a piece of skin and pulling it away from the sheep's body. This provides a pyramid, or "tent," of skin. The dose of medication is then injected into the tented area. If done properly, the medication is delivered between the skin and muscle.

DISEASES

Disease occurs when the balance is upset between an animal's resistance against disease and the presence or number of organisms or conditions that cause disease. For a disease-control program to be effective, the interaction between the animal, its environment, and the disease-causing agent(s) must be considered. Poor nutrition, bad weather, rough handling, or any other stress lowers an animal's resistance, and poor sanitation increases the number of disease-causing organisms. As a disease spreads through a group of animals, the disease-causing agent's virulence (its ability to produce disease) often increases.

This chapter acquaints the sheep owner with the more common diseases and disease-like conditions of sheep and provides recommendation for the *prevention* of specific diseases. Consult a veterinarian for further information on the diagnosis and treatment of specific diseases.

ABORTION

The abnormal or early termination of pregnancy is a "disease complex" that results from many causes. Although rough handling or fighting among sheep can cause abortion, most abortions are caused by fungi, bacteria, viruses, or other disease-causing organisms. Because the exact cause of abortion is often unknown, the aborting ewe, the fetus, fetal membranes, and fluids should be separated from the flock to prevent the possible spread of infection to healthy animals.

The fetus and fetal membranes should be submitted to a diagnostic laboratory. Diagnosis should be made as soon as possible so that steps can be taken to prevent further abortions. The most common infectious diseases causing abortions are vibriosis and enzootic abortion of ewes.

VIBRIOSIS

Vibriosis is caused by the bacterium *Campylobacter (Vibrio) fetus* var. *fetus* (or var. *jejuni*). Vibriosis causes abortion in the last few weeks before birth. Ewes generally do not appear ill afterwards, and the fetal membranes are usually passed normally. Left unchecked, vibrio abortion can spread from animal to animal through the affected ewe,

the fetus, and fetal membranes and fluids and can cause increasing numbers of abortions. Diagnosis can be confirmed only in the laboratory.

The best prevention is to vaccinate ewes several weeks before breeding. A second vaccination should be given in the middle of pregnancy (mid-gestation). After a ewe has received the two-vaccination series, in subsequent years only a single vaccination needs to be given in mid-gestation. In unvaccinated animals, antibiotics can control vibrio abortions until animals can be vaccinated.

ENZOOTIC ABORTION

Enzootic abortion of ewes (EAE) is caused by chlamydial organisms, which are classified as between bacteria and viruses. Abortion from EAE is usually not distinguishable in the field from abortions due to vibriosis. There is a greater chance that fetal membranes will be retained with EAE abortions, but diagnosis can be confirmed only in the laboratory.

A vaccine is available for the prevention of EAE; to be effective, it must be given before breeding. In case of an outbreak, antibiotics can provide variable control. EAE is a complicated disease, and control strategies should be discussed with your veterinarian.

BLUETONGUE

Bluetongue is caused by a virus transmitted from animal to animal by several species of tiny biting gnats. The disease often appears during dense gnat activity; in California, most cases are seen in late summer and fall. Affected animals develop a high fever and may have swollen faces and ears. When lameness occurs, the junction of the hoof wall and the skin may become inflamed (reddened). Ulcers may form on the gums. As the disease progresses, there is usually a nasal discharge. Many affected animals develop a secondary pneumonia. Pregnant ewes infected with the virus in the first third of gestation may produce deformed, or "dummy," lambs.

Although the disease can be prevented by controlling the gnat, eliminating their breeding sites is difficult because the gnat breeds in muddy areas around freshwater streams, drain canals, and organically rich ponds. Also, the gnat can fly several miles, and area-wide con-

trol is often not practical. Because the gnat is most active in the evening and at dawn, small flocks of sheep can be protected by bringing them into a barn before nightfall. Avoid shearing in late summer and fall, since shearing seems to attract gnats at that time in high-risk areas. Spraying insecticide or dipping sheep during late summer or fall can help reduce attacks.

Of the four types of bluetongue-causing viruses common in California, vaccines are available for three. Because there is virtually no cross-protection between types, all three vaccinations must be used. Sheep should be vaccinated before the breeding season because each modified live virus could damage a developing fetus. Sheep need time to develop resistance before becoming pregnant. Consult your veterinarian for more information on these vaccines.

BOILS (CASEOUS LYMPHADENITIS)

Boils in sheep are caused by the bacterium *Corynebacterium pseudotuberculosis*. After entering the body through a break in the skin, the bacteria settle in a lymph node, where they produce an abscess. The lymph nodes most commonly affected are those behind and under the jaw. The abscesses develop a thick wall that antibiotics cannot easily penetrate. When the abscesses are located inside the sheep's body, they lead to gradual wasting and are a major cause of the "thin ewe" syndrome. When the abscesses break open, a thick greenish-yellow material comes out that contains millions of bacteria that are a source of infection for other sheep. These bacteria can survive in the soil for a long time.

Boils are extremely difficult to control because vaccination is not always effective. Researchers have tried to make autogenous vaccines (those made from organisms collected from a particular ranch), with mixed success. Sanitation is critical in control. Whenever an abscess breaks open, the material should be disposed of and the abscess should be flushed with iodine. All shearing wounds should be treated with iodine. If an abscess breaks open during shearing, the equipment that came in contact with the abscess or its fluids should be thoroughly disinfected before shearing resumes. Because younger animals

are less likely to have abscesses, lambs should be sheared first.

CLUB LAMB FUNGUS

Club lamb fungus is a skin disease (ringworm) of sheep that can be transmitted to humans. Slick shearing (shearing the sheep very closely), repetitive washing, stress, and sharing of equipment make show animals more susceptible to infection (thus the name). Lesions can occur anywhere on a sheep, but they are most common on the back and sides. Initially, the skin becomes thick, red, and moist. Later it becomes crusty and scaly, usually in circular lesions. The wool breaks easily and is usually lost, beginning in the center of the lesion. The affected spots expand to full size in 4 to 8 weeks and spontaneously recover in 8 to 16 weeks. Wool regrowth may be black. Consult your veterinarian for proper diagnosis and treatment.

In humans, typical lesions generally become visible 2 to 4 weeks after exposure to the fungal spores. The infected areas begin as circular patches of itchy, dry skin. Prompt medical care should be sought, and the physician should be informed about contact with sheep and the possibility that club lamb fungus could be a cause of the lesions.

ENTEROTOXEMIA (OVEREATING DISEASE, PULPY KIDNEY)

This disease is caused by the bacterium *Clostridium perfringens* (usually type C or type D), which is naturally present in the intestine of sheep. When a sheep's digestive system is upset from overfeeding or from changing the type of feed too rapidly, the bacteria multiply in large numbers and produce a strong toxin that can kill the animal within hours. Sheep are often found dead without showing any sign of illness. In some cases, diarrhea and convulsions precede death. Generally, the healthiest, fastest-gaining lambs are affected first.

The disease is best prevented by vaccination and good feeding management. Ewes can be vaccinated with type C and D bacterin/toxoid. Two vaccinations must be given the first year, followed by a booster in following years. By giving the vaccinations during late pregnancy, protection is passed on to the lamb

through the colostrum. This protection normally lasts until 6 to 12 weeks of age. At this time, lambs should be vaccinated twice, at 6-week intervals, with the type C and D bacterin/toxoid.

If an outbreak occurs, the following steps, taken alone or in combination as needed, may help control it:

- Inject all animals with enterotoxemia antiserum (an expensive option).
- Add antibiotics to the feed.
- Change pasture or put sheep in drylot.
- Reduce bunk space to increase competition for feed.
- Sort sheep or lambs by size so larger lambs can't crowd out smaller lambs.
- Castrate and dock tails if possible (to throw lambs off feed).

EPIDIDYMITIS

Strictly speaking, epididymitis consists of inflammation of the epididymis, the small tubes that carry sperm from the testicles. The term *epididymitis*, however, is now commonly used to refer to any lesion in the epididymis or testicle. The disease can be caused by many types of bacteria, including *Brucella ovis*, *Actinobacillus* spp., and *Corynebacterium* spp. In true epididymitis, the tissues lining the epididymis are damaged, and sperm leak into the surrounding tissues. The body reacts to the escaped sperm by building up scar tissue, which can be felt as hard lumps along the epididymis. This type of lesion is most common with *Brucella ovis*. The other types of bacteria can cause orchitis, or swelling of the testicle, and they can also cause sores or abscesses in the epididymis or testicle. It is often impossible to distinguish the various types of lesions by feeling (palpating) them. *Brucella ovis* epididymitis will be discussed separately from the other types because it is the only form that is contagious among animals. The other types occur as isolated cases.

Brucella ovis epididymitis may make the ram partially or completely infertile (unable to impregnate ewes). The disease is transmitted when a clean ram breeds a ewe that has recently been bred by an infected ram or by sexual activity between rams. Although a ewe can eliminate the bacteria from her reproductive tract, the developing embryo may be

affected. The disease can result in an extended lambing season or a higher-than-normal percentage of dry ewes, abortions, or weak lambs.

The disease can be eliminated from the flock with a testing and quarantine/culling program. A vaccine is available, but its use interferes with the blood testing necessary for elimination of the disease. Depending on the size of the ram flock and the number of animals infected, several strategies can be used. Consult your veterinarian for the strategy most suited to your conditions.

In most control programs, all rams are blood-tested, and any rams that test positive are culled. An ideal time to start testing is 6 to 8 weeks after breeding season, when rams are most likely to have transmitted the disease to one another. This testing is repeated at 6-week intervals until all rams test negative. Any new ram introduced into the flock should also be blood-tested. Rams are then routinely checked by feeling the scrotum before and after the breeding season. Any ram in which lesions of the epididymis or testicles can be felt should be blood-tested. If the test is positive for *Brucella ovis*, the entire ram flock should be blood-tested until the organism is eradicated again. Regardless of the method used, all rams should be checked by feeling the scrotum several months before and after the breeding season. Any rams with lesions should be culled.

Other types of epididymitis and orchitis can also mimic the lesions caused by *Brucella ovis*. No effective prevention is available for controlling these diseases; testing and culling are the only options.

FOOT ROT

The bacterium *Dichelobacter nodosus* causes foot rot in sheep. These bacteria live in the wall of the hoof and sole, dissolving the tissues into a foul-smelling gray liquid. Infected sheep become lame and production (weight gain) is reduced. The disease is highly contagious among animals through the soil. Anything that injures the foot (gravel, wet conditions) promotes spread of the disease. Since the bacteria remain alive in the soil for no longer than 2 weeks, this disease can and should be eradicated from a flock, but the process requires careful attention. A vaccine is available to assist in control and eradica-

tion. For more details on control, see your veterinarian and the *Sheepman's Production Handbook* (listed in the bibliography).

MASTITIS (INFLAMMATION OF THE UDDER)

Mastitis usually occurs at lambing or within a few days afterwards. *Pasteurella* and *Staphylococcus* bacteria are the most common causes. Mastitis often kills ewes, and it should be treated immediately. The affected half of the udder is often destroyed, in which case the animal should be culled. Mastitis occurs more often with barn lambing than with range lambing; increased sanitation in the barn can help control it. Early detection (including checking the udder at lambing) and watching for swollen or hard udders or for ewes that do not permit nursing is important if treatment is to be successful.

NAVEL ILL (JOINT ILL)

The wide variety of bacteria that cause navel ill enter the lamb's body through the umbilical cord after birth. Once the bacteria enter, they can multiply and cause a generalized illness, or they may become isolated and form local abscesses or sores. The most common sites for abscesses are the liver and the leg joints. Animals with an affected joint are lame and have a hot, swollen, painful joint. This type of infection is difficult to treat, and the lamb usually is crippled for life. To prevent navel ill, dip the navel stump in 7 percent tincture of iodine immediately after birth to dry out the navel cord and kill any bacteria present (see "Care of Ewes and Lambs in the Jug" in the chapter "Lambing"). Dip the cord again in the iodine several hours later. Permit lambing only in a clean environment; if lambing is done in a barn, the lambing jugs should be cleaned and disinfected between births.

PNEUMONIA

The term *pneumonia* is generally used to refer to any infection in the lungs, without identifying the cause(s). Pneumonia in sheep can occur at any age, but it is most commonly seen in very young lambs and at weaning. Generally, a viral infection, combined with stress, causes the initial damage. Bacteria invade secondarily and produce the signs we recognize as pneumonia. An affected sheep

becomes listless, has a high fever, and may have labored breathing and a nasal discharge. Prevention in the lambing barn calls for adequate ventilation and prevention of drafts. Reducing stress also helps prevent pneumonia.

PREGNANCY TOXEMIA (PREGNANCY DISEASE, TWIN LAMB DISEASE, LAMBING PARALYSIS, KETOSIS)

A disturbance of the ewe's metabolism rather than an infectious disease, pregnancy toxemia occurs when the pregnant ewe does not take in enough carbohydrates or energy to meet her requirements and those of her fetus. Signs of disease are related to the degree of blood sugar deficiency. Affected ewes may lag behind the rest of the animals, appear to be blind, stand with their heads down, refuse to eat, and eventually lie down, unable to rise ("go down"). Ewes may die within 1 week of onset of the disease. Pregnancy toxemia occurs in the last few weeks before delivery and is more common in ewes carrying multiple lambs.

Prevention is important because treatment is generally ineffective (both lamb and ewe often die). Prevention involves maintaining ewes in good condition (avoiding excess body weight); avoiding interruptions in feeding due to environmental or management causes; and feeding diets with adequate energy sources, especially in the last 6 weeks of pregnancy. It is a good idea to give supplementary feed to pregnant ewes during the weeks before lambing. One treatment for pregnancy toxemia is to induce labor with drugs so that the ewe delivers the lamb; another is to deliver the lamb by cesarean section. Either treatment is very risky and should be performed by a veterinarian.

SCOURS

The term *scours* refers to diarrhea (loose stool) without specifying the cause. Lambs being raised on feed other than their mother's milk (artificial milk) that is low in fat and high in fiber can cause scours. Most artificial lamb replacer milk products are adequate in fat and low in fiber, but cow's milk or artificial calf milk replacers fed to lambs can cause scours. Most cases of scours in lambs nursing their mothers is caused by bacterial or viral infections. Scours can also occur as lambs start to eat solid feed such as grain, hay, or

pasture. Diets high in grain can cause scours. Lambs eating pasture that is very lush or high in moisture can have loose stools for several days.

Scours causes the lining of the intestine to become irritated, and fluid is lost into the intestine instead of being absorbed from the intestine into the body. Sheep, especially lambs, with scours usually die from dehydration (loss of body fluids) rather than from other effects of the bacteria or virus. Giving fluids immediately is essential in treating scours. Because there is no vaccine available to prevent scours, sanitation is very important. As soon as a sheep develops diarrhea, separate it from the flock and treat it immediately with electrolytes and an oral antibiotic. In a lambing barn, lambing pens must be cleaned and disinfected between births.

The first milk from the ewe (colostrum) contains antibodies that help protect the lamb from scours and pneumonia. Lambs should receive a minimum of 4 ounces (118 ml) of colostrum right after birth; colostrum should be force-fed using a stomach tube in lambs that won't nurse (see "Care of Ewe and Lamb after Birth" in the chapter "Lambing"). Shearing or tagging the ewe's rump and area around the udder helps prevent the newborn from trying to nurse on tags of wool soiled with fecal material and ingesting organisms that may cause scours.

SOREMOUTH (CONTAGIOUS ECTHYMA)

Soremouth is caused by a virus that causes localized blisters and scabs on the skin; in sheep it is found most commonly on the lips and nostrils of lambs and on the teats of ewes. The virus can survive for years in the environment and enters the skin through scratches and abrasions.

Lambs generally do not die from soremouth; however, they eat less until the dis-

ease runs its course, usually 3 to 4 weeks. When it spreads to the ewe's udder, more serious complications such as mastitis may occur.

Once soremouth becomes established in the flock, vaccination of replacement adults and lambs is necessary on a yearly basis. Lambs that are 1 to 2 months old should be vaccinated at marking time. The live virus present in the vaccine is applied to scratched skin at a "harmless" site (inside the ear, inside the thigh, or on the tail folds). A local infection occurs, with formation of a sore and then a scab. At the same time, immunity against later infection develops. Both the vaccine and naturally caused soremouth can produce a painful lesion in people that resembles a boil. Care must be taken and disposable gloves should be used when handling the vaccine and infected animals.

TETANUS (LOCKJAW)

The bacterium *Colstridium tetani* causes tetanus in sheep and many other animals. The bacteria form resistant spores that survive in the environment for long periods. The spores multiply when they get into deep wounds where there are anaerobic conditions (a lack of oxygen). As they multiply, they produce a strong toxin that affects the nerves. Affected animals become progressively stiff until they are completely rigid, with legs extended. Tetanus is most commonly seen in lambs a few weeks after tail docking and castration. Use of elastrator bands is occasionally associated with an increase in the occurrence of tetanus because of the anaerobic conditions produced under the bands.

Prevention of tetanus includes docking and castrating in temporary corrals (not using the same area year after year); keeping equipment clean and storing it in a disinfectant; and injecting lambs with 200 to 250 units of tetanus antitoxin at the time of docking and castration, if tetanus has been a problem in

the past. The antitoxin protects the animal for the 3 weeks it takes the wounds to heal.

An alternative to this is vaccinating ewes with tetanus toxoid several weeks before lambing. The immunity that develops passes to the lamb in the colostrum and protects the lamb during docking and castration. The vaccination schedule for this alternative is similar to the one given for enterotoxemia (see "Enterotoxemia," above).

WHITE MUSCLE DISEASE

An inadequate intake of the trace mineral selenium causes this condition. Many areas in California are known to be selenium-deficient. If there is any question about whether your flock has enough selenium, take blood samples and have them analyzed for selenium levels. Signs of white muscle disease include depressed weight gain, stiffness in walking, and sudden death. Supplemental selenium can be provided by injection or added to feed or salt mixes. Selenium injections are usually given to newborn lambs or to ewes at the time of breeding. Because too much selenium is toxic to animals, there are federal regulations governing the amount to be used in salt and feed mixes. If you have a question about selenium in your area, contact your local UC Cooperative Extension farm advisor.

PARASITES

Numerous parasites attack sheep, spending all or part of their lives in or on the host animal. Serious damage from parasites causes poor growth and development, weakness in lambs, and increased susceptibility to diseases in older sheep. Severe injury and even death can occur. The seriousness of the damage is mainly related to the type and number of parasites present and the length of time over which they are acquired.

Symptoms associated with internal parasites are weakness, thinness, loss of appetite, jaundice (yellowing), anemia (low red blood cell count), periodic diarrhea and constipation, chronic cough, lameness, and swelling of the jaw and abdomen in extreme cases. External parasites may cause some of the same symptoms as internal parasites, plus loss of wool, excessive nasal discharge, central nervous system disorders, and constant rubbing and biting of affected body areas.

Since parasite infestation is usually a flock-wide problem and not limited to a single animal, sheep owners should practice good management and sanitation to prevent parasites in or on their animals. Get veterinary assistance in diagnosing and treating parasites before problems become serious.

With the advent of dewormer that also kills ticks, keds, and sucking lice, control of external parasites has become simpler. Always

check the label to see which parasites are controlled, follow application instructions, and observe withdrawal periods.

EXTERNAL PARASITES

Sheep are often attacked by ticks, keds, lice, and flies. The damage from these attacks can include slow growth, anemia, stress, and increased susceptibility to infection by disease-causing organisms. The key to controlling external parasites is good management: sanitation, inspection, and use of drugs or pesticides. The list of materials approved for controlling external parasites changes frequently and also varies from state to state. Check with your local veterinarian or animal health suppliers for current recommendations.

TICKS

The spinose ear tick (*Otobius megnini*) attacks all domestic livestock as well as coyotes, deer, rabbits, cats, and dogs. This tick is found only in the ears of animals and is more commonly found in sheep raised in warm, dry regions of the state. Tick larvae (seed ticks) and nymphs (pre-adults) feed on blood in the deeper folds of the ear, causing irritation, head rubbing, and droopy ears. Nymphal ticks drop out of the sheep's ears and crawl into hiding places on wooden corral posts, feed troughs, sides of barns, and under the bark of trees, where they change into adults, mate, and begin to lay eggs (fig. 17). Larvae hatched from eggs crawl onto sheep that feed or bed near tick hiding places.

Ticks are difficult to control. Infested sheep must be treated with dust or liquid insecticide applied directly into both ears. A rubber-tipped oil can is best for applying liquids into the ear. Other animals on the property should be inspected, including pets, and all infested animals should be treated. Repeated ear treatment is necessary to eliminate ticks. Replacement stock should be thoroughly examined for ticks before entry into the flock.

KEDS

Although the sheep ked (*Melophagus ovinus*) is commonly called a tick because of its flat,

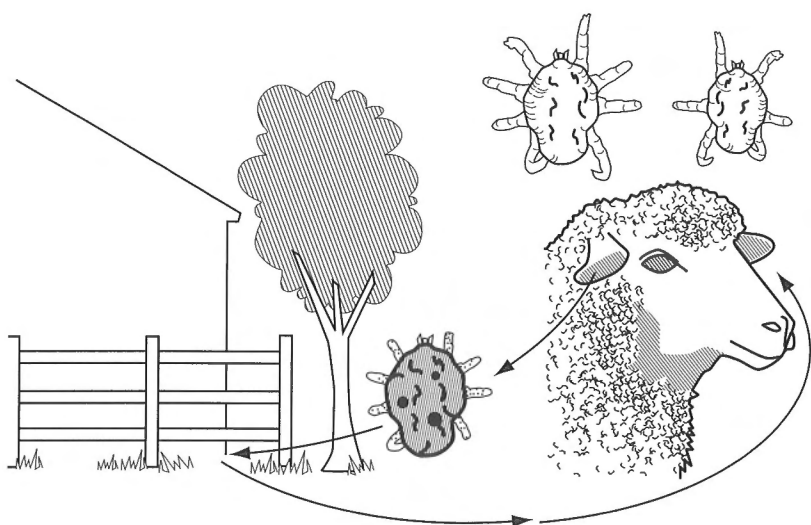


Figure 17. Life cycle of the spinose ear tick.

crablike appearance in sheep fleece, it is actually a wingless fly (fig. 18). Keds do not lay eggs, but give birth to living young maggots (larvae) that fasten to the wool with a gluey substance. Within a few hours, the maggots form brown puparia (larval casings) from which adult keds emerge in 2 to 4 weeks, depending on summer or winter temperatures. Keds always stay on sheep, and breeding is continuous all year. They are more common on sheep in mountain and foothill regions or in coastal areas subject to moist,



Figure 18. Sheep ked and pupa.



Figure 19. Use your hands to part the wool to look for sheep keds.

cool weather. Infestations usually occur from fall through spring and may cause considerable irritation and blood loss. Animals left untreated become nervous and vigorously rub, scratch, and bite their wool. Lambs suffer more than mature sheep and may fail to gain weight from loss of appetite and anemia. Examine affected sheep for keds by parting the wool, particularly on the shoulders, sides, thighs, and abdomen (see fig. 19).

Keds are easily controlled by dipping or spraying sheep. Replacement ewe lambs, particularly if purchased from cold or northern regions, should be routinely treated for keds and lice before placing them in contact with the ranch flock. Spring shearing eliminates most, if not all, keds. Wool should be gathered and stored in an area apart from the sheep. Keds normally die in 4 days when separated from the host animal.

LICE

Sheep are infested by two types of lice: blood-sucking (*Anoplura* spp.) and chewing (*Mallophaga* spp.). Like sheep keds, lice are a common cold-weather parasite and are more prevalent in mountainous and coastal regions. Both types of lice have similar life cycles, and they develop at the same time of year (fig. 20). Eggs (nits) are glued to the wool; after hatching, adults usually appear in 4 weeks. Lice are wingless and are transferred by contact between animals, which occurs more often when sheep are penned and crowded together. Certain mature sheep can be particularly susceptible to lice infestations. These animals (carriers) should be carefully inspected and treated before introducing them into flocks.

Lice can occur on all body regions, but on sheep some lice prefer the area of the dew claws on the legs, while other species infest the body, clustering in large numbers, which can usually be identified by matted wool on the back and flanks. Infested sheep become extremely nervous and constantly scratch, rub, and bite to relieve the irritation caused by the chewing lice. Bloodsucking lice may cause severe anemia if sheep go untreated; this contributes to stunted growth in young stock and to weight loss in older animals. Insecticides used to control biting lice are the same as those used for keds.

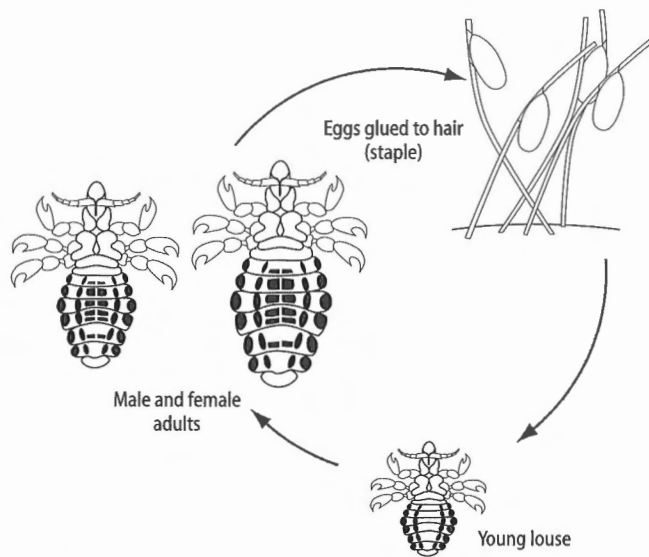


Figure 20. Life cycle of a bloodsucking louse in sheep.

BLOWFLIES AND WOOL MAGGOTS

There are many different types of blowflies, and all of them have similar life cycles and adult behavior. Blowflies are more common during early spring and fall, when adults may be seen resting outside on sunny surfaces of buildings and on plants next to barns and corrals. They have a long flight range and may travel several miles. Female blowflies lay eggs (blow) on animal carcasses and decomposed offal, but they may also lay eggs in a wide range of moist, decomposed plant material.

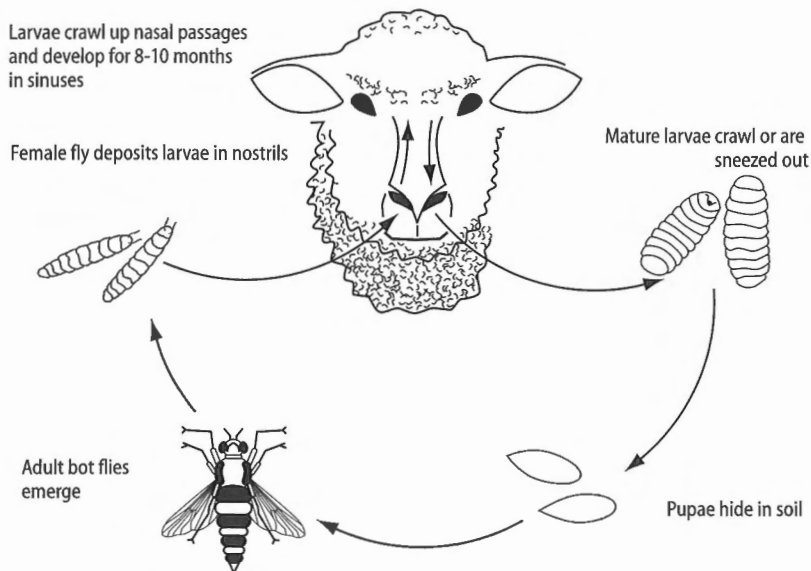


Figure 21. Life cycle of the sheep nose bot fly.

In sheep, the black blowfly (*Phormia regina*) and the secondary screwworm (*Cochliomyia macellaria*) most commonly lay eggs in the dead tissue of wounds (from shearing, castration, docking, etc.). Green and blue blowflies (*Phaenicia* and *Caliphoridae* spp.) lay eggs in similar wounds, but they also may blow stained wool, and their maggots may be found particularly around the rump.

To help reduce blowfly damage, practice good sanitation around sheep pens and chutes where shearing and surgical operations are conducted. Docking should be completed before the arrival of warm spring weather, and all tail wounds should be sprayed or covered with an insecticide to prevent fly strike. Sheep should be collected within 24 hours after shearing and treated with insecticide on a flock-wide basis, or individually for those animals with obvious shearing wounds. Dip or spray procedures are best for flock treatment, whereas single animals can be spot-treated with smear or with aerosol sprays. In hot, arid areas where blowflies may be active before lambing, the udder and vulva of tagged ewes should be routinely inspected for fly strike. Also, operators who use lambing sheds or shelters should replace urine- and manure-soaked bedding on a weekly basis to eliminate fly breeding sources.

NOSE BOTS

Nose or head bots are the larvae (maggots) of a nonbiting fly, *Oestrus ovis*. Adult flies annoy sheep by depositing live maggots in or around their nostrils. Persistent attack by female flies causes sheep to bunch together, hold their heads close to the ground, or seek escape by staying in shaded or brushy areas. Fly attacks are more common in late summer and fall in cold or northern regions, whereas adult fly activity often occurs in spring and fall in hot, arid southern areas.

The maggots crawl up the nasal passages, increasing in size until they come to rest in sinus passages. After a period of time, the maggots retrace their journey down the nasal passages and drop or are sneezed out of the nose. They fall on the ground, where they develop into adults (fig. 21). This cycle may take 1 year in cold or northern regions, but it may take as little as 6 months in warm or southern areas. Infested sheep often hold their heads to one side and may turn in circles, run into each other or into posts, or

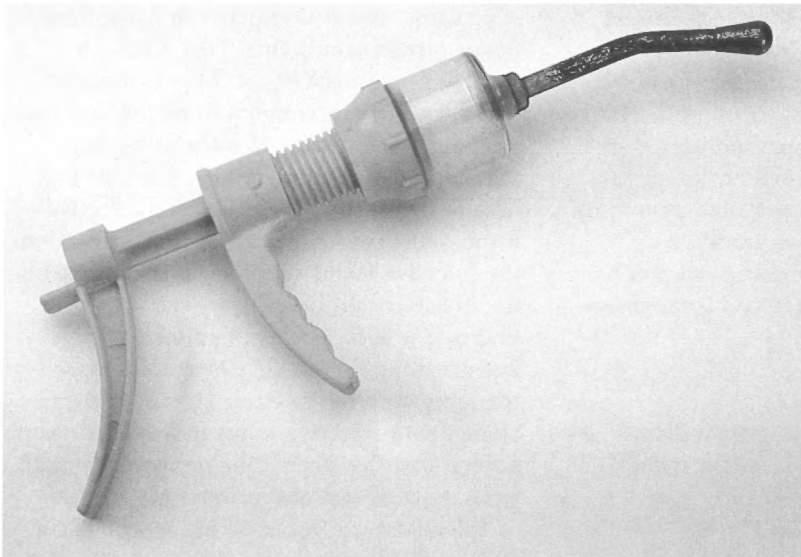


Figure 22. Drench gun.

merely stand with their heads pressed against fence posts. Dense maggot infestations cause excessive pus formation, hence the term “snotty-nose.” Pebbles, burrs, and secondary bacterial infection from irritated sinus passages may produce a similar discharge of pus from the nose.

There is no sure method of preventing nose bot fly attack. Covering sheep’s nostrils with tar-like preparations is an age-old remedy, but it requires almost daily application and is not practical under pasture or rangeland management. Check with your veterinarian or animal health-product suppliers for current control recommendations.

INTERNAL PARASITES

The internal parasites of greatest concern to sheep owners are the coccidia (protozoa) and the helminth worms (helminthes). The helminths are often referred to as roundworms (nematodes), tapeworms (cestodes), or flukes (trematodes). Parasites in the two groups have different life cycles; it is important to learn about the biology of these parasites to understand the recommendations for flock management and the use of antiparasitic drugs.

The list of drugs approved for controlling internal parasites changes frequently. In addition, different dewormers have different spectrums of activity (are effective against only certain internal parasites). Check with your local veterinarian or animal health-product supplier for current recommendations.

FECES COLLECTION FOR LABORATORY ANALYSIS

To detect internal parasites, submit a sample of feces (droppings) to a diagnostic laboratory or local veterinarian to identify the type and the number of parasites present. The following recommendations are given for collection of feces to be examined for worm egg counts in the laboratory.

- Collect only *fresh droppings*. Samples picked up from the ground may be too old and may be contaminated.
- If animals are scouring (have diarrhea), try to collect 1 to 2 ounces (30 to 59 ml) of liquid feces discharged from the anus in a small plastic bag or screw-top jar. Similar containers can be used for solid droppings (no more than 5 or 6 pellets). Tightly tie or cover the containers and label with the owner’s name, date sample was taken, and name or number of animal.
- Store containers in a cool place until delivered to the laboratory. *Do not* store containers in a warm area (pickup truck, shed, etc.) for more than 1 hour, since worm eggs, if present, will hatch and laboratory diagnoses will be inaccurate.
- Collect a representative sample: from 20 sheep in a flock of 100 or from all sheep in a flock of 15 to 20.

If your sheep require treatment for internal parasites, ask your veterinarian to prescribe a drug. Most drugs for this purpose are given as a drench. Drenching should be done by an experienced person, since improper drenching can cause serious mouth and throat damage as well as pneumonia or drowning if fluid is forced into the lungs. A drench gun is necessary to administer the drug. The automatic drench gun (fig. 22) is fast and easy to use for treating many animals. A single-dose gun can be used, but it is slower and not as easy to use. Make sure the single-dose gun has a bulb on the end that goes in the sheep’s mouth. The bulb stimulates the sheep to swallow, reducing the chance of getting drench fluid in the lungs.

Before drenching, make sure there are no rough or sharp edges on the drench nozzle that could damage the sheep’s mouth. Also, make sure that the bulb on the end of the drench nozzle is secure. The bulbs have been known to become loose, and sheep have swallowed them.

When being drenched, the sheep should stand quietly. Place a free hand under the jaw to hold the head. Slide the nozzle of the drench gun into the side of the mouth. This should force open the sheep's mouth. Gently slide the nozzle over the back of the tongue (fig. 23). Slowly deliver the desired amount of drench drug into the sheep's throat. If the fluid is forced too fast, the sheep will not be able to swallow fast enough, and some material may get into the lungs.

COCCIDIOSIS

Coccidiosis is a common intestinal disease of young sheep in farm flocks, feedlots, and

sales yards, and it may occur in range flocks under certain conditions. This disease is caused by protozoa of the *Eimeria* species that are widely distributed in nature and may remain alive for many months on moist, grassy pastures and meadows. Extreme dryness or direct sunlight kills many infective forms (oocysts) of the protozoa. When eaten, the infective forms enter mucous cells lining the intestine and multiply by the thousands in 2 to 3 weeks. New contaminant forms emerge from the tissue cells and are passed in the feces onto the ground. These forms change into infective forms in from 2 days to several months, depending on weather conditions, type of soil, and plant cover (fig. 24).

Infective forms of *Eimeria* cause massive tissue cell damage in the gut. Lambs in particular show a loss in appetite, wool-slipping, and bloody diarrhea 2 to 3 weeks after exposure. Lambs may be immune if they come from areas where coccidiosis exists. Although immune lambs remain healthy, they can be carriers of *Eimeria* and can contaminate a new environment.

Coccidiosis can be controlled with proper management. Reduce infection levels, particularly in range flocks, by building off-ground feed bunkers and water troughs fitted with float valves, and by giving supplemental feed in different areas each day. Because you cannot predict when sheep will be exposed to disease-producing levels of infective *Eimeria*, it is best to disperse the ewes and their lambs quickly after weaning to prevent lambs from becoming infected. Corrals and barns used for holding ewes and lambs at weaning should not be used for other purposes. Lambs should be separated and turned to pastures or rangeland and should be carefully watched for the next 3 to 4 weeks. When buying lambs for finishing in farm flocks, it is best to take delivery at the ranch where they are reared to avoid exposure to coccidia, which inevitably occurs at sale yards. All lambs should be considered highly susceptible upon entry to coccidia-infected environments (pasture, range, farm feedlots).

Anticoccidial drugs placed into supplemental feed during the first 4 weeks of initial exposure are effective against the early reproductive forms of coccidia. Sulfonamides and

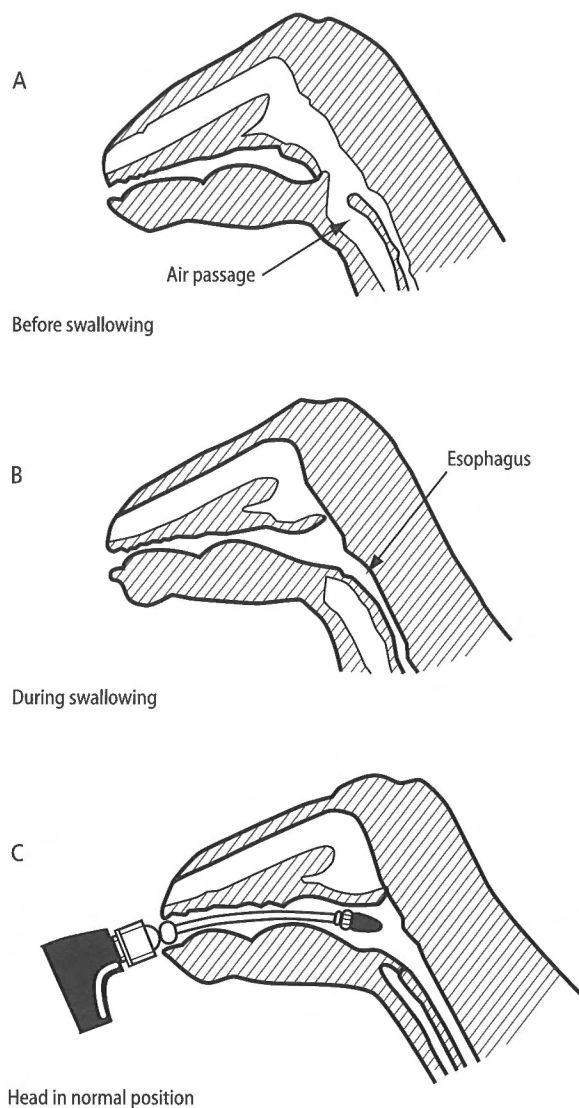


Figure 23. Using a drench gun. (A) Sheep's air passage. (B) Esophagus closing during swallowing. (C) Correct position of the drench gun nozzle in the sheep's mouth.

amprolium are the best drugs for treating disease-producing levels of coccidia in lambs. These chemicals should be given in consultation with a veterinarian.

ROUNDWORMS IN STOMACH AND INTESTINES

The barber pole, or large stomach, worm (*Haemonchus* spp.) sucks blood and may produce severe anemia, killing infested sheep. Other nematodes do not suck blood but live on lymph, cellular debris, and gut contents. The most common of these are the middle stomach worm (*Ostertagia* spp.); black scour worm (*Trichostrongylus* spp.); Cooper's intestinal worm (*Cooperia* spp.); thin-necked worm (*Nematodirus* spp.), which occur in the first 20 feet (6 m) of the small intestine; and the nodular worm of the large intestine (*Oesophagostomum* spp.). Dense worm infestations may cause severe scouring (diarrhea) and death, especially in lambs and weaners.

The life cycle of these helminth worms (fig. 25), unlike that of the coccidia, does not involve an intermediate host (animals that contain only the immature forms of the parasite). Helminths infect sheep when the sheep eat infective larvae (young worms), which crawl on grass in damp situations. Inside the sheep, these larvae enter the mucous cells lining the stomach or gut and become adults. Mating and egg laying continue for several weeks to months if the sheep are left untreated. Thousands of eggs are passed daily in the feces onto pasture, where, after several days, larvae hatch from the eggs and the cycle is repeated.

Helminth worm eggs are resistant to heat, cold, drying, and moisture, and some can persist on pastures for 1 year or longer. In some cases, the infective larvae may be ingested with water that has accumulated from excessive, repeated flood irrigation of pastures and mountain meadows. These larvae are washed from the soil and grass into shallow ponds or potholes where sheep drink. If pastures have proper drainage or are allowed to dry out, or if hay is cut and the stubble is allowed to dry, most, if not all, of the infective larvae will die in 2 to 3 months. Sheep kept under drylot management and dewormed at proper intervals should have fewer problems with these roundworms.

ROUNDWORMS IN LUNGS

The lungworm (*Dictyocaulus* spp.) is found in the airways of the lungs and in the trachea of sheep. Reproduction occurs in these sites, where eggs hatch and larvae are coughed up into the mouth and out onto the ground, or

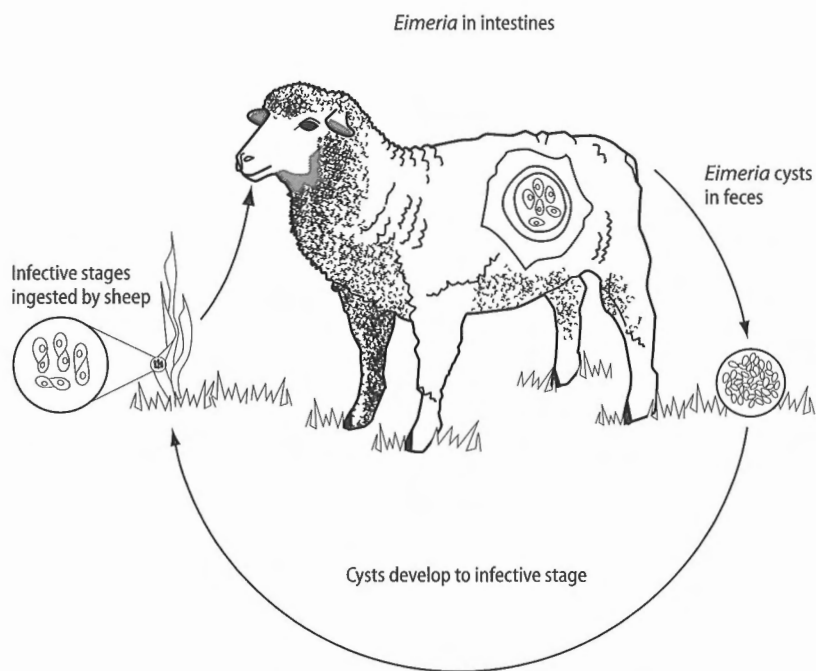


Figure 24. Life cycle of the *Eimeria* spp. internal parasite, which causes coccidiosis in sheep.

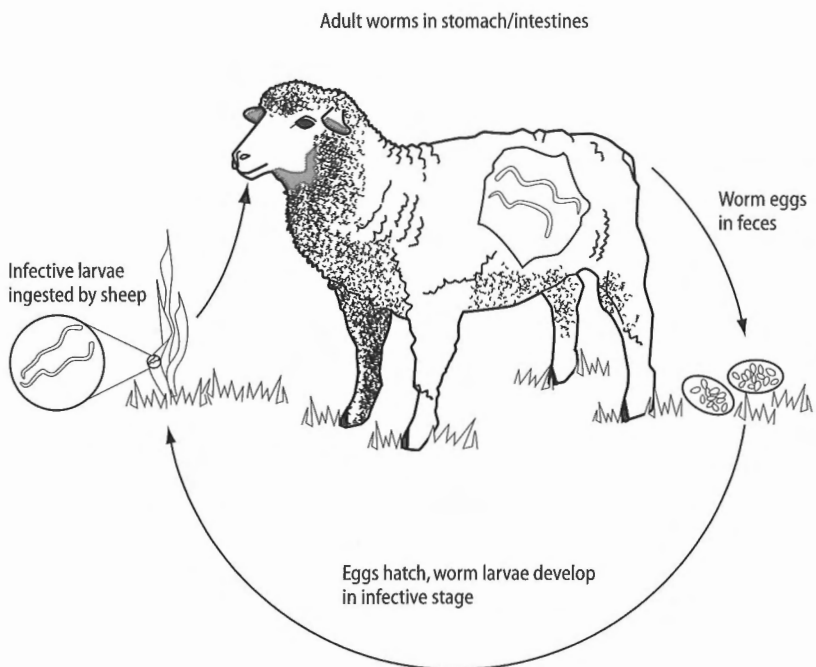


Figure 25. Life cycle of roundworms in sheep.

more commonly, go down the esophagus and pass out with the feces. The cycle on the ground is similar to that of other roundworms (see fig. 25), and sheep are reinfected

treat the symptoms properly. Sheep are more prone to lungworms when they are raised on irrigated pastures or mountain meadows.

LIVER FLUKES

Liver flukes (*Fasciola hepatica*) are very common internal parasites of sheep and cattle. Adult flukes live in the bile ducts of the liver, where they cause the duct tissues to swell and harden. Adults feed on bile contents, and fluke larvae feed on liver cells and on blood during their passage through the liver tissue to reach the bile ducts. In dense fluke infections, the liver does not function properly; animals infested with flukes are more prone to get infectious diseases. Also, young flukes produce conditions in the liver that allow growth of bacteria that are responsible for the highly fatal black disease. Sheep raised in areas known to be infested with liver flukes should be vaccinated annually.

Adult flukes produce eggs that pass from the bile ducts of the liver into the gut and out with the feces. The "ground cycle" of the liver fluke is unique (fig. 26). A tiny form hatches from the egg and swims around in water until it penetrates a certain type of water snail. These forms live inside the snail for almost 2 months, where they reproduce in great numbers. Forms that leave the snails swim in the water briefly before they develop a protective cyst, either on grass or on the surface of the water. These cysts are ingested by the animal when it eats the grass or drinks the water. After ingestion, the small flukes emerge from the cysts in the intestines, bore through the gut wall, and wander around the abdominal cavity until they come to the liver, where they grow to the adult stage.

Control of liver flukes should be aimed at breaking the life cycle in pastures. Water control is the first goal. Irrigated pastures should have proper sloping for complete drainage into ditches that are fenced off from sheep. Large potholes should be filled or fenced off.

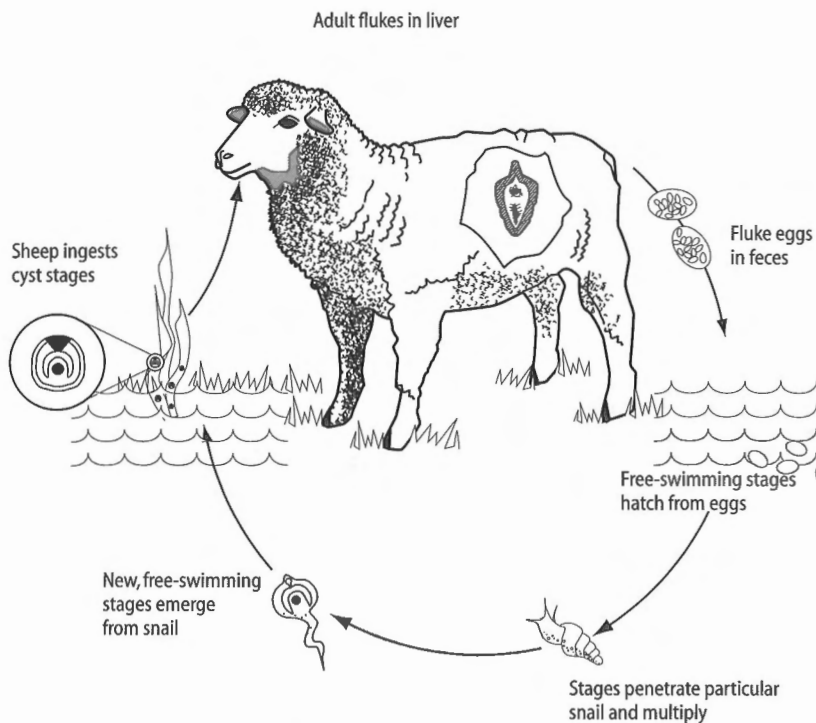


Figure 26. Life cycle of liver flukes in sheep.

by eating grass containing infective worm larvae. Disease-producing levels of infection are most common from winter through early summer, but in some areas of California infection can occur year-round. Once inside sheep, the infective larvae burrow through the gut wall and pass through various organs by way of the lymphatic and blood system. The larvae change into adult worms upon reaching the lungs. Parasitized sheep cough and may have labored breathing; younger animals may gain less weight. Disease caused by lungworms must be distinguished from other diseases such as pneumonia in order to

If it is impossible to control the water, arrange for it to collect in deep, plant-free ponds from which the sheep are prevented from drinking.

There are currently no chemicals approved for control of snails on pastures. Antiparasitic drugs (dewormers and anthelmintics) are used against flukes primarily to reduce deaths due to chronic disease. Treatment in late spring should be repeated in October or November.

TAPEWORMS IN INTESTINES

Tapeworms are cestodes, or flatworms, with long, segmented, ribbonlike bodies. Two common types in sheep are the broad tapeworm (*Moniezia* spp.) in the small intestine and the fringed tapeworm (*Thysanosoma* spp.) in the small intestine and in the bile duct leading from the liver to the gut. Like liver flukes, tapeworms use an intermediate host to complete their development (fig. 27).

Segments measuring from $\frac{1}{2}$ to $\frac{3}{4}$ inch (1.3 to 1.9 cm) long break off the body of the tapeworm in the gut and pass out with the feces onto the ground. These segments break open and release hundreds of eggs, which are ingested by mites that live in pasture grasses. Sheep are infected when they feed on the grass and ingest the mites. The closer to the ground the sheep feed, the greater the opportunity to also take in the mites containing infective forms of the tapeworm. Immature tapeworms are released from the mite in the intestines and quickly attach to the gut wall, where they develop into adult worms. Tapeworms do not usually cause noticeable symptoms of disease, but can, in large numbers, cause blockage of the gut or bile duct, especially in young lambs. Sheep over 1 year old can acquire a form of immunity.

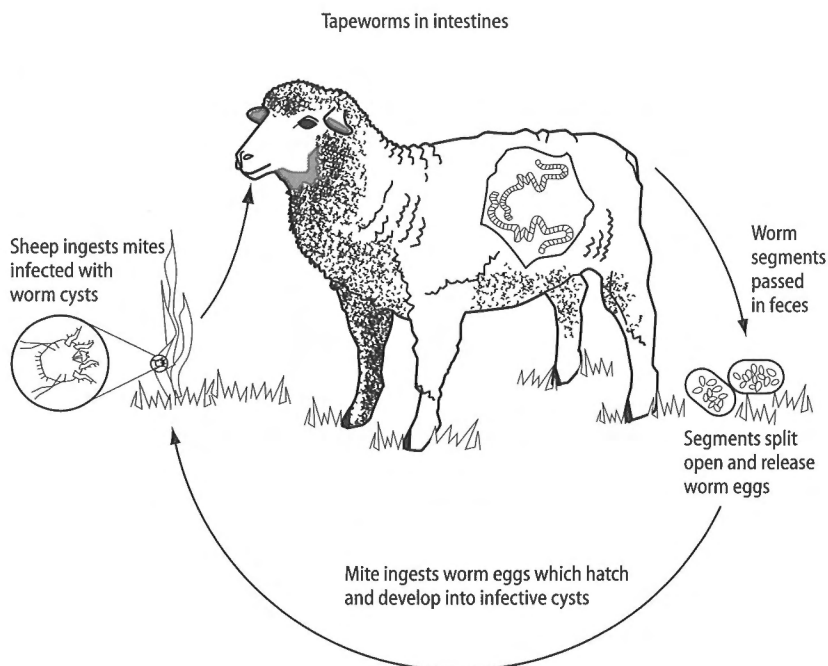


Figure 27. Life cycle of tapeworms in sheep.

WOOL

The income from the sale of wool can vary considerably, depending on the quality and quantity of wool produced per sheep. Many factors are involved in determining the value of wool. Generally, the value of wool increases as the fiber diameter decreases. Staple length (the length of wool fibers) and strength also play a role in determining the value of wool.

For most owners of small flocks, the percentage of their total income that comes from the sale of wool is quite small unless they supply wool for the niche market of hand-spinners. Producers who have hand-spinner specialty flocks can earn as much as 40 to 50 percent of their sheep enterprise income from the sale of fleeces. For more information on producing wool for the hand-spinner market, obtain a copy of "Marketing Out of the Mainstream: A Producer's Guide to Direct Marketing of Lamb and Wool" from Sheep Industry Development (SID), 6911 South Yosemite St., Englewood CO 80112-1414.

GRADES

Grading wool is the process of classifying wool according to the diameter of its fiber. There are three systems for grading wool: Blood, or American, grade; Count, or Bradford, grade; and Micron grade (fig. 28).

BLOOD, OR AMERICAN, GRADING SYSTEM

The Blood grading system is the oldest and least descriptive grading system. It originally considered the amount of Merino breeding (or "blood") the animal possessed and the typical grade of wool produced by the animal. Wools are divided into seven categories in the Blood system, ranging from fine to braid. Fine wools would be produced by pure Merinos, whereas half-blood wool would be produced by a crossbred animal with half of its genetic makeup coming from Merino. Animals producing common or braid wool would have no Merino breeding in their background. Today the Blood system is seldom used since it describes only the relative fineness of the fiber.

COUNT, OR BRADFORD, GRADING SYSTEM

The Count grading system describes the fineness of the fiber more accurately than does the Blood system. The Count system is divided into 14 grades based on the number of hanks of yarn that can be spun from 1 pound (454 g) of clean (scoured) wool that is spun as finely as possible; each hank is 560 yards (512 m) long. A very fine wool that would be graded as 80's would produce 80 hanks from 1 pound of clean wool, or 44,800 yards (40,965 m) of yarn. Coarser wool may produce only 36 hanks of yarn and be graded as 36's. The higher the number of the grade, the finer the fibers and the more valuable the wool. This is a theoretical grading system, since wools are not normally spun to determine the actual number of hanks they would produce. Today very little wool is commercially purchased based on its Count grade.

MICRON GRADING SYSTEM

Micron grading is the most precise way to grade wool. A micron is 0.001 mm (1/25,400 in). There are several methods of determining the average micron count of a wool sample. The two most widely used methods are the optical fiber diameter analyzer (OFDA) and the Laserscan. These two methods have an advantage over other methods since they give the distribution of the fiber as well as the mean fiber diameter in approximately 90 seconds. When selecting stud rams and replacement ewes, knowing their fiber distribution is very important since the quality of wool increases as the uniformity of distribution increases.

The best age to take fleece samples for micron grading is between 16 and 18 months old. Samples from older animals become more difficult to interpret since the ewe flock is in production and some ewes may have raised lambs whereas some ewes may not have, and ewes that did not raise a lamb usually have a higher micron count. A rule of thumb is that a ram's micron count at 18 months of age will be equal to the average micron count of his female progeny. Ram wool gets coarser with age: there is normally a difference of 2 microns between the test results at 18 months and 24 months. For every additional year in

	Delaine Merino													
	Rambouillet													
			Targhee											
			Romeldale											
			Columbia											
					Southdown									
							Shropshire							
							Suffolk							
							Hampshire							
							Horned Dorset							
							Montadale							
							Finnish Landrace							
							Cheviot							
							Corriedale							
									Oxford					
											Romney			
													Border Leicester	
													Lincoln	
													Cotswold	
Count Grades	80's	70's	64's	62's	60's	58's	56's	54's	50's	48's	46's	44's	40's	36's
Micron Grades	17.70 to 19.14	19.15 to 20.59	20.60 to 22.04	22.05 to 23.49	23.50 to 24.94	24.95 to 26.39	26.40 to 27.84	27.85 to 29.29	29.30 to 30.99	31.00 to 32.69	32.70 to 34.39	34.40 to 36.19	36.20 to 38.09	38.10 to 40.20
Blood Grades	Fine		Half Blood		Three-Eighths		Quarter Blood		Low Quarter		Common		Braid	

Figure 28. Three systems used for grading wool. Count grading is based on the number of hanks of wool spun from 1 pound (454 g) of wool. Micron grading is based on measuring the diameter of the wool fibers. Blood grading is based on the amount of Merino blood in the individual sheep.

age, the results increase about 1 micron. Wools from ewes increase only about 1 micron over their lifetime.

WOOL CONTAMINATION

One of the biggest problems with small-flock wool clips (production) is the amount of contamination in the wool. Wool can be contaminated from natural, acquired, or applied sources. Natural contaminations include high levels of wax, suint (perspiration naturally found in wool), and colored fibers. The amount of wax and suint can be reduced by selection during breeding, but the amount they can be reduced is very limited.

Acquired contaminants include vegetable matter (VM), polypropylene, colored fibers from other animals, and stained wool; these contaminants can be eliminated or significantly decreased by improved management.

Often, a small change in management can make a vast difference in the amount of wool contamination.

Applied contamination refers to materials such as paint brands and dewormers that get onto the wool during the course of management activities. Avoid using paint brands if possible; ear tags, chalk, or other tags or marks on the head or neck do not contaminate the wool as much as paint. If paint branding must be used, use only scourable (washable) paint, and brand the sheep after shearing rather than before shearing. Do not apply too much paint. Some dewormers may stain wool; avoid spilling dewormer on sheep during treatment. Also, some topical (applied to the skin) parasite control medications may stain wool or contaminate lanolin. Apply these topical medications after shearing, and follow all label instructions and withdrawal times.

COLORED FIBERS

Colored fibers are the most serious form of natural contamination. A majority of wool mills in the United States and overseas require fewer than 5 colored fibers per ounce of top when making white or pastel fabrics. Presently, the best-prepared U.S. clips seldom have fewer than 10 to 15 colored fibers per ounce. Contamination from colored fibers may be natural (when sheep produce wool of varying color) or acquired (when hair or fur from other animals or wool from other sheep gets into the wool). Lowering the amount of colored fiber in the small-farm flock clip greatly improves the quality of the clip.

Natural contamination from colored fibers can be controlled through culling and shearing floor management:

- Ask shearers to take out spots of colored fibers and remove them from the fleece.
- Remove the belly wool and bale it separately.
- Any animals that have colored fibers (other than animals kept for the sale of naturally colored fleeces for the hand-spinner market) should be culled.

Acquired colored fiber contamination includes hair or fur from other animals such as dogs, goats, cats, and horses, as well as wool from blackface and colored sheep. White wool fiber can be classified as a contaminant in a natural-colored fleece. The following suggestions can help control acquired colored fiber contamination:

- Sheepdogs should not be permitted in the shearing barn.
- Prevent direct contact between sheep and other animals.
- Do not work sheep in areas used by other animals.
- Do not run blackface or colored sheep with white sheep. An Australian study indicated that running 2 black sheep with 100 white sheep increased the black fiber count from 1 to 34 dark fibers per 100 grams (3.5 oz) of wool.

- Shear blackface and colored sheep last. Clean shearing boards thoroughly after shearing colored sheep.
- Never sack or bale blackface or colored wool with white wool.

VEGETABLE MATTER

Wool with excessive vegetable matter (VM), which includes seeds, burrs, straw, bits of grain, etc., must be carbonized before carding. In carbonizing, wool is immersed in a diluted sulfuric acid solution. The acid reduces the VM to a carbon compound that is removed mechanically during carding and combing. Carbonizing wool is expensive and lowers the value of the wool.

Producers should take every possible measure to decrease the amount of VM contamination in wool. Several management practices can help lower VM contamination:

- Avoid throwing hay on the backs of the sheep or pouring grain on their heads and necks during feeding.
- Shear sheep before plants in the pasture go to seed.
- Restrict sheep from grazing areas that contain plants known to cause contamination, especially when fleeces are long. These areas can be successfully grazed just after shearing, when freshly shorn fleeces are not likely to become contaminated.
- In extreme cases, use herbicides to control weeds that cause contamination.
- Vegetation should be cleared from corrals before use.
- Avoid bedding sheep on hay or straw prior to shearing.
- Skirting (removing inferior wool from) fleeces prior to packing lowers the amount of VM and increases the value of the wool.

POLYPROPYLENE

Polypropylene (plastic) contamination is a very serious problem that costs the U.S. sheep industry an estimated 10 million dollars annually. Small pieces of polypropylene can become entangled in the fleece and cannot be removed mechanically or chemically. They must be removed by hand, which is extremely expensive. Most domestic mills will not accept wool contaminated with polypropylene.

Plastic hay baling twine is the primary source of polypropylene contamination; however, food wrappers, garbage bags, and tarps used as ground cover during shearing have been reported as other sources of contamination. When polypropylene twine is used to tie bales of hay, every possible precaution should be taken to dispose of the twine. When a hay baler ties a bale off, two pieces of polypropylene approximately 1 inch (2.5 cm) in length are cut off. These small pieces fall to the ground or remain on the bales and can eventually become polypropylene contamination in wool.

STAINED WOOL

Wool stained by bacterial discoloration (fleece rot), urine, and feces can cause economic losses. Good management practices can decrease the amount of stained wool:

- Select sheep or wool types that adapt to your environment. In high-rainfall environments, select a breed or strain that can withstand moisture to help control fleece rot.
- Avoid penning sheep in corrals for long periods of time.
- Avoid working sheep in muddy corrals. Laying gravel in corral areas decreases the amount of mud staining.
- If ewes are lambing in a barn, provide clean bedding at all times.
- Tag sheep before lambing. By tagging the majority of the stained wool is removed from the rump (see “Tagging” in the chapter “Lambing”).

FEEDING AND WOOL PRODUCTION

In most breeds of sheep the wool follicle produces wool 365 days a year. A sheep's nutrition level greatly affects the quality and quantity of wool produced. In general, when sheep are being fed a high-quality ration, the individual fibers are longer, stronger, and thicker (have a higher micron count and thus a lower value); the opposite is true for sheep fed a ration that does not fully meet their nutritional requirements.

The most serious problem that can result from underfeeding is that the wool fibers produced are so fine that they are easily broken (are “tender”). The price paid for tender wool is discounted because the fibers break during the carding and spinning process, resulting in lower-quality yarn. Animals that have had a fever (body temperature above 104°F, or 40°C) may also produce tender wool. Check a fleece for tenderness before sacking or baling. This can be done by taking a lock of wool the thickness of a pencil, holding it between the thumb and forefinger of each hand, and then flicking it with a middle finger (this is equivalent to applying about 7.5 pounds of pressure). If the lock breaks, the wool is tender and should be marketed as tender wool. The strength of wool is very important to hand-spinners; wool produced for the hand-spinner market should have better-than-average strength.

SHEARING

Before shearing begins, several steps should be taken to assure that the wool clip is kept as clean as possible. Weeds, hay, and other vegetable material should be removed from holding pens. Corrals and holding pens should be sprayed with water to reduce the dust. Shearing floors and catch pens should be thoroughly cleaned. All gates should be checked and any repairs should be done before shearing begins. During shearing, the shearing floor should be swept regularly.

Sheep must be completely dry when shorn. Wet or damp wool should never be sacked or baled. Bacteria on wet or damp wool causes staining, considerably decreasing the value of the clip. Keep sheep calm during shearing. Sheep that have been properly fed and watered do not fight during shearing as much as do sheep that have been held off feed and water. When sheep fight the shearers, it becomes more difficult to remove the fleece in one piece, and second cuts often must be made, decreasing the staple length and value of the wool.

Shearing is generally done by professional shearers, who furnish their own tools. Usually the owner must provide facilities for penning the sheep, as well as a shearing floor and a sacking stand for the wool. Polypropylene string should never be used to tie wool or sew up wool sacks. Polypropylene string causes a very serious contamination problem and makes the wool clips very difficult to sell.

Once the shearer has completed shearing a sheep, the fleece should be picked up and placed on the skirting table; the belly wool should be placed in a sack. The fleece is now

ready for the process of removing undesirable wool (skirting). Undesirable wool may include stained wool, wool that is heavily contaminated with vegetable matter, off-colored wool, and matted wool. Wool that is to be sold to hand-spinners is skirted more carefully than wool sold commercially. Any tender or broken wool should be sacked separately or sacked with the skirtings.

Today, most wool is baled in square sacks without strings or ties. However, most people who own a small flock of sheep cannot afford the equipment to bale wool. An older method of packaging wool is to use a wool sack. Wool sacks should not be made of plastic. They hold from 20 to 40 fleeces, weighing 225 to 300 pounds (102 to 136 kg). Tags, belly, skirting, colored, lamb, ram, and ewe wool should each be sacked separately. Owners of small flocks often sack the bellies and skirting together. Extremely dirty fleeces should also be sacked separately. On each sack, write the age of the clip in months and the type of wool (oil-based paint should never be used to mark sacks). Sacks should be stored in a cool, dry location out of the sun while waiting to be shipped.

SHEARING FACILITIES

Shearing facilities need not be elaborate and should be designed with the size of flock in mind. When designing a shearing facility, consider two important goals: reducing the stress on the sheep during shearing, and keeping the flooring in the catch pens as clean as possible. Slated floors in catch pens

are ideal since they allow urine and feces to pass through and prevent vegetable matter and feces from getting on the shearing floor.

The shearing floor should be of solid wood construction and should be smooth so that fleeces do not become snagged. Each shearer should be allowed a shearing area of 5 feet by 6 feet (1.5 by 1.8 m), and shearers should be stationed at least 5 feet (1.5 m) apart. When shearers are forced to shear in close areas, the danger of the shearer and sheep being injured is increased, and fleeces are more readily broken, which makes them more difficult to skirt. The shearing area should be well ventilated and well lit. Fluorescent lights provide an excellent and economical source of light.

SHEARING TIME

Most sheep are shorn in spring after lambing and when the weather is warm. They are easier to shear in warm weather when the yolk (the natural yellow grease in a fleece) is soft

and serves as a lubricant. In cold weather, the yolk becomes gummy and the shears become coated with yolk and dirt, making it hard to push the shears through the wool.

Ewes can be sheared before lambing, but they must be handled carefully to prevent abortion. Sheep should be protected from the weather for 2 or 3 days after shearing while they adjust to their new environment. Another practice that helps them adjust after early shearing is shearing with a rake comb, which leaves about ¼ inch (6.5 mm) of wool on the sheep, just enough to provide protection from the weather. Rake-comb shearing requires greater skill because the teeth of the comb are wider than in normal combs, increasing the chances of cutting the sheep.

FENCING

Fencing is very important in producing and managing sheep. It serves two basic purposes: to confine sheep to the area(s) in which you wish to have them remain, and to keep out dogs and other predators. In addition, fencing pasture and rangeland can

- eliminate or reduce the need for herders
- increase the grazing capacity of land
- permit rotational and deferred grazing so pasture can be rested
- control straying and trespassing
- permit seasonal control of hazardous areas such as bogs or poisonous plants
- protect new pasture seedlings until they are established

Types of fencing include woven wire, board, electric, or these in combination. Barbed wire is not recommended for sheep because sheep are prone to injury when they come in contact with the barbs, which also tend to pull the fleece. Also, predator control is not as efficient with barbed wire fencing.

Board fences, using 1 by 6 or 2 by 6 lumber laid in a horizontal pattern, are excellent for sheep. The cost of construction can be high, however. Corral and interior fencing should be 36 to 40 inches (91 to 102 cm) tall, and outer or perimeter fencing should be at least 60 inches (1.5 m) tall to keep out dogs and predators. The spacing between boards must be narrow to prevent sheep from getting out; 4-inch (10-cm) spacing between the bottom boards is ideal. The spacing can be increased slightly between successive boards until it is 6 to 8 inches (15 to 20.5 cm) between the top boards.

Lumber used for fences and gates should be treated with an approved wood preservative. Fences built with treated lumber last longer and have lower annual costs. Board fence alone is not good protection against predators; woven wire added to board fence gives excellent protection, but it is costly.

Woven wire field fencing, widely used to contain sheep, makes excellent fencing when properly installed. Ideally, field fencing that is 47 inches (120 cm) tall with 6-inch (15-cm) stays is best. It is tall enough to restrict “jumpers,” and the height and wire spacing

make it more difficult for dogs to enter. Running a strand of electric fencing along the top and bottom of the fence makes it more sheep-tight and predator-proof.

Under certain conditions, llamas and certain breeds of guard dogs can provide effective protection against predators. Their effectiveness depends on the individual animals and how they are managed. Further information can be obtained from the USDA-APHIS-WS National Wildlife Research Center, Logan, UT, and the U.S. Sheep Experimental Station at Dubois, ID.

Electric fencing, widely and successfully used throughout farming areas where livestock are raised, is an effective, safe, and inexpensive means of providing temporary or permanent fencing. The fences must be properly constructed and be energized with an approved controller (commonly called a “fence charger”). In recent years, electric fencing has undergone much development, particularly in New Zealand and the United Kingdom. Its rising popularity is due not only to its cheapness but also to its effectiveness. The high-powered low-impedance energizer, developed in New Zealand, is very effective. In contrast, American-manufactured controllers are high-impedance controllers, which are more apt to short out when weeds or long grass touch the fence. The low-impedance energizer reduces shorting and allows up to 60 miles (97 km) of fence wire to be electrified with little voltage loss. Even when plant growth covers much of the fence, the low-impedance energizer is relatively unaffected. Electric fencing, if properly installed, has also proven to be very effective in controlling predators. Contact your local UC Cooperative Extension office or electric fence equipment suppliers for more information.

MARKETING

Marketing sheep and wool can be a problem for most small producers, since there can be few options for selling sheep or wool. Live sheep can be sold

- by word-of-mouth
- through an auction yard
- by advertising in newspapers and trade magazines
- to commercial sheep slaughtering plants
- to other producers (ewe lambs)
- as club lambs (top-quality lambs for 4-H and FFA)

Wool can be sold to

- home spinners (most want colored wool)
- commercial wool buyers
- local wool buyers (the price is usually quite low)
- the public at fairs (if available)

Home spinners are a specialized market that may require specific types of wool. The breeds of sheep that produce these specialized wools are not always ones that produce the best market lambs. Wool and lamb pools, the Internet, and telephone auctions may improve marketing conditions, but at this time, these options are very limited.

APPENDIX A: Sheep Equipment

Well-designed corrals, barns, and equipment are essential if sheep are to be handled with minimum stress. Give your equipment needs considerable thought and planning before you build your sheep facility.

First, evaluate the space you have. Place your equipment in it efficiently. Locate barns, corrals, and feeders so that they promote efficiency and allow sheep to move through them easily. Sheep do not like blind spots,



Figure A.1. Light panel.



Figure A.2. Eight-rail panel.



Figure A.3. Gated 8-rail panel.

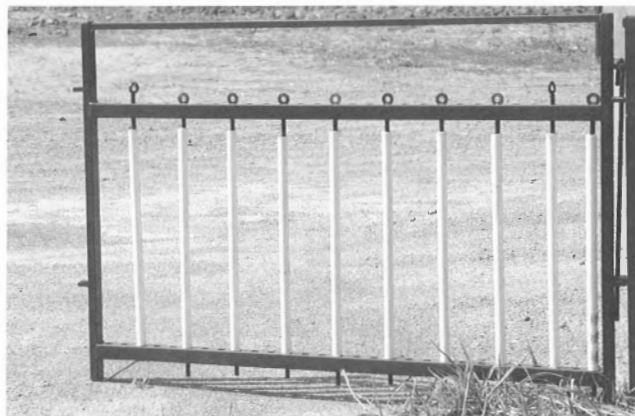


Figure A.4. Creep panel.



Figure A.5. Head gate.

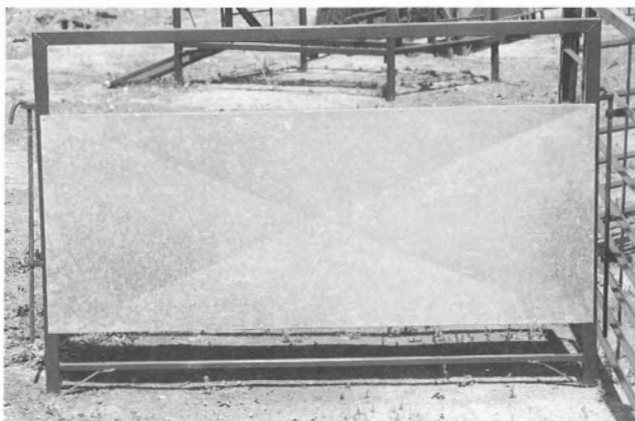


Figure A.6. Solid panel.

sharp corners, or dead ends. Also, locate barns and corrals where they will not be flooded in wet weather.

Next, evaluate the talent, time, and economic resources available. Do you want to buy most or all of the equipment, or do you want to build it yourself? There is a great deal of well-designed and well-constructed com-

mercial sheep equipment available that meets the needs of most sheep producers (see figs. A.1–A.11). If you want to build the equipment yourself, many UC Cooperative Extension offices have access to building plans for most types of equipment. Blueprints can be purchased at a minimal cost.

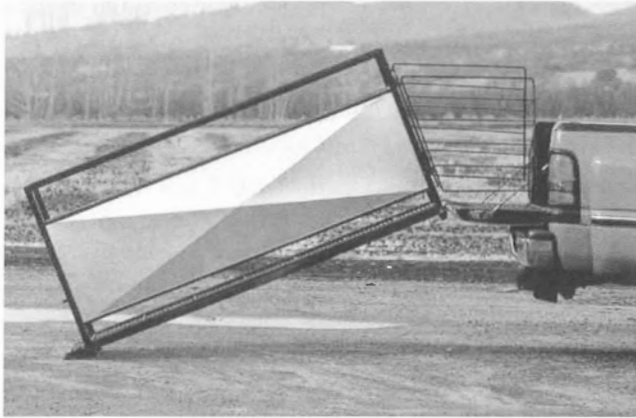


Figure A.7. Solid panel loading.

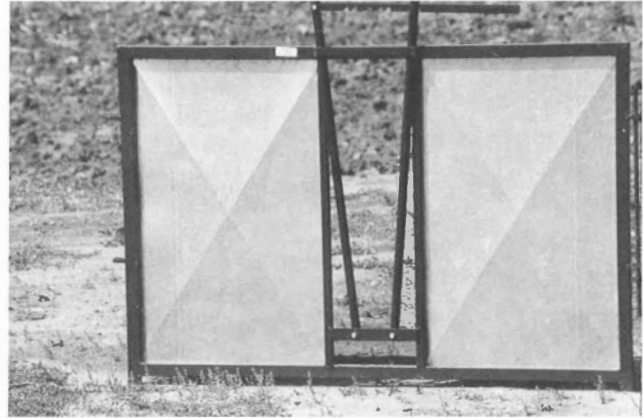


Figure A.8. Grafting panel.

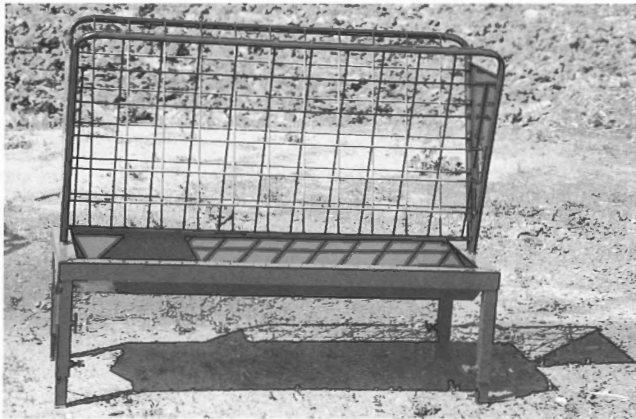


Figure A.9. Free-standing feeder.

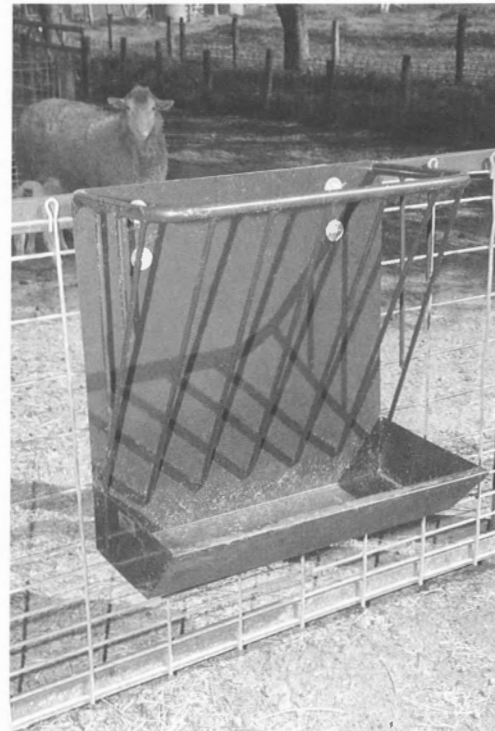


Figure A.11. Hanging feeder.

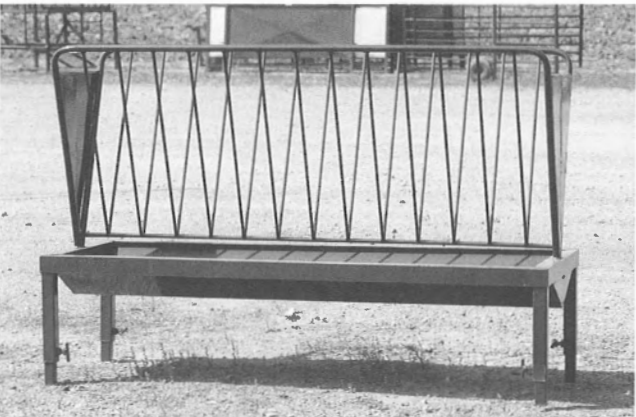


Figure A.10. Hay and grain feeder.

APPENDIX B: General Tips on Feeding, Facilities, and Management for Sheep

GROWING AND FATTENING LAMBS

- For hand-feeding roughage or concentrate, provide a minimum of 8 linear inches (20.5 cm) of feeder space per head.
- For self-feeding grain or concentrates, allow 3 linear inches (7.5 cm) of feeder space per head.
- For feeding a complete ration, allow 4 linear inches (10 cm) of feeder space per head.
- Sheep need clean water—free choice is best. Lambs can drink a minimum of 2 to 3 gallons (7.6 to 11.4 l) of water per head per day, depending on body size and climate.
- Provide watering space as follows: open tank or trough, 1 linear foot (0.3 m) per 20 head; automatic bowl, 1 linear foot (0.3 m) per 30 head.

BREEDING SHEEP

- For hand-feeding roughage or concentrate, provide a minimum of 1 linear foot (0.3 m) of feeder space per head.
- For self-feeding grain or concentrate, allow 6 linear inches (15 cm) of feeder space per ewe. If salt or other feed intake inhibitors are used, less space may be needed. For self-feeding hay or silage, provide a minimum of 6 linear inches (15 cm) of roughage rack space per ewe.
- Provide at least 2 to 3 gallons (7.6 to 11.4 l) of clean water per ewe per day.
- Provide watering space as follows: open tank or trough, 1 linear foot (0.3 m) per 20 head; automatic bowl, 1 bowl per 30 head.
- Provide a minimum of 16 square feet (1.5 sq m) of space for each lamb and ewe during lambing.

GENERAL MANAGEMENT

- Provide economical housing for lambs. Open sheds or windbreaks may be adequate in mild climates. In open sheds, provide at least 6 square feet (0.6 sq m) per head.
- Provide minimum lot space as follows: all dirt, 20 square feet (1.9 sq m) per head; paved, 12 square feet (1.1 sq m) per head.
- Build hard-surfaced lots with a slope of $\frac{1}{4}$ to $\frac{1}{2}$ inch per foot (2.3 to 4.3 cm per m). In dirt lots, provide a slope of 2 inches per foot (16.4 cm per m) or more, depending on soil and weather conditions.
- Provide a minimum paved area of at least 5 feet (1.5 m) around water troughs, feed bunks, roughage racks, and shed entrances.
- Provide artificial shade unless sheep have access to natural shade. Allow 6 to 8 square feet (0.6 sq m) per head. Build shade structures 8 to 10 feet (2.4 to 3 m) tall.

Source: Adapted from Church 1972.

GLOSSARY

- abortion.** Abnormal or early termination of pregnancy.
- anemia.** Deficiency of red blood cells or a low quantity of hemoglobin.
- antibodies.** Circulating protein molecules that help neutralize disease organisms.
- association (with a ram).** Turning a vasectomized ram in with ewes to stimulate estrus.
- autogenous vaccines.** Vaccine made from organisms collected from a specific disease outbreak.
- black disease.** A bacterial disease associated with liver fluke infection that can cause rapid death in sheep.
- black face breeds.** Meat breeds of sheep.
- black fleece.** A fleece containing so many black fibers that white or light-colored cloth cannot be made from it. It is generally of lesser value than white fleece.
- booster vaccination.** A second or multiple vaccination given to increase an animal's resistance to a specific disease.
- breach birth.** A birth in which the hind feet of the newborn are presented first.
- breed.** Animals whose color, body shape, and wool grade are similar to those of the parents; also, the process of mating sheep.
- broken mouth.** A sheep that has lost some of its permanent incisors, usually at 5 or more years of age.
- bummer.** A lamb that is not raised by its mother. Bummer lambs are usually raised on a bottle.
- castration.** Removal of male sheep testicles.
- clip.** Wool from a given flock; also, the total yearly wool production.
- colostrum.** The first milk a ewe gives after birth. High in antibodies, this milk protects the newborn lamb against diseases.
- condition.** Amount of fat and muscle tissue on an animal's body.
- conformation.** The shape of a sheep's body.
- constipation.** A condition in which the contents of the large intestines (bowels) are discharged at long intervals or with difficulty.
- cotted wool.** Fleeces in which the fibers are matted or felted.
- creep.** A feeding area where lambs can feed but ewes are excluded.
- crimp.** The natural waviness of wool fibers.
- crossbreed.** A sheep resulting from the mating of two different breeds; also, to mate sheep of two different breeds.
- crutching.** To remove wool from the inside of a sheep's back legs and belly; tagging. Also, wool removed from sheep during crutching or tagging, which is usually free of manure (as opposed to tags, which contain a lot of manure).
- cull.** To sell or eliminate from a flock.
- dam.** A female parent ewe.
- dental pad.** In sheep, an extension of the gums on the front part of the upper jaw, a substitute for front upper teeth.
- dew claw.** In sheep, a rudimentary toe located on the back of each leg just above the pastern (ankle) joint.
- diarrhea.** Watery, loose feces. *See* scours.
- dock.** To remove most of a sheep's tail; also, the stub end of a sheep's tail.
- drench.** To give liquid medicine by mouth.
- emaciation.** Loss of flesh, resulting in extreme leanness.
- energy.** A nutrient category of feed, usually expressed as TDN (total digestible nutrients).
- enterotoxemia.** Disease-like condition in sheep in which bacteria naturally present in the sheep's digestive system produce high levels of toxin that can kill sheep; also known as overeating disease or pulpy kidney.
- epididymis.** Tubules that carry sperm from the ram's testicles to the seminal vesicles.
- estrus.** Period during which a ewe is receptive (will mate with the ram) and can conceive (become pregnant).
- ewe.** A female sheep.
- finishing.** Feeding an animal to produce a desirable carcass for market.
- fleece.** Wool as it is shorn from the sheep. The fleece should remain in one piece.

- flushing.** Increasing a ewe's level of nutrition before and during the breeding season.
- fly strike.** Egg-laying by green and blue blowflies in wet or stained wool.
- founder.** An inflammation of the sensitive tissue that attaches the hoof to the fleshy portion of the foot, causing severe pain. Founder is usually associated with eating large quantities of grain (carbohydrates).
- gestation.** Pregnancy.
- grafting.** Convincing a ewe to raise a lamb that is not her own.
- granny ewe.** An older ewe or a pregnant ewe close to lambing that tries to claim another ewe's newborn lamb.
- grease wool.** Wool shorn from the sheep before it has been cleaned.
- heritable.** Qualities or traits that can be passed from one generation to the next.
- jaundice.** Yellowishness of the skin, mucous membranes, or secretions.
- jug.** A pen in which a ewe and her lambs are kept for the first 24 hours after birth; also known as a jail.
- kemp.** A chalky, white, brittle, weak fiber that is mixed in with the normal fibers of a fleece. Kemp will not take dye; it reduces the value of a fleece.
- lactation.** Period during which a ewe is producing milk.
- lamb.** Sheep of either sex under 1 year of age; also, the process of delivering a newborn lamb.
- lambing out of the wool.** Shearing ewes before they lamb.
- larvae.** Immature stages of an insect tick, or worm.
- libido.** Sex drive.
- lymphatic system.** Vessels and ducts used for conveying the liquid portion of blood (lymph).
- mastitis.** Inflammation of the udder.
- nymph.** In insects and ticks, an immature stage that is unlike the adult, having incompletely developed sex organs.
- oocyst.** Fertilized cell of a parasite.
- open faced.** Sheep with a large area around the eyes that is free of wool, as opposed to being wool blind.
- orchitis.** Inflammation of the testicle.
- orphan.** A lamb that is not raised by its mother; also known as a bummer.
- overshot jaw.** Bone structure defect in which a sheep's upper jaw is longer than the lower jaw, causing the lower teeth to hit behind the dental pad; also known as parrot mouth.
- ovulation.** Release of an egg from the ovary.
- parturition.** Birth.
- pastern.** The joint between the hoof and the leg.
- pelt.** The skin of a sheep with the wool on.
- pneumonia.** Infection in the lungs.
- polled.** Bred to lack horns.
- pregnancy toxemia.** A disturbance of the ewe's metabolism in which the pregnant ewe does not take in enough carbohydrates or energy to meet her requirements and those of her fetus; also known as pregnancy disease, twin lamb disease, lambing paralysis, or ketosis.
- protein.** A nutrient category of feed that is used for growth, milk production, and repair of body tissue.
- puberty.** Sexual maturity.
- pulpy kidney.** *See enterotoxemia.*
- puparia.** Resting (nonfeeding) stages of insects.
- purebred animal.** An animal of a recognized breed whose bloodline contains only that breed for many generations. A purebred animal may or may not be registered, but all registered animals are purebred.
- quarantine.** To isolate or separate a sheep from other sheep.
- ram.** Male sheep of any age that has not been castrated; also known as a buck.
- ration.** Total feed given an animal during a 24-hour period.
- rectal prolapse.** A portion of the rectum that protrudes past the anus.
- registered animal.** A purebred animal that has a registration certificate and number issued by the breed association.
- scoured wool.** Wool that has been cleaned or scoured.
- scours.** Diarrhea in sheep, caused by viruses, bacteria, or improper nutrition.
- seasonal breeders.** Ewes that come into estrus during part of the year; the estrus season depends on breed and climate.
- smooth mouth.** A sheep that has lost all of its permanent incisors, usually 7 or more years of age.

- staple.** Wool fiber; also, the length of wool fibers.
- suint.** Water-soluble perspiration naturally found in a fleece.
- tagging.** Removing soiled wool from the inside of a sheep's back legs and belly; crutching.
- tags.** Heavy, manure-covered locks of wool.
- teaser ram.** A vasectomized ram used to bring ewes into estrus.
- tender wool.** Wool that has a weak or tender area in it. The tender area is called a break. Tenderness reduces wool value.
- trachea.** Windpipe, leading from the throat to lungs.
- undershot jaw.** Bone structure defect in which a sheep's upper jaw is shorter than the lower jaw, causing the lower teeth to extend beyond the dental pad on the upper jaw.
- vascular.** Pertaining to or provided with vessels such as veins and arteries.
- vasectomized ram.** A ram that has had the spermatic cords cut and cannot ejaculate sperm cells; these rams cannot impregnate ewes but have sex drive.
- virulence.** An organism's ability to produce disease.
- wether.** A male sheep that has been castrated before it develops secondary sex characteristics.
- white face breeds.** Wool breeds of sheep.
- wool blind.** Sheep with wool growing too close to the eyes; opposite of open face.
- wool tie.** A string or twine made of paper used for tying fleeces.
- yearling.** A sheep of either sex that is approximately 1 to 2 years of age; a sheep that has cut its first set of incisors.
- yolk.** The naturally occurring yellow grease in a fleece that keeps the wool in good condition.

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