Proceedings . . .

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CONTENTS

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HEALTH AND DISEASE

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Preventive Health Management

With rare exception, the epidemiological aspects of diseases affecting sheep are directly influenced by the management system that man selects, either by accident or design. "Management system," as used here, includes all management practices to which sheep are subjected, including environment, nutrition, health care (preventive and therapeutic), handling techniques, etc. Because management practices are often directly correlated with disease incidence and control, a basic understanding of this relationship is critical to successful sheep raising. As we progress in the evolution of animal science technology, the management systems under which sheep are reared continue to change. Such change usually involves greater concentration of animals per unit of area. Consequently, we may expect diseases to manifest themselves differently, in some cases, than has previously been observed. By changing and intensifying management systems we establish a different environment under which disease may flourish and which may necessitate a modified or intensifed, approach to flock health. In effect, more awareness of the need to change preventive health regimen may be necessary if morbidity and mortality are to be minimized.

For many years disease control has been viewed in the context of treatment of the sick animal. True, vaccines have been utilized to some extent, but generally to prevent potential catastrophies for which no effective treatment was available, such as blackleg or enterotoxemia. Furthermore, disease loss has been tallied traditionally in numbers of dead sheep. But what about the lambs that recovered from clinical coccidiosis that never did grow out, the "poor doers." Or what about the lambs that had subclinical parasitism, never showed actual signs of illness, but that did "poorly" on feed. These examples of loss are also very real to the producer, although subtle, and not nearly so dramatic as an epizootic that kills dozens, or even hundreds, of sheep. Nevertheless, if we are to achieve maximum levels of reproductive efficiency in our flocks, and obtain the highest rate and efficiency of gains in our lambs, we must recognize the significance of preventive flock health management and utilize currently available knowledge and technology to minimize disease loss. Depending upon the type and size of operation, the degree to which we are able to intensify management will vary. Intensified management, then, is one mechanism by which we can increase lamb survival and weaning percentages. The poultry, swine, and dairy industries are prime examples of this concept. Ultimately, it is likely that "intensified agriculture" will feed the world.

Whenever animals, or people, are concentrated, the opportunity for disease transmission is increased. Since infectious disease is most often transmitted by either direct or indirect contact with infected animals, it becomes apparent that the extent of "togetherness" will inevitably have a direct effect on disease occurrence. The latter is a generally predictable relationship and should guide the producer or veterinarian in planning a preventive health program. The concept of preventive health planning is not new to human medicine, as evidenced by public health programs in most cities for many years. The principles of preventive health programming are equally applicable to human or animal populations:

I. Prevent exposure of animals to disease-producing organisms and situations through the:

(1) Practice of good sanitation.
(2) Isolation of newly acquired animals.
(3) Maintenance of a healthy environment.
(4) Eradication of disease.

II. Maintenance of a high level of resistance in the animal population by:

(1) Providing adequate nutrition -- feed, water, minerals and vitamins.
(2) Utilizing available vaccines.
(3) Selection of apparently healthy, disease resistant animals.

III. Prevent disease spread by:

(1) Isolation or "quarantine" of sick animals.
(2) Establishing an early, accurate diagnosis upon which a control plan can be based.
(3) Close observation of the flock.
(4) Application of effective treatment of sick sheep.

Unfortunately, there are no specific preventive flock health programs that can be recommended for universal adoption by all sheep producers. Due to extreme variation in disease prevalence between farms, preventive flock health programs must necessarily be developed for each individual operation, dependent on the management system employed, and the occurrence of disease problems that must be addressed on a particular farm. For this reason, it is of paramount importance that veterinarians and sheep producers understand the epidemiologic aspects of specific diseases in specific management situations. A textbook solution will be applicable, in many cases, to a majority of disease problems. On the other hand, the basic cause of disease loss is often obscure and will require expert observation and interpretation before solutions are realized.

It has been said that the most valuable sheep in your flock is the first one to die. This philosophical hypothesis is predicated on the assumption that an early diagnosis could be used to implement preventive flock health measures (such as vaccination) to stop a developing major disease outbreak. In practice, the hypothesis has proven to be quite valid and of extreme importance if we are to minimize loss from disease. Mortality data are an invaluable tool that can be used to assess all phases of a management program for adequacy in the control of disease. Inadequate management, at any given point, will result in morbidity or mortality. Characteristically, mortality caused by disease (infectious and non-infectious) in sheep operations is highest in lambs from birth to 30 days of age. For example, we frequently observe "dead pits" burdened with carcasses of lambs that died during the lambing season. For whatever reason, sheepmen have been relatively disinterested in the cause of such losses, when routine necropsy of neonatal deaths would probably have identified a management weakness responsible for the losses. In the author's experience, routine surveillance of dead sheep can be the key to correcting or modifying a management system to prevent disease loss.

The diagnosis is often possible by observation of diagnostic lesions on necropsy. Sometimes, however, such lesions are not evident, and laboratory procedures (such as bacterial or viral isolations) are required. Highly sophisticated veterinary diagnostic laboratories are available throughout the U.S. for conducting this work and serve as viable support resources for veterinarians and sheep producers. This is the space age and we have space age technology at our fingertips. There is no reason to stumble in the darkness of ignorance.

Sanitation and Disease

Without exception, the environmental factor most often associated with sheep diseases is "poor sanitation." The term sanitation has been referred to rather loosely for many years and somehow sheep producers have become immune to the term's significance. Livestock producers, including sheepmen, tend to rely on alternative management practices (vaccines and drugs) as a "crutch" to poor sanitation management. Specifically, what is meant by "sanitation management?" For the sake of practicality, let's consider examples of how the lack of proper sanitation can lead to serious disease outbreaks.

First, what about feeding on the ground, particularly a band of ewes in late pregnancy. The two diseases that commonly cause abortion in ewes are contagious as well as infectious. That is, the diseases are spread from infected to uninfected animals by transmission of infecting microorganisms, such as bacteria or viruses. Transmission may be direct, as in the case of a sheep suffering from viral pneumonia coughing into the face of a susceptible sheep. In many diseases, however, disease transmission is by "indirect" contact; from an infected sheep to the environment (feed, water, ground) and then picked up by the susceptible animal from the environment. Such is the case with the diseases causing abortion previously mentioned. Infected ewes abort infected fetuses. Uterine discharges following abortion also contain microorganisms that caused the abortion. If these fetuses and discharges are expelled on feed or into drinking water, susceptible ewes become infected by ingestion of the contaminated food or water. This is the classic method of disease transmission for both vibriosis and chlamydial abortion. Thus, in this example, sanitation is related to feeding management. Ideally, feed and water must be free from potential contamination by infected animals, in this situation the aborting ewe.

Another example of sanitation-disease interrelationship is demonstrated by penned lambs (nursing or recently weaned) where extreme moisture and manure are allowed to accumulate, or when the feed becomes contaminated with manure. Under these conditions we frequently observe either subtle or, many times, dramatic effects of coccidiosis on rate and efficiency of gain, or severe death loss. The final diagnosis of the problem would be "coccidiosis", but the "cause" was "poor sanitation", resulting in the ingestion of large numbers of coccidia from the environment. Such losses can and must be prevented through understanding and application of the basic principles of sanitation management.

A less obvious practice leading to both diarrheal disease in neonatal lambs and probably mastitis in ewes is related to "bedding" in jugs or where pregnant ewes are confined for lambing. First, the need for cleaning, disinfection, and re-bedding jugs between ewes is mandatory for optimal lamb survival. The same rational is applicable to the drop lot, since pregnant ewes spend a large part of their time lying in whatever is provided. If that happens to be bedding from jugs (contaminated with fecal material from scouring lambs), or week-old straw soaked with manure, the ewe's teats can be expected to be laden with bacteria that can cause mastitis in the ewe or scours in the newborn nursing lamb. In this instance, we define "sanitation" in yet a different context, yet equally as important as the others.

Of course there is the manure and mud filled lot where the sheep begin to limp or hobble around holding one foot up in the air. A particular bacterium that survives only in moisture and manure initiates the irritation to the skin around and between the claws of the hoof, causing a condition called "scald". If present in the environment, another bacteria invades the underlying tissues of the foot and the sheep become infected with contagious foot rot, a dread disease that has put many a sheepman out of business. Awareness of the environmental conditions conducive to this disease followed by appropriate preventive sanitation measures will, in most cases, preclude serious outbreaks of contagious foot rot, a disease associated with sanitation management.

Saving the Newborn Lamb - Management for Baby Lamb Survival

The most critical time in a lamb's life is between birth and seven days of age. During this period a lamb is extremely vulnerable to several common causes of death. A study at the U.S. Sheep Experiment Station showed that 46% of all neonatal lamb deaths was caused by diarrheal disease (scours), 20% was caused by starvation, and almost 8% caused by penumonia. It is likely that these same causes of death account for a majority of newborn lamb deaths throughout the U.S. In most instances, the management weaknesses responsible for such losses can be identified and are correctable, once we understand the underlying reasons for the deaths. The following discussion of baby lamb management is directed primarily toward shed lambing operations.

About the first contact that a lamb has with a good management program is when his umbilical cord is cut (about 2 inches from the abdomen) and the remaining stump is immersed in 7 percent tincture of iodine. This practice is considered "essential" for preventing losses from navel ill. Iodining the navel should be accomplished as soon as possible after the lamb is born. Occasionally we may observe a lamb 24-48 hours old with a full, moist navel. The navel is normally dry and shriveled by this time. Regardless of the age of the lamb, persisting moist navels should be re-dipped in iodine daily until drying occurs.

Next, we should be aware of a primary deficiency in newborn lambs. That is, a lamb's thermoregulatory system (internal thermostat) is only partially functional at birth and does not become completely functional until the lamb is about 3 days old. In effect, this means that a lamb's body temperature fluctuates with drastic changes in environmental temperature until his internal thermostat is able to compensate. If a newborn lamb is subjected to cold temperatures, it too becomes cold, perhaps too cold to suckle, and soon dies from starvation. The stress of chilling also reduces the lamb's resistance to diseases such as scours and pneumonia. The practice of providing shelter to ewes with newborn lambs in lambing sheds is intended to minimize losses in lambs from environmental exposure. Also, during the confinement period in the shed, a bond is formed between the ewe and her lamb that reduces the risk of abandonment and starvation when they are put with other ewes and lambs in mixing pens. Unfortunately, many producers turn ewes with lambs out into mixing pens when thelambs are 1-2 days old. Needless to say, 1 day in the shed is surely not long enough and 2 days probably isn't long enough, especially if the weather is inclement. To this a producer might reply, "I have to move them out so there will be room for ewes with new lambs."

The problem here lies in the fact that the producer simply doesn't have enough individual pens (jugs) for the number of ewes lambing. A general rule of thumb is that one jug is needed for every 10 ewes expected to lamb. Theoretically, the 1:10 ratio will provide necessary jug time for every ewe and her lambs. What usually happens is, however, that a small percentage of available jugs are used for sick ewes or ewes with sick or weak lambs, thus reducing the actual number of usable jugs. In geographic areas where winter or late winter storms are common during lambing, a ratio of one jug for every 8 ewes is probably a better and safer estimate of jug requirements.

Starvation is estimated to kill about 10 percent of all lambs born in the U.S. every year. Between inflation and production costs it is unlikely that the average producer can withstand such loss. Fortunately, we can substantially reduce losses from starvation through good management.

Flanks and udders of ewes should be shorn prior to lambing so that the lamb is not hindered from nursing. When the ewe and lambs are put into the jug, a stream of colostrum should be milked from each teat in order to remove the wax-like plug in the teat canal. By doing this, the lamb will be able to suckle the ewe with less difficulty. Also, the producer will be able to estimate milk production in the ewe and make necessary grafts at the most opportune time. Shortly after the newborn lamb is able to stand, it should be assisted in suckling if unable to achieve this important task independently. Each lamb should be checked (the abdomen should be somewhat distended behind the ribs) to be sure it has suckled within an hour after birth. The value of colostrum within 2 hours of birth cannot be overemphasized. Antibodies developed by the ewe against infectious viruses and bacteria are absorbed through the colostrum by the lamb at a decreasing rate beginning at birth. These antibodies provide disease protection to the lamb for several weeks following birth. Therefore, without early absorption of colostral antibodies, the lamb is extremely susceptible to disease. Occasionally, we observe lambs that are too weak to suckle. Many producers keep a nippled pop bottle filled with warm milk handy for weak lambs. Although many lambs have been saved by the pop bottle method, some degree of risk is involved due to possible drowning (accidently getting milk into the lungs).

Drowning usually occurs in lambs that are too weak to swallow. An alternative technique without the risk of drowning is the esophageal feeding probe. A few ounces of warm colostrum can be administered safely and directly into the lamb's stomach in less than a minute. Colostrum, even cow's colostrum, is far superior to milk or any other milk product for getting the newborn lamb started. Not only is colostrum extremely high in energy but it also contains those all important antibodies discussed previously. Many producers obtain fresh colostrum from a local dairy, freeze the colostrum in ice cube trays, and thaw the cubes as needed during lambing.

Once we have the lamb going, we must watch for signs of disease, such as scours or pneumonia. Successful treatment of either of the latter is highly dependent on early diagnosis as well as proper treatment. To facilitate early diagnosis, lambs in lambing sheds should be examined twice each day, while mixing pen lambs can usually get along pretty well with only one daily checking.

In addition to disease, lambs in sheds and mixing pens should be watched for signs of starvation. If a lamb is thin and weak, examine the ewe for adequate milk. Ewes will, for unknown reasons, sometimes stop producing milk in quantities adequate for normal lamb growth. Ewes with mastitis (bluebag) generally produce little or no milk. If the ewe is not producing enough milk, for whatever reason, the lamb should be grafted to another ewe or reared as an orphan. Do what is necessary to save the lamb, but don't wait too long.

When examining a lamb, which can be accomplished very quickly after some practice, look for specific signs, such as depression, increased respiratory rate, diarrhea, or perhaps a slight bubbly froth around the mouth (usually an indication of dehydration and impending scours). The lamb need not be picked up for routine examination, but a cane is handy for moving the lamb into viewing position.

When the lamb is moved to a mixing pen, some thought to providing shelter for the lambs can be critical. The shelter can be anything from a canvas covered panel (with dry straw underneath) attached to the north wall of the pen to an elaborate shed complete with creep feeders inside. Either will provide needed shelter when a storm threatens your lamb crop.

In summary, excessive neonatal lamb mortality is usually a result of one of the following circumstances:

(1) Environmental exposure - insufficient confinement facilities.
(2) Starvation - insufficient attention to suckling and grafting.
(3) Disease - either unexpected outbreaks against which no preventive measures were taken or laxity in observation and treatment of routine disorders.

USEFUL R_X AT LAMBING

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Profit in the sheep business begins with lamb survival. Unfortunately, lambs and ewes are subject to a variety of maladies following birth that can be life thereatening. Used properly, a relatively modest arsenal of medications and a few basic supplies can save the lives of several to several hundred lambs, and thereby dramatically affect the profitability of your operation. A word of caution - improper use of drugs may interfere with recovery or cause death. Consequently, the use of such compounds must be used judiciously and preferrably after consultation with a veterinarian.

During the past several years, first as a practicing veterinarian, then as the first veterinarian at the U.S. Sheep Experiment Station, I have had the privilege of exchanging ideas with sheep producers, scientists, and veterinarians around the country. This opportunity has resulted in the formulation of several flock health practices related to the use of drugs to increase lamb and ewe survival. The following practices, although not all universally effective, will provide a general guide to frequently encountered veterinary problems and their clinical management. In no way are the recommendations intended to replace the "on the scene" reliability of an experienced sheep veterinarians' advice, but rather to form a basis of consideration for medically managing common problems associated with lambing. Several of the drugs listed, particularly antibiotics, are not approved by FDA for use in sheep. These drugs may be used legally in sheep, however, if prescribed by a licensed veterinarian.

Dystocia (difficult birth) due to failure of the cervix to dilate - With some frequency we observe ewes that are in labor without giving birth to lambs. In some cases, labor may be prolonged while in other ewes the duration of labor may be relatively short. For whatever reason, either physical exhaustion due to labor or hormonal insufficiency, labor terminates without cervical dilation. This is the type ewe that, when missed, is found dead for "unknown reasons" several days later. If we had been downwind from such a ewe the day before she died, we would certainly have detected a foul odor, that of the decaying lambs still in the uterus. The diligent shepherd will keep a watchful eye on the potential dystocia prospects and will, after not more than 3 hours after the onset of labor, examine the ewe. Examination of the birth canal requires the following: adequate restraint of the ewe, a clean and disinfected hand and forearm, and the application of a suitable obstetrical lubricant to the examination hand. Upon examination we will usually find a mal-positioned lamb that simply requires "straightening out" and delivery. In some ewes, however, we will detect a cervix that is partially dilated (perhaps enough to permit passage of one or two fingers into the uterus) but not sufficiently to permit birth of a live lamb. These cases are usually managed successfully with drug administration. Two hormone preparations are used. First we must sensitize the uterus by one intramuscular injection of estradiol. One hour later, an intramuscular injection of oxytocin, repeated at hourly intervals, will usually result in cervical dilation and normal lambing. If the latter has not occured after three oxytocin injections, the lambs should be delivered by caesarian section.

Uterine hemorrhage following lambing - Occasionally we observe a ewe that shows excessive uterine bleeding immediately after lambing. The causes of this problem are variable, but are usually controlled by an intramuscular injection of oxytocin. Continued hemorrhage following the administration of oxytocin is indicative of a tear in the wall of the uterus and would require immediate surgical repair.

Mastitis (Bluebag) - Inflammation of the mammary gland accompanied by infection by bacteria is commonly observed in ewes within a few weeks following lambing. Producers should observe ewes with lambs for evidence of this serious disease. Affected ewes may be depressed and obviously sick; or they may attempt to walk while holding a hind leg up; or the lamb(s) may be gaunt and thin. When any of these conditions are observed, the ewe's udder should be examined. Acute bluebag is evidenced by a hard, swollen, hot and sometimes darkened (blue) mammary gland. The ewe, in such cases, may have a high fever (105-107^{o}) and will be extremely sick. Milk production by a ewe with bluebag has usually terminated requiring that her lambs be either grafted or reared as orphans. Ewes with acute bluebag may die quickly, therefore immediate treatment is important. The objective of treatment in these cases is to salvage the ewe for slaughter since future milk production ability is usually destroyed in affected ewes. There are probably several antibiotics that can be used effectively to treat mastitis. For the past several lambings I have used a dry cow (antibiotic) intramammary infusion product that contains a long acting synthetic penicillin. Once acute bluebag is diagnosed, the affected ewe is given an injection of oxytocin intramuscularly to stimulate milk letdown. After about 3-5 minutes the contents of the affected gland should be milked out by hand. Don't be surprised if little or nothing is obtained from the infected gland. Following milking, the teat end is disinfected with alcohol and one tube of the mastitis antibiotic is infused into the gland through the teat canal. At this time I start the ewe on daily (3-5 days) injections of a preparation containing a combination of penicillin, dihydrostreptomycin, dexamethazone and an antihistamine. In my experience the latter drug combination is effective in combating the septicemic shock associated with acute mastitis.

Retained placenta - We frequently observe ewes with retained placenta. This condition in ewes appears to be associated with or even a cause of metritis, an often fatal inflammation and/or infection of the uterus. Because of the potential threat caused by retained placenta, I feel more comfortable after taking conservative steps to insure that such ewes have "cleaned out" before they leave the lambing shed. Many times a "tag" of retained placenta is observed protruding from the ewe's vulva the day after lambing. A gentle tug usually results in withdrawal of the retained portion of the placenta. If the placenta is still firmly attached within the uterus I administer estradiol and a shot of antibiotic (penicillin - dihydrostreptomycin). This treatment generally causes expulsion of the retained placenta within 24 hours and you are all through. Occasionally you may detect a ewe with a decaying retained placenta by the foul odor and darkened discharge from the ewe's vulva. Such cases are serious and require immediate treatment with estradiol and systemic antibiotics. If the cervix is open antibiotics should be infused into the uterus. Sometimes we find that the cervix has closed in this type of ewe and therefore must wait about 24 hours for the estradiol to cause cervical dilation thus permitting infusion of antibiotics into the inflamed uterus.

SELECTED THERAPEUTICS FOR COMMON DISEASE PROBLEMS IN SHEEP*

I. Ewes

1. Inducement of labor in the pregnant ewe:

    a. Examine ewe to be sure that a malpositioned lamb isn't the problem.
    b. Administer 3 mg. Estradiol intramuscularly to ewe.
    c. One hour after the Estradiol, administer 30-50 units of Oxytocin intramuscularly.

2. Post-partum uterine hemorrhage: 30-50 units of Oxytocin intramuscularly.

3. Bluebag:

    a. Milk out infected gland.
    b. Infuse dry cow mastitis antibiotic preparation into gland.
    c. Administer injectable antibiotics (Pen-Strep) to ewe daily for 3-5 days.

4. Retained placenta: (24 hours or longer after lambing)

    a. Remove placenta manually if cervix is still open. Instill uterine antibiotic boluses.
    b. If cervix is partially closed, administer 3 mg. Estradiol and injectable antibiotics (Pen-Strep). Remove placenta manually the next day, instill uterine antibiotic boluses and give Pen-Strep.

5. Pregnancy toxemia:

    a. Administer 10 mg. Dexamethasone intramuscularly.
    b. Drench ewe with 6 oz. of glycerine every 12 hours.
    c. Ewe will lamb in approximately 48 hours. Continue to drench until ewe begins to eat.

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* The treatments listed above have proven effective at the U.S. Sheep Experiment Station but may not be as effective in other locations due to differences in infecting organisms, resistance to antibiotics, etc. In such cases, your local veterinarian will be your most reliable source of information. Some of the drugs listed do not have FDA approval for use in sheep. Consult your veterinarian before using any of the drugs listed.

6. Pneumonia:

Administer 4 cc Tylan 50 intramuscularly per 100 pounds of body weight and 20 cc of Albon (12.5% sulfadimethoxine) solution orally (drench) per 100 pounds of body weight. Treatment should be continued for 3-5 days. Dosage of Albon should be reduced to 10cc/100 pounds of body weight after the first day of treatment.

II. Lambs

1. Scours:

Administer 1cc/5 pounds of body weight of Spectam Scour Halt (spectinomycin sulfate) orally. Repeat treatment every 24 hours. Tribrissen 120 (tablet) once daily has also been highly effective for treating scours. In severe cases with dehydration, administer antibiotic every 12 hours and inject (subcutaneously or intra-peritoneally) 200 cc of Lactated Ringer's solution, also at 12-hour intervals.

2. Pneumonia:

Very young lambs - ½cc Tylan 50 intramuscularly and 1cc Albon (12.5% sulfadimethoxine)/5 pounds body weight, orally. Treatment should be continued for 3-5 days. Dosage of Albon should be reduced to 1cc/10 pounds of body weight after the first day of treatment. Tribrissen 120 (tablet) in combination with Tylan 50 has also proven to be very effective for pneumonia in lambs.

Information on vaccination programs is available in The Sheepman's Production Handbook available from The Sheep Industry Development Program, 200 Clayton Street, Denver, Colorado, 80206.

Esophageal lamb feeding probes are available from:

Magrath Co.
P. O. Box 148
McCook, NE 69001

To simplify the presentation of information, it is sometimes necessary to use trade names. No endorsement of products is intended nor is criticism of unnamed products implied.

NUTRITION OF THE EWE IN DRYLOT

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Introduction

Feed represents the largest production cost in a sheep operation. To keep feed costs at a minimum the sheep producer should feed ewes to meet only their needs for lamb and wool production. Ewes that are underfed will have fewer and lighter lambs while those ewes that are overfed will become fat and inefficient in the use of the nutrients. Knowing what to feed and when to feed it is important in meeting the ewe's requirements for wool and lamb production. The science and the art of feeding sheep is based on the producer's ability to provide a feed supply that will equal the feed demand. If feed supply does not meet feed demand lamb and wool production will suffer, yet if excess feed is provided production efficiency is decreased and the end result is reduced returns to the producer. Balancing the feed supply means both providing an adequate quantity as well as the quality of nutrients to meet the productive needs of the ewe.

The nutrient requirements of the mature ewe are directly related to the nutrients the ewe must provide for lamb growth and wool production. The nutrient requirements are directly influenced by a great many factors, i.e., body size, body condition, number of lambs produced, length of lactation period, and climatic factors and stage of production of the ewe. These factors must be considered if specific nutritional or feeding requirements or recommendations are to be effective.

Nutrient Requirements

The nutrient requirements of the ewe are related to the different stages of the reproductive cycle. The three main phases are gestation, lactation, and maintenance. The nutrient requirements for ewes during these three phases of the reproductive cycle are listed in Table 1. The most critical phases during the reproductive cycle are during the last few weeks of gestation, lactation, the last two to three weeks prior to breeding and the first four weeks of the breeding season (flushing). These critical phases are illustrated in Figure 1. The energy requirements for a ewe during a full reproductive cycle are directly related to those needed for lamb growth, wool growth, and maintenance of body weight. To illustrate the differences in energy requirements during the productive cycle the requirements are divided into three phases, i.e., the gestation period of about five months, the lactation period of three to four months, and a dry period of about four months.

1. Gestation Phase. The ewe's nutrient requirements in early gestation are only slightly above the needs to maintain body weight and adequate wool growth. Often lower quality feeds can be used during this time to save on feed costs. The last six weeks of gestation become much more critical in terms of the nutrient requirements of the gestating ewe. Growth of the lamb fetus accelerates at this time and the ewe must consume enough nutrients to maintain her body weight, provide wool growth and allow the fetus to develop. Pregnant ewes should be fed adequately so they are gaining weight during the last six weeks of gestation. Much of this weight growth is a result of the increasing weight of the fetus (Figure 2). Those ewes not properly fed during this phase may actually lose weight or body condition while the fetus is still growing; however, this will penalize the ewe and result in lower milk production during the lactation phase.

2. Lactation Phase. The nutrient requirements of the lactating ewe are considerably higher than any other time of the year. Energy requirements are two to three times higher than they are during maintenance. Additional feed must be provided if the ewe is suckling twins versus suckling a single lamb. The nutrient requirements also reflect the difference during the lactation period for the first eight weeks versus the second eight weeks. It has been well documented that the ewe will provide less milk in the latter stages of the lactation phase than they do in the early stages of this phase. Therefore, the nutrient requirements are somewhat less during the last half of the lactation phase. The actual liveweight of the ewe may decrease during the early part of the lactation phase and then remain steady or slightly increase during the latter part of the lactation phase. Ideally the ewe would not gain or lose weight during this time. However, it is often difficult to provide all the nutrients needed by the ewe for lactation if she is suckling twins. It is rather easy when feeding ewes in drylot to match feed offered with the nutrient requirements as they change during the reproductive cycle. However when ewes derive most of their nutrients from grazing, the lambing period should occur just prior to the growth of green grass. This will help insure that the ewe is receiving enough nutrients for adequate milk production, wool growth, and maintenance of body weight.

3. Maintenance Phase. Maintenance of dry ewes may not seem to be of great importance as the productive ewe should either be pregnant or lactating during most of the year. However, it is important that the ewe maintain her weight and condition during the dry phase so that breeding difficulties do not occur. The only productive function of the dry ewe is for one-half to one pound of wool growth per month during this phase. The requirements in terms of feed quantity and quality are quite low and some economies in the yearly feed cost of the ewe can be achieved at this time. Towards the end of the maintenance phase thought should be given to the condition of the ewe. It is extremely desirable to increase the nutrient intake of the ewe during the last three to four weeks prior to the initiation of the breeding season. This increase in

nutrient requirements (flushing) has been shown to increase the ovulation rate and therefore the number of lambs born per ewe. The flushing of the ewe should continue for the first three to four weeks of the breeding season.

In summary the ewe is expected to gain only in wool growth during the maintenance phase, gain some weight during early pregnancy, contribute some body tissue to milk production during early lactation, and return to her normal weight plus her fleece at the end of the year (Figure 3). This scheme does not represent many practical situations as differences in area and feed costs and feed supplies will influence the variation in the body weight of the producing ewe. The weight changes depicted in Figure 3 should tend to maximize the efficiency of feed utilization.

Feeding Programs

Matching the ewe's nutrient requirements with the feeds available is necessary for efficient feed utilization and optimum productivity. Table 2 outlines four feeding programs that will match energy and protein requirements for all phases of the reproductive cycle. The examples outlined in the Table vary from a summer pasture, winter drylot feeding to feeding in drylot the entire year. The summer grazing (ration 1) example will vary according to types of pasture and stocking rates. The feeds used in example 4 can easily be used in a mechanized feeding system. The annual feed requirements for a 154-pound ewe are outlined in Table 3. The feed requirements in pounds of feed, pounds of digestible energy and pounds of total feed as hay or grain are listed for each phase of the reproductive cycle. Table 4 illustrates the differences in the total requirements for ewes producing single or twin lambs and those requirements for a ewe producing 1.5 lambs per year. These feed requirements should be used as guidelines as your actual feed requirements will vary according to the size of ewe, her body condition, number of lambs raised, length of the lactation period and environmental factors.

Table 1. NUTRIENT REQUIREMENTS FOR A 154-LB EWE

Ewes	Dry matter lbs	TDN lbs	Crude protein %	Calcium %	Phosphorus %
Maintenance	2.6	1.45	8.9	.27	.25
Gestation:					
First 15 weeks	3.1	1.69	9.0	.23	.21
Last 6 weeks	4.6	2.68	9.3	.21	.20
Lactation:					
First 8 weeks (S)	5.5	3.59	10.4	.48	.34
Second 8 weeks (S)	4.6	2.68	9.3	.21	.20
First 8 weeks (T)	6.2	4.00	11.5	.48	.34
Second 8 weeks (T)	5.5	3.59	10.4	.48	.34

(S) Single lambs (T) Twin lambs

FIGURE 1

ENERGY REQUIREMENTS FOR A 70 Kg (154 lb) EWE DURING A 12 MONTH REPRODUCTIVE CYCLE

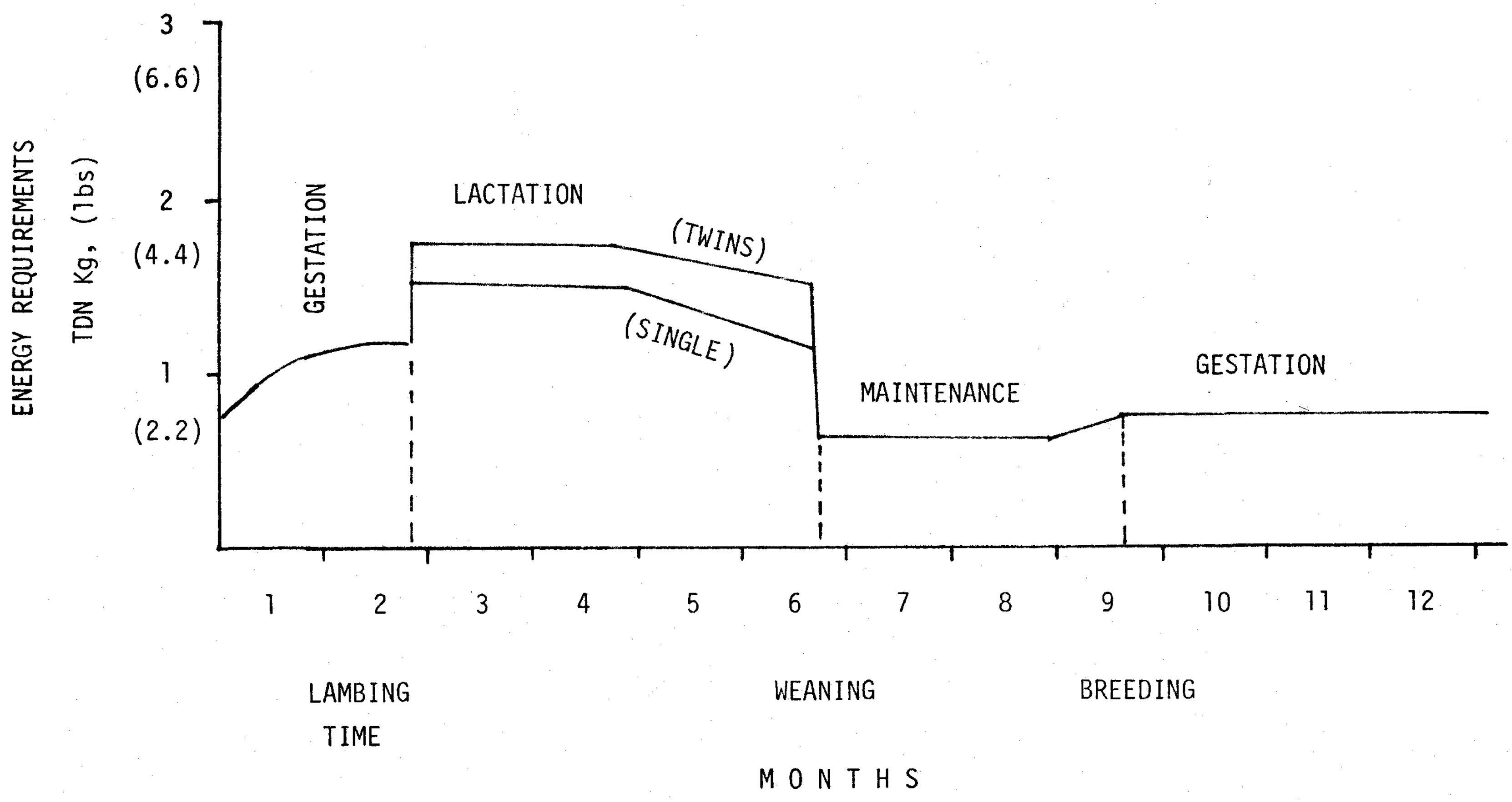


FIGURE 2

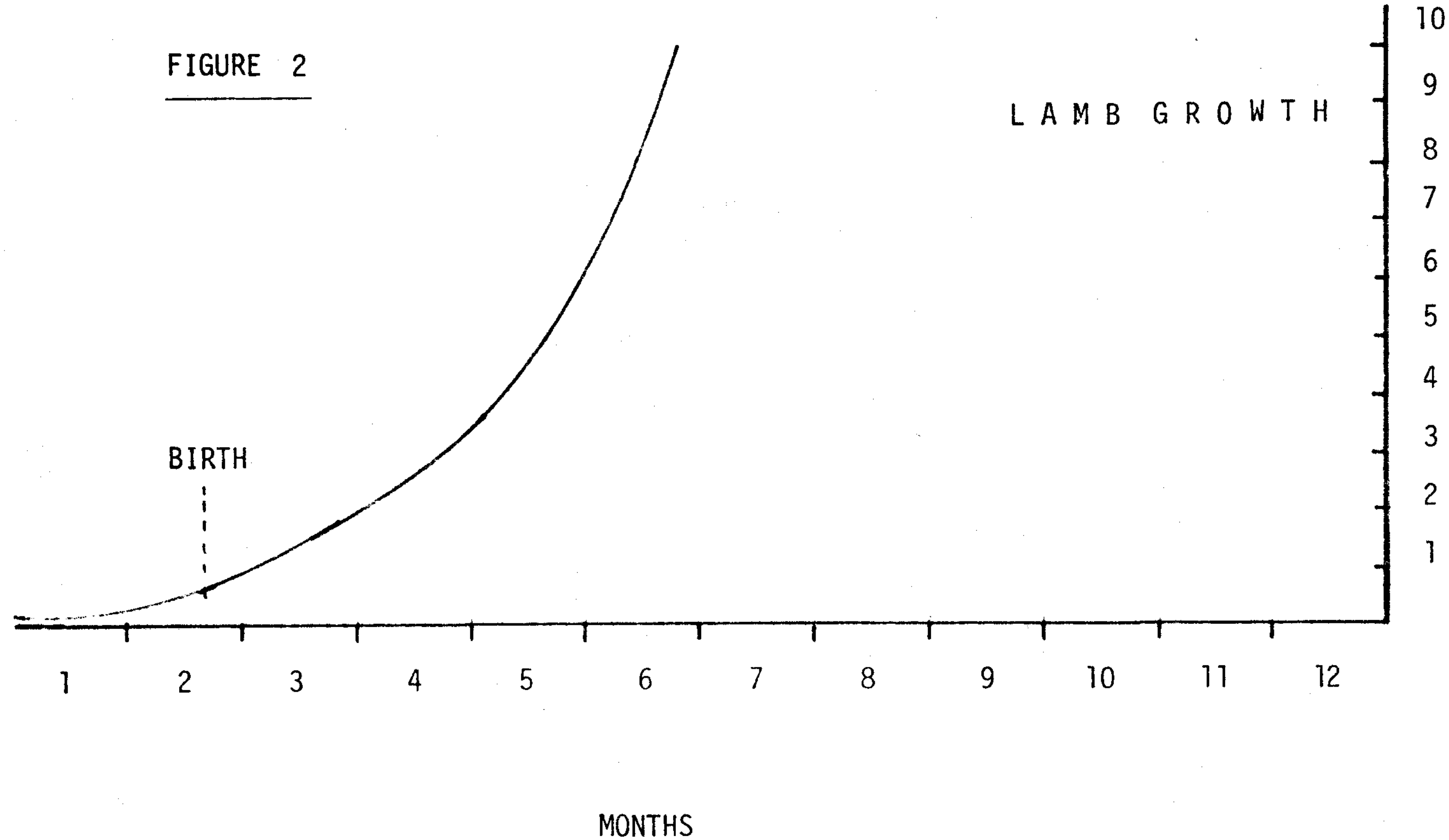
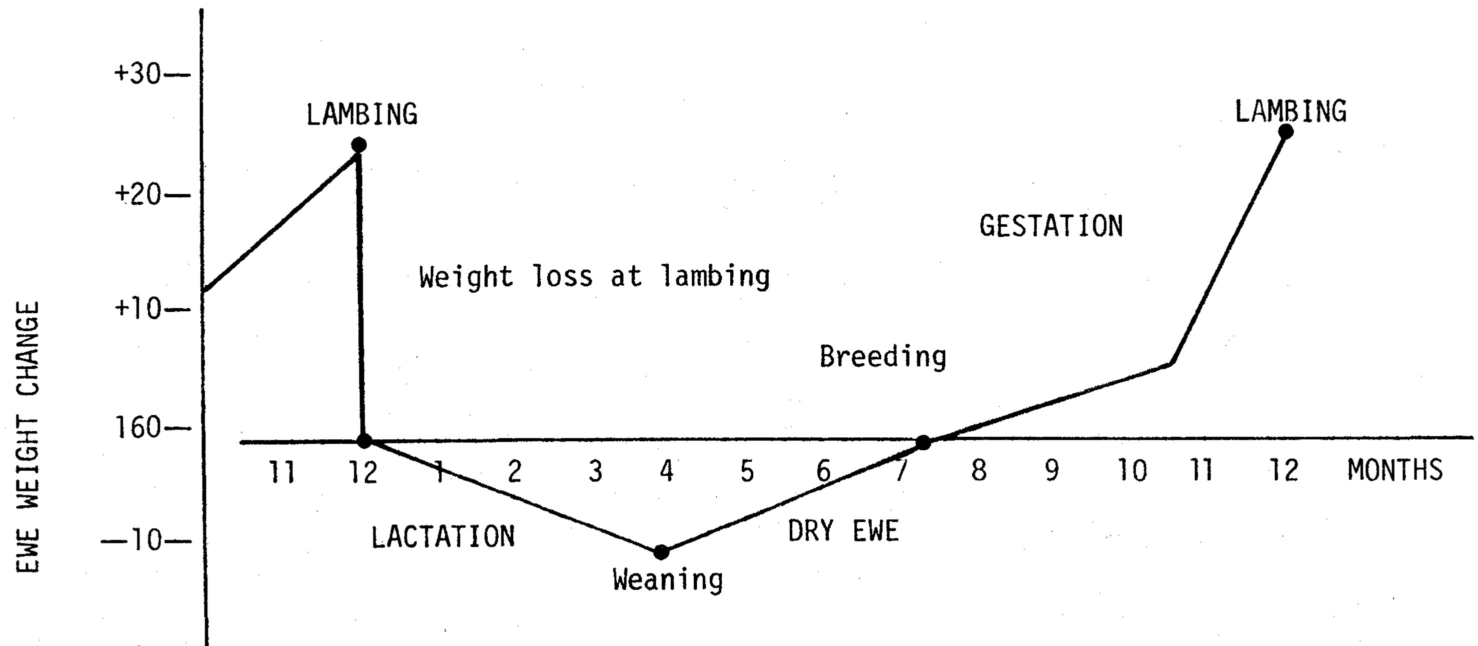


FIGURE 3

WEIGHT CHANGES NORMALLY EXPECTED IN A YEAR FOR A 160 POUND EWE GIVING BIRTH TO AND REARING TWIN LAMBS.



Note: Weight changes expected in the same ewe giving birth to and rearing a single lamb would be approximately two-thirds of the above changes.

Table 2. FEEDING PROGRAM FOR 154-POUND EWE

Reproductive phase	Ration No. 1	Ration No. 2	Ration No. 3	Ration No. 4
Maintenance TDN 1.45 lb Protein .27 lb	Poor-avg pasture	4 lb poor-avg hay	7 lb corn silage. ½ lb 25% protein sup	3.0 lb good alfalfa hay
Flushing TDN 2.0 lb Protein .30 lb	Good pasture	Avg pasture 1 lb grain	4 lb hay 1 lb grain	2 lb alfalfa hay. 4 lb corn silage. .5 lb grain
Early gestation TDN 1.70 lb Protein .27 lb	Avg pasture	4 lb hay	7 lb corn silage. 3/4 lb 25% protein sup	2 lb alfalfa hay. 4 lb corn silage
Late gestation & late lactation TDN 2.6 lb Protein .43 lb	4 lb good mixed hay. 1 lb grain	5 lb corn silage. 1 lb good hay. 2 lb 16% protein sup	7 lb corn silage. 2 lb 16% protein sup	3 lb alfalfa hay. 4.5 lb corn silage
Early lactation TDN 3.60 lb Protein .66 lb	5 lb good 2nd-cut alfalfa hay. 1 lb grain (corn or barley)	5 lb avg (mixed) hay. 1½ lb grain	10 lb corn silage. 1 lb good alfalfa hay. 1½ lb 24% protein sup	2 lb alfalfa hay. 12 lb corn silage

Table 3. ANNUAL FEED REQUIREMENTS OF A 154-LB EWE

	Days	Feed, 90% DM Per day (lb)	Feed, 90% DM Total (lb)	DE Per day (Mcal)	DE Total (Mcal)	Total feed Hay	Total feed Grain
Maintenance	105	2.7	280	2.90	3.04	280	0
Early gestation	105	3.2	338	3.39	356	338	0
Late gestation	42	4.7	196	5.37	225	180	16
Early lactation, single	56	5.7	318	7.17	401	213	105
Early lactation, twins	56	6.3	354	8.01	448	227	127
Late lactation, single	56	4.7	261	5.37	300	240	21
Late lactation, twins	56	5.7	318	7.17	401	213	105

Table 4. ANNUAL FEED REQUIREMENTS OF A 154-LB EWE

	Days	Feed-90% DM Total (lb)	DE Total (Mcal)	Total feed Hay	Total feed Grain
Total feed					
Ewe with single	365	1393	1564	1306	142
Ewe with twins	365	1486	1734	1357	248
Ewe with 1.5/lambs	365	1439	1649	1331	195

ELECTRIC ANTI-PREDATOR AND LIVESTOCK FENCING - A PROVEN MANAGEMENT TOOL

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Introduction

Fencing as a means of excluding canid predators from domestic livestock has received continued interest for many years. Modern use of barrier fencing as a nonlethal method for controlling canid depredation on domestic livestock began in Australia about 1900. By 1908, over five thousand miles of dingo fencing had been built in South Australia. In the United States, "coyote proof" fencing was introduced in 1911, although present knowledge would indicate that either the fence could not have been "coyote proof" or that our coyotes are a lot smarter than they used to be. Since that time, various researchers have tested a multitude of fence designs to deter coyotes.

Because of the relatively low cost involved, electric fencing has been a concept of particular interest. Unfortunately, the results of research on conventional electric fencing have been discouraging. Investigators have concluded generally that poor grounding of the coyote and power drainage cuased by fence contact with vegetation reduced the electric shock to the extent that the electric fences tested were ineffective in deterring coyotes. Occasional undocumented reports of effective use of electric fencing for warding off coyotes and dogs have sustained interest in the eventual development of practical, effective, electric anti-predator fencing. The obvious advantages of such a fence would be (1) relatively low cost (2) environmental acceptability and (3) immediate availability.

In 1978, research at the U.S. Sheep Experiment Station clearly showed that properly designed electric fencing, utilizing high voltage energizers, can effectively protect sheep from coyotes and thus contradicted conclusions from other research on electric anti-predator fencing.

Fencing Components and Construction

Fence Design. An electric, anti-predator fence consists of 7 to 12 alternating ground and charged wires. Variations in the number of wires needed, including the charged trip wire, is dependent on relative depredation pressure and differences in coyote behavior. For example, in geographic areas where the ground remains frozen throughout the winter months, coyotes tend to jump over fences, thus requiring higher electric fences with the maximum number of wires. Conversely, in warmer climates, coyotes tend to prefer digging under fences. In arid areas where poor grounding prevails due to lack of moisture, the charged trip becomes extremely important. This wire is placed 8 inches from the main fence around the outside perimeter and 5 to 6 inches from the ground. If a charged trip wire is used, the bottom wire on the main fence should be grounded. If no trip wire is used, the bottom wire on the fence should be charged.

All ground wires are connected to four 1 inch steel pipes, at least 6 feet apart from one another, and driven at least 5 feet into the ground. The ends of the pipe extending above the ground are connected by wire, and then connected to the ground wires on the fence. All charged wires are connected to the energizer.

Wire. Galvanized, high tensile steel wire (12 or 12.5 gauge) is recommended. Smooth wire stretchers should be used to stretch the wire to about 175-pound tension.

Post. Wood corner and brace posts are recommended. Because of the powerful strain on corner posts, both corner and brace posts should be set at least 3 feet deep in concrete. Line posts may be either fiberglass (no insulators needed) or wood or steel with plastic or porcelain insulators. All wires must be free running from corner to corner to allow for proper tension and maintenance.

Power. A high-voltage energizer must be used to overcome voltage drainage caused by vegetation and the resistance of the animal's body.

Other Considerations

1. Depending on land contour, line post spacing may have to be modified from the distances shown - Irregular terrain requires that posts be closer than they would be on level land.

2. Since any electric fence is potentially dangerous, "Electric Fence" or "Danger" signs should be installed on the fence at least every 100 yards.

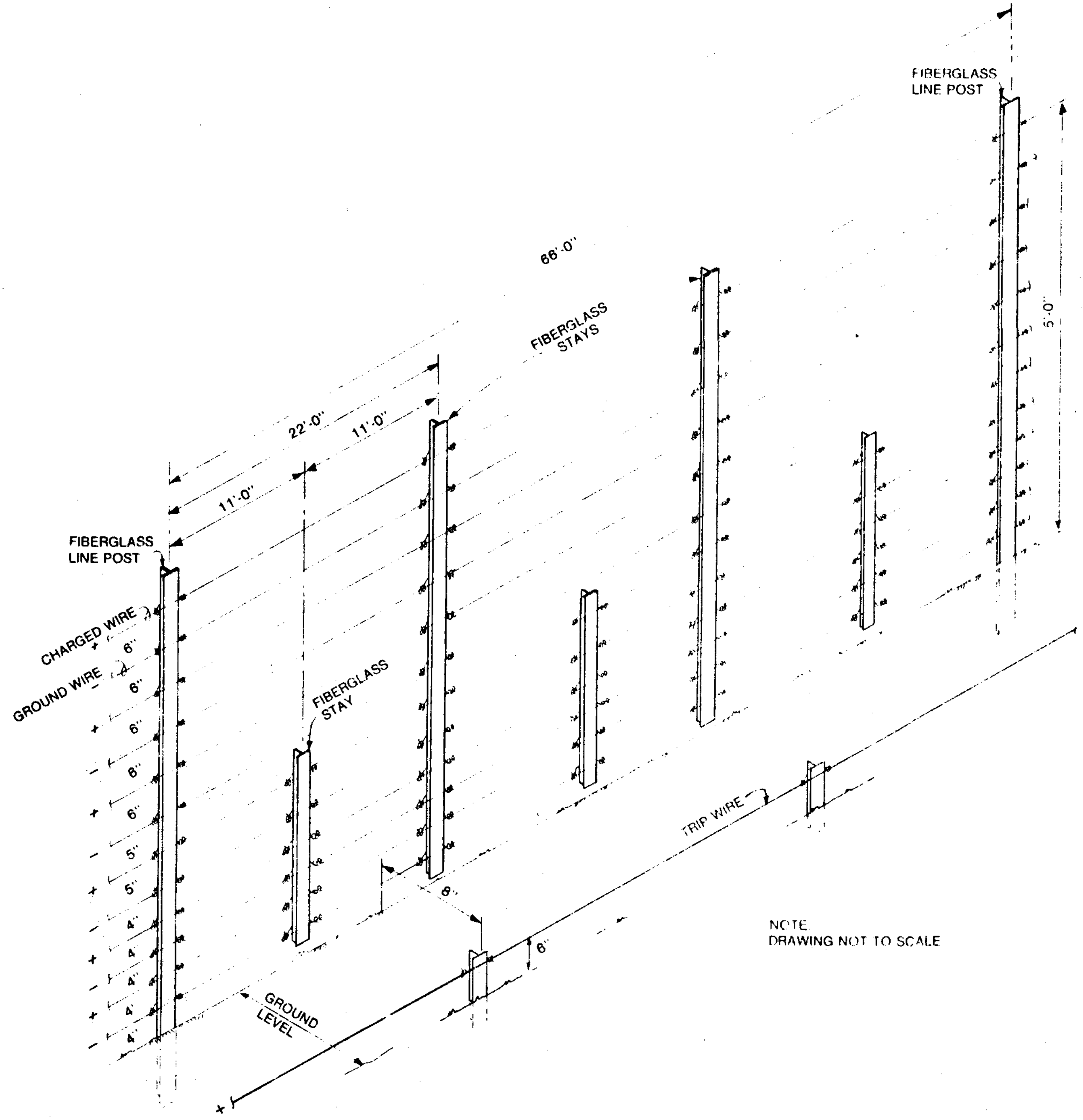
3. The charged trip wire will prevent a coyote from digging under the fence under average soil conditions. In extremely sandy soil, however, a coyote can begin digging far enough out from the trip wire to dig completely under it and the fence.

4. If cattle inhabit land adjacent to the electric fence, the charged trip wire may be difficult to maintain.

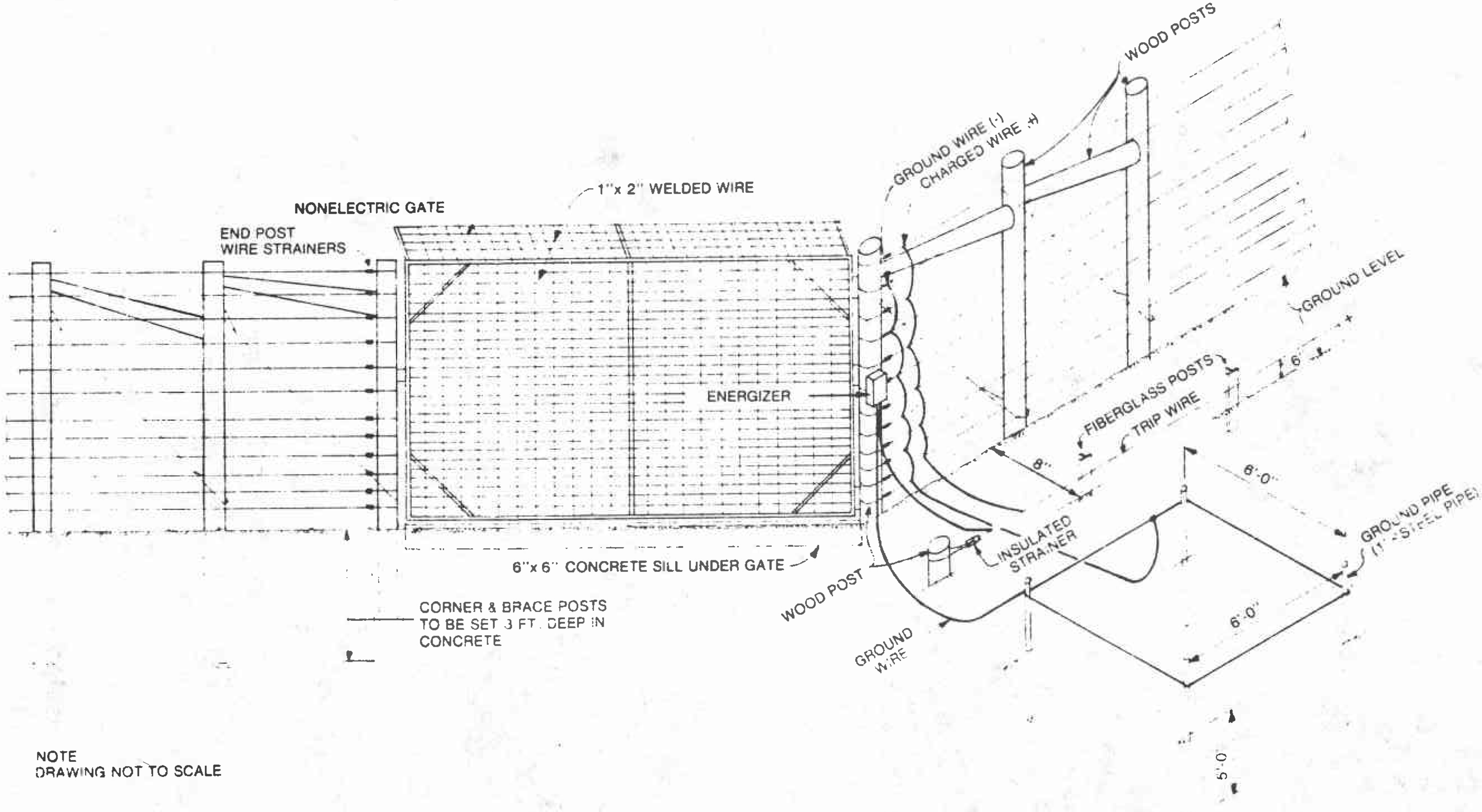
5. Local laws should be consulted with regard to use of electrical equipment.

Conclusions

The electric fence described has evolved as a practical, non-lethal method for preventing coyote depredation on sheep and has widespread, but not universal application. A recent survey of such fences confirmed, without question, that electric fencing, when properly designed and constructed, is effective and is in current use by many sheep producers. USDA Leaflet Number 565, "Constructing An Effective Anticoyote Electric Fence" provides additional information on this subject.

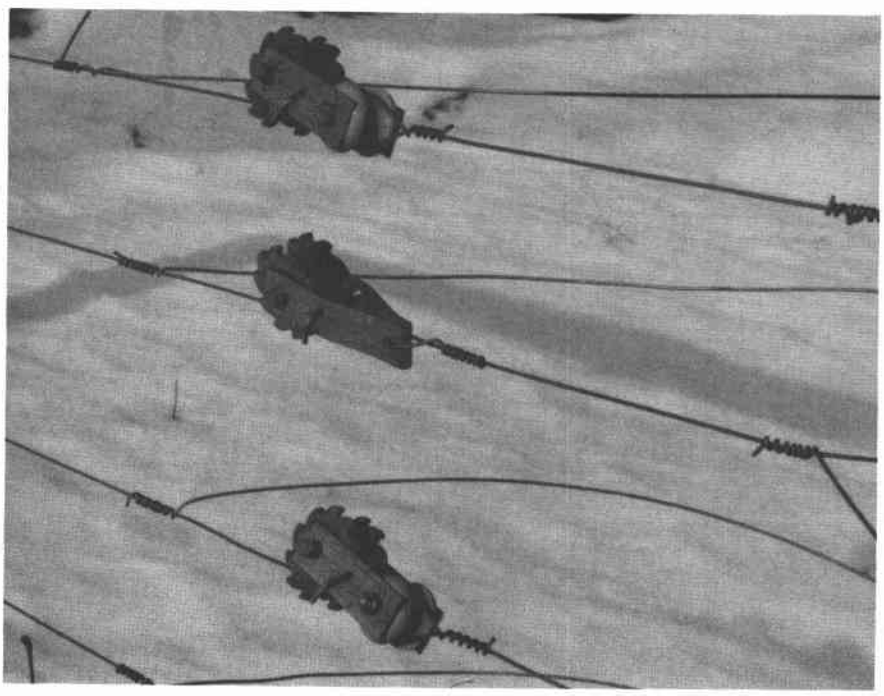


Electric fence configuration.

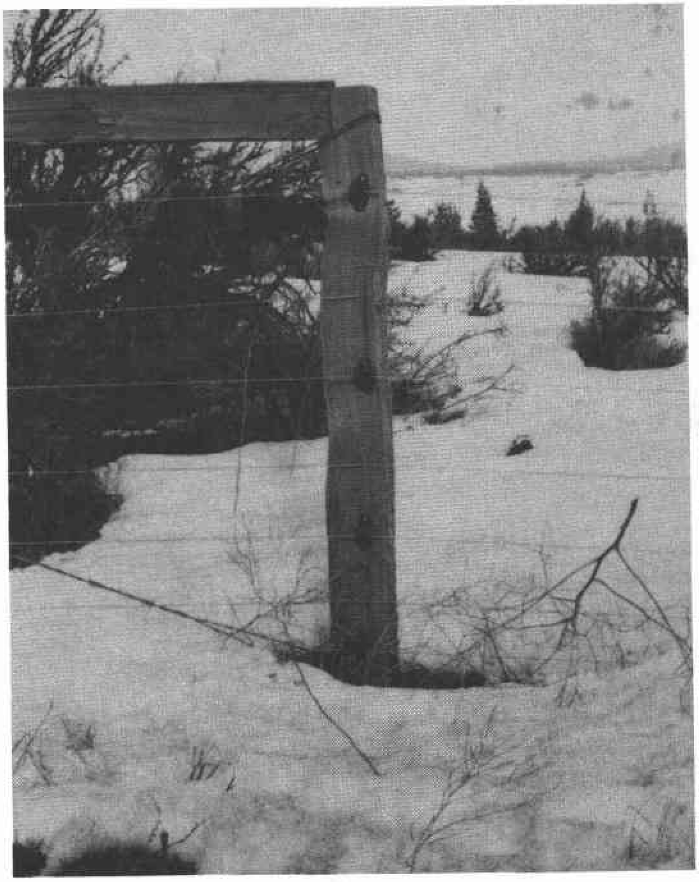


Nonelectric, coyote-proof gate.

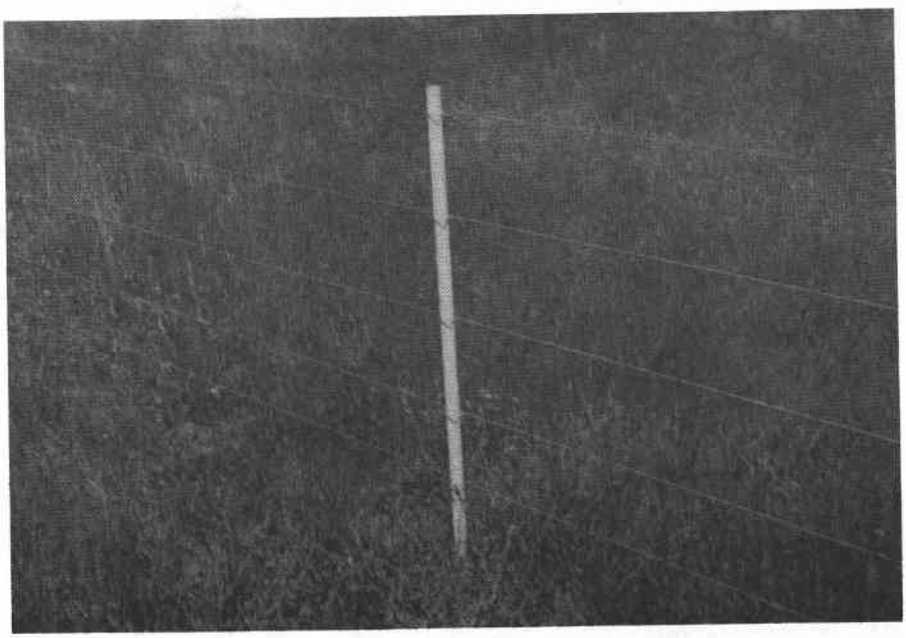
Mr. Theo Caldwell (Goldendale, WA) tightens a strainer on his electric livestock and anti-predator fence.



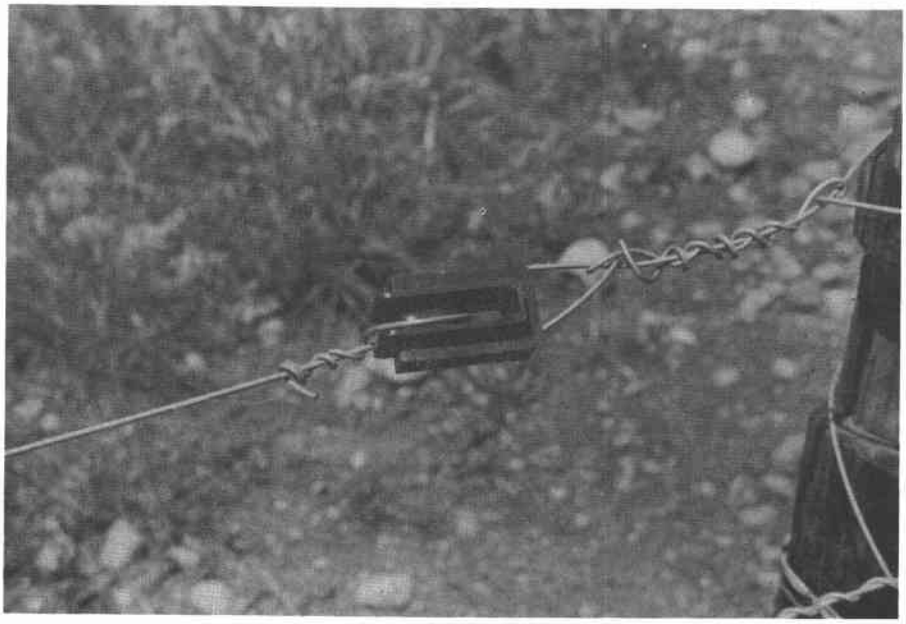
Insulated and non-insulated strainers.



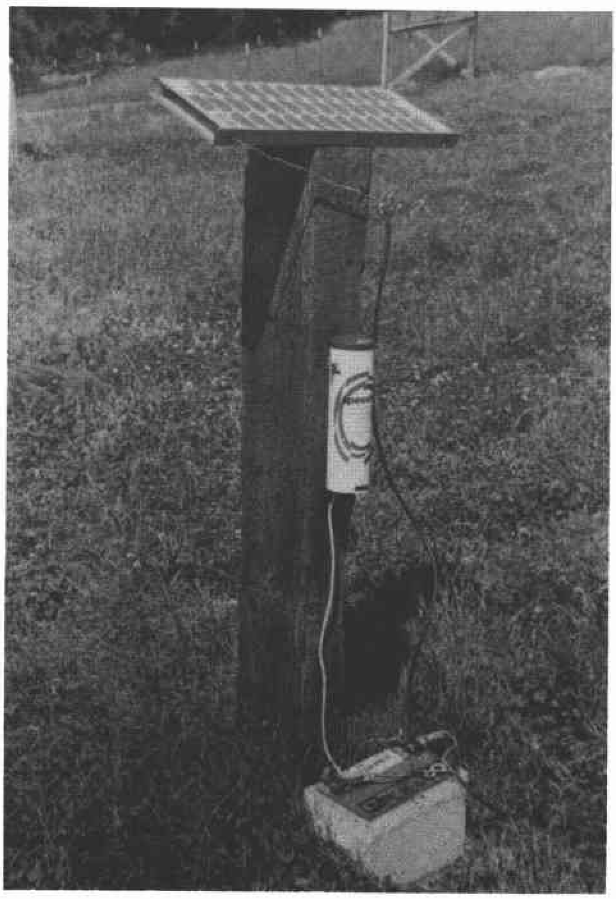
Nail on insulators for attaching charged wires to wood posts.



Fiber glass line posts eliminate the need for insulators.



A terminal insulator.



Solar generators are available for maintaining power in 12V systems.

PREDATOR CONTROL: TECHNICAL/POLITICAL DEVELOPMENTS

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Introduction

In predator control, as with other arenas of wildlife management, politics exert a real influence over the conduct and scope of management. Often, reaction to management practices results in political events that directly affect what can and cannot be done in the realm of management. This exemplifies the current situation in the management of predator damages to livestock. Two developing political events have the potential to greatly influence the conduct of management of predator-induced livestock losses in Oregon. These events are: 1) the recent policy directive concerning conduct of animal damage control activities by Interior Secretary Cecil Andrus; and 2) the petition drive by Greenpeace to place on the November 1980 ballot a proposal to ban the use of leghold traps in Oregon.

Proposed ADC Policy/Management

Secretary Andrus proposed a number of changes in management goals and restrictions on techniques for the ADC program. The Fish and Wildlife Service was to work towards rapid implementation of these goals.

> 1. ...preventive control should be limited to specific situations where unacceptably high levels of losses have been documented during the preceeding 12 months. ...our goal should be to minimize and phase out the use of lethal preventive control, including creation of buffer zones... the use of aerial shooting, particularly in winter, should be tightly controlled...
>
> 2. Emphasize corrective control, utilizing non-lethal, non-capture methods and focusing on offending animals to the greatest degree possible... The practice of denning should be eliminated...
>
> 3. ...encouraging the use of appropriate livestock husbandry techniques which decrease exposure of livestock to predators.
>
> 4. Expand the availability of extension services to ranchers... all efforts will be made to utilize traps in the most selective and humane manner possible...

These management goals will emphasize control programs that are less preventive and more corrective in nature, requiring sheep growers to sustain damage before lethal controls can be applied. The programs will place greater reliance on extension-related self-help programs for ranchers, perhaps patterned after the Kansas Extension-Trapper program, where much of the responsibility for lethal control efforts was placed on the ranchers themselves who were assisted by extension specialists that taught them how to trap and snare coyotes as the primary method of control. Emphasis on the extension thrust however, using as a keystone trapping and snaring, will conflict with the emphasis on utilization of non-lethal, non-capture methods.

The most significant questions, however, center on feasibility of this management philosophy in light of current and projected management realities. An objective review of these proposed management policy changes has been made by a group of highly qualified scientists from the western United States who serve on a continuing committee (WRCC-26) to coordinate, plan and conduct research on methods for reducing the impact of predation on livestock. Some of the comments were:

1. Limitation of preventive control to areas where "unacceptably high levels of losses have been documented during the preceding 12 months" indicates that producers are required to sacrifice livestock to predators. Most producers do not feel such obligation in order to maintain predator populations. Moreover, producers suffering loss may have a distinctly different concept of "unacceptably high levels than administrators who have no such investment, little interest, and little concern. This Committee questions the concept of requiring livestock producers to withstand arbitrary loss levels. This is not consistent with sound business practices.

Minimizing and phasing out of lethal controls in the future may be possible through research; at present, the possibility is purely theoretical and speculative. The members of WRCC-26 have been extensively involved in the predator related research over the past several years and do not believe that this goal is in the realm of possibility, other than political, at this time.

In addition, buffer zones have consistently been found to be essential, particularly in lambing, kidding, and calving areas, and where sheep and goats range, to prevent excessive predation on livestock.

In summary, and based on the current state of knowledge, this goal is completely unacceptable to the WRCC-26 Committee.

2. Emphasis on corrective control indicates that producers must suffer loss before action in initiated and is unacceptable to most producers. The requirement to use non-lethal, non-capture methods and focus on offending animals clearly ignores the majority of research and operational findings to date, as well as the experience of highly competent livstock producers. The past decade of research has failed to develop such methods, despite extensive efforts; except for total exclusion of predators, these methods have shown little promise to date.

3. The use of husbandry techniques to reduce exposure of livestock is not new; such methods have been and are currently in use but have limited application, particularly for livestock on range.

4. Extension of information on livestock husbandry and methods of predator damage control has been routine in Western states for decades through the Extension Service of the land grant universities and county Extension agents. At this time, there appears to be no significant new information available which has not been extended to producers.

Extension has the capability to provide damage control information but can only extend results which are based on sound research and demonstrated application to local situations. Expansion of the Extension function for more extensive direct contact with livestock producers will require substantital additional staff and funding.

Proposed Ban on Leghold Traps

Greenpeace is sponsoring an initiative petition to place on the November 1980 ballot a proposal to ban the use, sale of snare, leghold traps for most purposes.

The question is: "Shall sale, use of snare, leghold traps be forbidden, except for predator control until 1985, or to protect human health?"

The explanation is: "Proposed measure would forbid sale and use of snare and leghold traps, except temporarily to control predatory animals causing livestock loss, with State Agriculture Department permit. After November 10, 1985, measure would forbid sale and use of snare and leghold traps for any reason except to protect human health and safety, with State Health Division permit. Would not forbid use or sale of mouse, rat, gopher traps, or live "box" traps. Imposes penalties for violations.

The first 5 sections of the petition are of interest and recorded below:

Section 1. (1) Snare and leghold traps including, but not limited to "long spring," "flat underspring," "coil spring," and "body grip" traps shall not be sold or used within the State of Oregon, except as hereinafter provided. (2) "Trap" has the meaning given that term by ORS 496.006 (11).

Section 2. (1) Snare and leghold traps may be used to control predatory animals only after verification of livestock losses. (2) "Predatory animals" has the meaning given that term by ORS 610.002.

Section 3. (1) The State Department of Agriculture shall verify the loss of livestock due to predatory animals and upon such verification shall issue a permit for the use of snare and leghold traps to control such predatory animals. (2) Such permit shall allow trapping only within a clearly defined geographical area and only for a limited time period as necessary to control the predatory animals as shall be specified by the State Department of Agriculture. (3) The Department shall charge such amount for each permit as the Department may prescribe, but not more than $10.

Section 4. Snare and leghold traps shall not be sold within the State of Oregon unless the prospective purchaser presents a valid permit for the use of such traps.

Section 5. (1) Snare and leghold traps shall not be sold or used within the state of Oregon for any reason whatsoever except when human health and safety is endangered after November 10, 1985. (2) The determination that human health and safety is endangered shall be made by the Oregon State Health Division. (3) Upon such determination a permit shall be issued allowing trapping within a clearly defined geographical area for a limited time period.

Essentially, if passed, the initiative would make the use of leghold traps and snares for control of livestock losses to predators illegal after 1985. This action would conflict directly with the policy changes proposed by Secretary Andrus that call for increased use of these devices by ranchers who will assume a greater responsibility for lethal control of losses. The initiative would also prevent the use of leghold traps and snares by government trappers to resolve predator/livestock conflicts. Presently 80-90% of the successfully resolved conflicts utilized the use of these traps and snares. A third conflict generated by this petition would be to civcumvent Secretary Andrus' desire to stress corrective rather than preventive control methods, and to utilize selective control methods. Removal of traps and snares would eliminate the primary corrective tool that is selective when properly used.

The Oregon Environmental Council has deliberated on the merits of the proposed initiative, weighing the impacts of the ban on animal damage control operations against impacts of the use of the devices on target and non-target wildlife. It should be noted that this agency, which represents the collective viewpoint of a number of environmental gropus in Oregon has chosen to remain neutral on the petition and not to support it.

Proposed ADC Policy/Research

Secretary Andrus made several proposals regarding conduct of research that call for careful scrutiny. The overall goal of research was to, "... redirect and refocus research efforts to support the above goals and to achieve the long-term objective of preventing predator damage rather than controlling predators." Specifically, two directives within the policy statement are important:

1. Emphasize the development and testing of non-lethal/non-capture control methods (such as scare devices, aversive agents and fencing) and intensive husbandry techniques and practices. Testing should be done under a variety of seasonal, geographic and ranching conditions so that practical conclusions may be drawn for field applications.

2. In recognition of Presidential policy concerning use of toxicants, continue research on toxicants displaying species specific characteristics and delivery systems with use patterns that are selective for target individuals. Further research on compound 1080 is to be terminated.

WRCC-26 Committee members responded to the first directive by stating:

Members of this Committee have been intensively involved in all phases of research on such methods. Research to date does not warrant the assumption in this directive that success will be achieved and "practical conclusions drawn for field application." Within the five years proposed.

Response to the second directive was more voluminous:

This Committee endorses a continued search for and research on specific selective toxicants. However, the assumption in this directive that such toxicants are currently known is in error; they have yet to be found and developed. At present, there is no known compound which is as selective and has such a significant research base as Compound 1080.

It is the concensus of this Committee that the 1080 toxic collar, for example, is without question one of the most selective methods possible where it can be applied to remove killer coyotes preying on sheep and goats. It has been developed to a stage where it can be an effective operational method to reduce livestock losses; and it is safe and selective, with no known secondary hazards. There is, therefore, absoluately no biological or economic reason for prohibiting its use; thus, prohibition of the rest of 1080 must be purely political.

The delivery of toxicants to target individuals only is the basis for use of the 1080 toxic collar. However, this Committee questions the value of conducting such research, since the single most selective delivery mechanism for a selective toxicant, the 1080 collar, has been prohibited after several years of research.

This Committee strongly supports research, development and use of Compound 1080, until more selective, safer and effective toxicants are available. However, these policy directives, prohibiting its use as it reaches an operational state, cannot be encouraging to research workers.

It is not yet clear what the outcome of the proposed policy changes concerning research will be. However, it is probable that there will be increased emphasis on research directed at non-lethal methods for control of livestock losses. To date, research on non-lethal methods has not been especially promising, as the summary below implies. There have been some successes, notably electric fencing, which may well have application in the Oregon sheep industry.

Status of Research on Non-Lethal Methods

Members of the WRCC-26 Committee have been committed to conducting research on non-lethal as well as lethal methods for controlling depredations on livestock. The following summarizes results of research with individual non-lethal methods.

Guard dogs. Initial results conflicting. Dogs raised as pups require 18-24 months time spent directly with flocks to condition response to predator attacks. In some cases the dogs harassed and chased sheep, in others, depredation losses declines. Research continues.

Chemosterilants. No effective chemosterilant found for female coyotes. A compound has been identified that satisfactorily induces sterility in males, but no delivery system has been identified. The compound breaks down in the digestive tract of coyotes when eaten, and attempts to find a carrier to prevent this have failed.

Lithium Chloride. Despite initially encouraging pen work by Gustavson, and field work in Saskatchewan, recent research in controlled situations indicates that coyotes are not deterred from preying on livestock/poultry by encountering lithium chloride in dead animals. The coyotes do learn not to eat dead animals, but are not averted from chasing and killing live animals. A carefully controlled field study in Alberta indicates that sheep ranches where lithium chloride was used suffered identical losses of sheep to ranches where lithium chloride was not used.

Biological Management of Coyote Populations. Research designed to simulate high coyote population densities failed to affect coyote reproduction. It was hypothesized that coyotes would respond to stimuli simulating high population density but test coyotes were not affected and continued to reproduce at a normal rate.

Repellents. No repellants have been found that consistently prevent coyotes from attacking sheep and goats. Early experiments with a red pepper extract looked promising in pen studies, but field trials indicated some flocks had reduced predation losses whereas others actually had increased loss rates.

Fencing. For farm flock situations, electric fencing is very promising. Demonstration fences on 25 western Oregon sheep ranches have resulted in 60-90% reductions in losses of sheep to coyotes and dogs. One New Zealand type charger is now legal and the number of sheep ranches using this fencing, ranging in cost from $350-$1,000/mile, is increasing. This fencing may well have application on eastern Oregon sheep ranches.

Andrus' revised policy for research indicates increased support for investigation of cultural methods. This point should not be lost, especially in light of the findings from our 1977 survey, that sheep ranchers practicing intense management (3 or more anti-predator practices) had 78% fewer ewe losses and 64% fewer lamb losses than ranchers practicing less intense management (2 or fewer practices). Only 38% of the intense managers lost sheep to predators, whereas 63% of the other managers lost sheep. Included in these practices were non-lethal methods, such as shed lambing, night penning, and use of herders. However, it must be noted that also included was the use of lethal methods such as shooting and trapping. It must continually be stressed to all interested parties that in addition to the need and place for non-lethal methods, lethal methods must be retained and used in concert with as many other options as possible to reduce losses of livestock to predators.

THE FINNISH LANDRACE BREED OF SHEEP IN THE UNITED STATES

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Introduction

The Finnish Landrace (Finnsheep) breed of sheep was developed from home-bred stock in eastern and north-eastern Finland. Finland lies between the latitudes of 60° and 70° north with approximately 1/4 of its total land area north of the Artic Circle. The mean annual temperature varies from 26°F in the north to 41°F in the south. Approximately 40% of the mean annual percipitation of 25 inches is in the form of snow. Due to the short growing season and long winters, feed production is limited largely to forages and sheep have to be confined indoors for a major portion of the year.

The Finnsheep breed is one of the breeds classified in the general sheep type of Scandinavian short-tail. The Finnsheep breed is characterized by a short-tail, short ears, head and legs free of wool, white in color, relatively poor mutton conformation and live weights ranging from 110-135 pounds in mature ewes. Of the 150,000 sheep found in Finland, approximately 95% are of the Finnsheep breed. The sheep are raised in extremely small flocks. Two thirds of the flocks are composed of only 1 or 2 adult sheep and less than 1% of the flocks have 10 or more adult sheep.

The Finnish Sheep Breeders Association administers a production testing program for the breed and no animal without a complete set of production records has been allowed into the herd book since 1948. The Finnsheep breed in Finland is very prolific, producing on the average 2.5 lambs per litter. This is the main reason why since 1962 Finnsheep animals have been exported from Finland to over a dozen different countries. In Finland, the breed is also reputed to reach sexual maturity at an early age and to have a low percent barren ewes each year (less than 2%).

In 1968, a sample of the Finnsheep breed was imported into the United States jointly by the University of Minnesota and the United States Department of Agriculture. Shortly after this importation a majority of the Agricultural Experiment Stations in the United States with a sheep research program began evaluation of this breed. This paper will attempt to demonstrate the importance of reproductive rate to the efficiency of lamb meat production and will present scientific data that demonstrate how the Finnsheep breed can improve flock performance.

Importance of Reproductive Performance

In the United States, approximately 95 lambs per 100 ewes mated are present at docking age. This figure is much too low when one considers that sheep have the potential to lamb for the first time at approximately 12 months of age, to produce a high percent of twin births and to produce more than one lamb crop per year.

The efficiency of lamb production (pounds of lamb produced per pound of feed fed to the entire flock in a year) can be greatly improved by an increase in the reproductive rate of the ewe flock. It is estiamted that 60-80% of the feed required to produce a lamb is consumed by the ewe. An increase in the reproductive rate of the flock offers the single greatest opportunity to reduce this ewe maintenance cost per pound of lamb produced by dividing the cost with the greater poundage of lamb produced. Table 1 points out the increased efficiency that can be obtained by an increase in reproductive rate.

Table 1. EFFICIENCY OF LAMB PRODUCTION AT VARIOUS REPRODUCTIVE RATES (Shelton, 1971)

No. of lambs marketed per ewe per year[a]	Lbs of feed per lb of lamb[b]
.75	15.4
1.00	13.0
2.00	8.8

a Once-a-year lambing with lambs marketed at 100 lb liveweight.
b Includes lbs of feed fed to the entire flock (65% TDN).

In addition to improving the efficiency of lamb production, an increase in reproductive rate will also result in an increased rate of genetic improvement in the flock if a good selection program is in operation. For any given flock size, a certain number of replacements are needed each year. As reproductive rate increases and more animals are available for selection, the proportion of those available that are required for replacements decreases. If only a small proportion of the ewe lambs available are needed as replacements, the shepherd has to retain only those ewe lambs that are truly superior and the flock will improve at a relatively rapid rate. If on the other hand, a large proportion of the ewe lambs must be retained due to a poor flock reproductive rate, many lambs will become flock members that are only average or perhaps even below average in performance. Flock improvement will be relatively slow under these circumstances.

An increase in the reproductive rate of a flock can be brought about in three ways:

1. Major emphasis should be placed on selection for ewe fertility and twinning rate. Research has shown that a 2-3% yearly increase can be realized in number of lambs born if selection is totally on reproductive rate.

2. Crossbred ewes should be used since reproductive traits show a large amount of heterosis. Crossbred ewes have been shown to wean approximately 25% more pounds of lamb per ewe exposed than the average of ewes of the pure-breeds making up the crossbred and to often exceed the best pure-breed.

3. Genetic material from breeds that excell in reproductive performance should be infused into commercial flocks to improve this trait. At present, the Finnsheep breed is the most prolific breed available to American sheep producers.

The remainder of this paper will present experimental results with the Finnsheep breed in the United States.

Ewe Lamb Reproduction

Presented in Table 2 is the reproductive performance of Finnsheep-cross ewes and domestic ewes when lambing at approximately 1 year of age. It is apparent that Finnsheep-cross ewes reach sexual maturity earlier than available domestic breeds. At all 4 locations, percentage of ewes lambing increased as the proportion of Finnsheep breeding increased. Number of lambs born per ewe lambing was also the highest for those ewes containing the greatest percent Finnsheep breeding.

Table 2. REPRODUCTIVE PERFORMANCE OF FINNSHEEP-CROSS EWE LAMBS

Locality	Cross	No ewes exposed	% Ewes lambing	Lambs born per ewe lambing	Lbs lamb weaned per ewe exposed
University of Minnesota[a]	Finn	53	95	1.66	
	3/4Finn x ¼Std	68	92	1.56	
	½Finn x ½Std	271	92	1.38	
	¼Finn x 3/4Std	60	79	1.20	
	Standard	189	72	1.08	
Clay Center, Nebraska[b]	½Finn x ½Std	315	85	1.54	14[e]
	Standard	301	58	1.08	6[e]
Oregon State University[c]	½Finn x ½ Std		72	1.62	49
	½CDR x ½Std		37	1.18	26
Dubois, Idaho[d]	½Finn x ½Std	374	90	1.55	62
	¼Finn x 3/4Std	377	81	1.22	46
	Standard	277	23	1.06	11

a Standard = Suffolk, Targhee, Minnesota 100.
b Standard = Suffolk, Hampshire, Dorset, Rambouillet, Targhee, Corriedale.
c Standard = Suffolk, Columbia; C=North Country Cheviot, D=Dorset, R=Romney.
d Standard = Rambouillet, Targhee, Columbia.
e Lbs. boneless lamb per ewe exposed.

Table 3. REPRODUCTIVE PERFORMANCE OF 3-YEAR-OLD FINNSHEEP-CROSS EWES

Locality	Cross	No ewes exposed	% ewes lambing	Lambs born per ewe lambing	Lbs lamb weaned per ewe exposed
University of Minnesota[a]	Finn	17		2.44	
	3/4Finn x ¼Std	11		1.88	
	½Finn x ½Std	71		1.76	
	Standard	75		1.10	
Clay Center, Nebraska[a]	½Finn x ½Std	95	93	1.93	29.5[b]
	Standard	155	86	1.54	21.3[b]
Dubois, Idaho[a]	½Finn x ½Std	134	95	2.14	88
	¼Finn x 3/4Std	127	97	1.73	87
	Standard	94	90	1.38	65

a Standard breeds same as given on Table 2.
b Lbs. of boneless lamb per ewe exposed.

These data clearly indicate that the infusion of Finnsheep breeding into domestic flocks will result in increased lamb production from ewe lambs.

3-Year-old Reproduction

In order to give an indication of reproductive performance of adult Finnsheep-cross ewes, data from 3 locations for 3-year-old ewes is presented in Table 3. As was the case with ewe lamb reproduction, as the proportion of Finnsheep breeding increases, the number of lambs born per ewe lambing also increases. The older ewes, however, don't show a large advantage of Finnsheep-cross ewes over standard ewes for % ewes lambing.

Wool Production

Wool production data presented in Table 4 shows that ¼ Finnsheep ewes will produce approximately 1 pound less wool than standard breeds. Wool weights were reduced further when ½ Finnsheep breeding was used. There is a general trend for ewes of increasing Finnsheep percentage to produce coarser grading fleeces.

Lamb Survival

From Tables 2 and 3 it is evident that the use of Finnsheep breeding in a commercial flock will result in an increase in number of lambs born per ewe exposed. An increase in number of lambs born is of little value unless a majority of the additional lambs survive. Table 5 presents lamb survival to weaning for lambs of various percentages of Finnsheep breeding.

Table 4. WOOL PRODUCTION OF FINNSHEEP-CROSS EWES

Locality	Cross	No. of Ewes	Grease Fleece Weight (lb.)	Grade
University of Minnesota[a]	Finn	53	4.85	38%[c]
	3/4Finn X ¼Std	68	5.44	25%[c]
	½Finn X ½Std	271	6.39	53%[c]
	¼Finn X 3/4Std	60	6.39	58%[c]
	Standard	189	7.24	64%[c]
Dubois, Idaho[a]	½Finn X ½Std	374	7.9	59[d]
	¼Finn X 3/4Std	377	9.0	60[d]
	Standard	277	10.1	61[d]
Hopland, California[b]	½Finn X ½Std	48	7.8	
	¼Finn X 3/4Std	95	7.9	
	Standard	122	9.1	

[a]Standard breeds same as given on Table 2.
[b]Standard = Targhee, Corriedale.
[c]% of fleeces grading 3/8 blood or better.
[d]Spinning count.

Table 5. LAMB SURVIVAL TO WEANING OF FINNSHEEP-CROSS LAMBS

Locality	Cross	% alive at weaning
University of Minnesota[a]	Finn	89
	3/4Finn X ¼Std	80
	½Finn X ½Std	77
	¼Finn X 3/4Std	69
	Standard	71
Clay Center, Nebraska[a]	½Finn X ½Std	81
	Standard	63
	¼Finn X 3/4Std	61
	Standard	59
Hopland, California[a]	¼Finn X 3/4Std	63
	1/8Finn X 7/8Std	72
	Standard	71

[a]Standard breeds same as given on Tables 2 and 4.

The data generally shows that lambs of Finnsheep breeding have greater survival rates than standard breeds even though a higher percentage of multiple born lambs are present. Generally mortality rates increase as number of lambs born per ewe increases. The only exception was observed in the Hopland, California data where ¼ Finnsheep lambs had a lower survival rate to weaning than 1/8 Finnsheep and standard lambs. The Hopland Field Station is located in an area where the range conditions are not conducive to high survival rates among twin lambs. However, even with the higher lamb mortality, more ¼ Finnsheep lambs were present at weaning per ewe exposed than 1/8 Finnsheep on standard lambs due to a higher number of lambs born per ewe exposed to the ½ Finnsheep dams.

High survivability among lambs of Finnsheep breeding is one of the breeds real assets.

Lamb Growth and Carcass Traits

The Finnsheep breed is relatively fine boned and has a mutton conformation that would appear to be inferior to most of our domestic breeds. This has led to some speculation about the growth rates and carcass traits of Finnsheep-cross individuals. Presented in Table 6 are growth and carcass traits for Finnsheep-cross lambs.

The growth traits presented are adjusted for type of birth, age of dam and sex of lamb. Since it is known that, on the average, twin lambs have poorer growth rates than single lambs due to twin lambs not receiving adequate milk for optimum growth, adjustment for this factor and others known to affect growth are desirable so that the crosses can be compared on an equal basis. From Table 6, it can be seen that Finnsheep-cross lambs are lighter at birth than standard breed lambs but that their weaning and post-weaning weights are very similar. These data would indicate that the Finnsheep breed cannot be criticized for poor growth rate. It must be remembered, however, that the actual unadjusted weights of Finnsheep-crosses will probably be slightly lighter than the standard breeds because there will be more twin lambs represented in the Finnsheep-crosses.

As the proportion of Finnsheep breeding increases, there is a corresponding increase in % kidney (internal) fat and a slight decrease in backfat thickness. More detailed studies have shown that Finnsheep-crosses and standard breeds have a similar percent of their carcass weight in fat, but the Finnsheep-crosses have more internal fat and standard breeds have more subcutaneous fat. Loin eye areas showed a tendency to decrease as the proportion of Finnsheep breeding increased. Differences between Finnsheep-crosses and standard breeds for % of carcass weight in boneless cuts were very small.

Ewe Longevity

Presented in Table 7 is ewe survival data for Finnsheep cross ewes. Under the relatively harsh range conditions of the Hopland Field Stations, the ½ Finnsheep ewes have left the flock at a faster rate than the ¼ Finnsheep and standard ewes. A study conducted at Oregon State University has also

Table 6. GROWTH AND CARCASS TRAITS OF FINNSHEEP-CROSS LAMBS

Locality	Cross	Birth Weight (lb)	Weaning Weight (lb)	22 Week Weight (lb)	% Kidney Fat	Backfat (in)	% Boneless Cuts	Loin Eye Area (in^2)
University of Minnesota[a]	Finn	5.7	38.9		5.6	.11	44.7	1.78
	3/4Finn X ¼Std	6.8	39.8		5.2	.12	44.9	2.06
	½Finn X ½Std	7.4	39.3		4.2	.13	45.2	2.05
	¼Finn X 3/4Std	7.4	40.7		4.1	.13	45.4	2.17
	Standard	7.9	38.4		3.1	.16	45.6	2.11
Clay Center, Nebraska[a]	½Finn X ½Std	8.3	41	98	4.8	.13	45.0	
	Standard	9.2	41	97	3.3	.16	45.2	
	¼Finn X 3/4Std	7.2	32.9	79	4.6	.28	43.3	
	Standard	9.2	36.1	83	4.0	.30	43.2	

[a] Standard breeds same as given on Table 2.

Table 7. SURVIVAL OF FINNSHEEP CROSS EWES

Locality	Cross	No. Starting Trial	% remaining at 5 years
Hopland, California[a]	½Finn X ½Std	48	53
	¼Finn X 3/4Std	95	71
	Standard	122	68

[a]Standard breeds same as given on Table 4.

shown that ½ Finnsheep ewes leave the flock at a rate slightly greater than other crossbred ewes. In farm flocks, where ewes are not put under nutritional stress, lower survival rates of ½ Finnsheep ewes has not been reported.

Conclusion

Research data collected in the United States clearly shows that the infusion of Finnsheep breeding into our commercial sheep flocks will result in more lambs weaned per ewe exposed; especially in flocks where ewes are mated to lamb at approximately 1 year of age. Finnsheep-cross ewes will produce lambs that are lighter at birth but similar in weaning and post-weaning weights than lambs from standard U.S. breeds. However, the Finnsheep-cross ewes will produce lambs whose carcasses have greater amounts of kidney fat and smaller loin eye areas. Finnsheep-cross ewes will generally sheer lighter fleeces and may leave the flock at a faster rate than ewes of standard breeds.

Table 8 presents the projected performance of ¼ Finnsheep and ½ Finnsheep ewes based on the data presented previously, given a certain performance level of the standard breed. Average individual lamb weaning and 22 week weights are less for Finnsheep-cross ewes than for standard ewes because of a larger number of multiple born lambs from Finnsheep cross ewes. The data clearly show the advantage of Finnsheep cross ewes in pounds of lamb at 5½ months per ewe exposed. If lamb value is figured at $.60 per pound and ewe fleece wool at $1.25 per pound, the ½ Finnsheep and ¼ Finnsheep ewes are projected to return $28.10 and $11.35 more gross income per ewe exposed than standard ewes when lambing at 1 year of age, respectively. At older ages, ½ Finnsheep and ¼ Finnsheep ewes return $25.10 and $16.15 more gross income per ewe exposed per year than standard ewes, respectively.

Using the yearly production figures presented in table 8 and the ewe mortality figures presented in table 7 where it is shown that the ½ Finnsheep ewes leave the flock at a faster rate than ¼ Finnsheep or standard ewes, it is calculated that the total pounds of lamb at 22 weeks produced over 5 years per ewe entering the flock would be 542 for ½ Finnsheep ewes, 544 for ¼ Finnsheep ewes and 430 for standard ewes. This shows the value of high reproductive rates. Even though the ½ Finnsheep ewes might be expected to leave the flock at a faster rate than the ¼ Finnsheep or standard ewes, their lamb production per ewe exposed per year is high enough to offset their increased ewe mortality.

Table 8. PROJECTED PERFORMANCE OF FINNSHEEP-CROSS EWES GIVEN THE PERFORMANCE OF A STANDARD BREED

Cross	% Ewes Lambing	Lambs Born per Ewe Lambing	% Lamb Survival	Lamb Weaning Wt. (lb)	Lamb 22 Week Wt. (lb)	Lbs. lamb at 22 weeks per ewe exposed	Fleece Wt. lb.
Ewe Lamb Production							
½Finn X ½Std	.80	1.68	.80	51	88	94	8
¼Finn X 3/4Std	.65	1.38	.80	52	89	64	9
Standard	.50	1.20	.80	53	90	43	10
Mature Ewe Production							
½Finn X ½Std	.95	2.25	.85	54	92	167	8
¼Finn X 3/4Std	.95	1.88	.85	60	98	150	9
Standard	.95	1.50	.85	62	100	121	10

88/76

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