SHEEP SKILLATHON STUDY GUIDE

TAKEN FROM THE

SHEEP INDUSTRY DEVELOPMENT PROGRAM'S

SHEEP PRODUCTION CURRICULUM

THIS CURRICULUM WAS DEVELOPED FOR THE

AMERICAN SHEEP INDUSTRY ASSOCIATION

BY USING THE

SHEEP PRODUCTION HANDBOOK

AS ITS SOURCE

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BREEDING AND SELECTION

I. Terms and definitions

a. Trait – characteristic of animal
b. Locus – physical location of a gene on a chromosome
c. Purebreeding – mating of rams and ewes of a common genetic group (usually a breed)
d. Crossbreeding – mating of rams and ewes of different breed composition
e. Homozygous – the two genes that form a gene pair are identical
f. Heterozygous – the two genes that form a gene pair are different
g. Dominant – is a heterozygous gene pair, it is the allele that expresses itself; a dominant allele is usually denoted by upper-case letters (A)
i. Gene pairs can also be homozygous dominant.
h. Recessive – in a heterozygous gene pair, it is the allele that does not express itself; it is usually denoted by lower case letters (a)
i. Gene pairs can also be homozygous recessive.
i. Genotype – listing of genes that an animal has
j. Phenotype – physical expression of genotype
k. Epistasis – the expression of genes at one locus are influenced by genes present at another locus
l. Variation – term used to quantify genetic and phenotypic differences among animals in performance
m. Heritability – proportion of differences among animals for performance traits that are due to differences in the additive effects of their genes
n. Standard deviation – average deviation of each individual in the population from the population average
o. Correlation – measures the relationship between two variables (can be positive or negative)
p. Contemporary group – group of animals of similar breed composition, age, and sex raised together
q. Selection – practice of determining which individuals will be allowed to mate and produce offspring
r. Selection differential – how much better or worse the selected individuals are, compared to the entire group of individuals eligible for selection
s. Generation interval – average age of the reproducing adults in the flock at the time of lambing
t. Single-trait selection – only selecting for one trait at a time (ie: 60-d wt or 120-d wt)
u. Multiple-trait selection – selecting for several traits at the same time (ie: fertility, milking ability, and growth rate)
v. Fertility – proportion or percentage of ewes lambing that were exposed to rams
w. Prolificacy – number of lambs born per ewe lambing
x. Total ewe productivity – overall reproductive measure that is the pounds of lamb weaned per ewe exposed to rams
y. USDA Yield Grade – estimate of percentage of trimmed and boned major retail cuts in the carcass
z. Fleece weight – weight of shorn wool from one animal
aa. Staple length – length of wool fiber in fleece
bb. Seedstock flock – one that sells breeding stock, primarily rams, to commercial flocks or other seedstock flocks
cc. Commercial flock – one that sells pounds of lamb and/or wool
dd. Mating system – how selected breeds and individuals will be paired at mating
ee. Heterosis – superiority of the crossbred individual relative to the average performance of the purebreds included in the cross
ff. Complementarity – developing a cross between two breeds that maximizes strengths and minimizes weaknesses of each breed
gg. Defect – characteristic which reduces the possibility of survival or impairs the producing ability of the animal

II. Classification of sheep breeds by function or use

a. Ewe breeds
    i. These are generally white-faced breeds of the fine-wool type that are fairly prolific
b. Ram breeds
    i. These are meat type breeds used for market lamb production
c. Dual Purpose breeds
    i. These can be used as either ewe or ram breeds

III. Traits to consider in breed selection

a. Adaptability – ability to survive and reproduce in a given environment with available resources
b. Reproductive efficiency – measured by the number of lambs weaned per ewe
    i. It is a combination of many different traits.
c. Rate of lamb growth – measured by how fast the lamb gains weight
d. Wool production – includes both quality and quantity of wool
    i. Wool production may be more important in some operations depending on their production goals.

IV. Organization of genetic material (Transparency #1)

a. Sheep have 54 chromosomes (27 pairs)
    i. Chromosomes carry the genetic material that controls how the animal looks and performs.
b. Chromosomes are made up of DNA
    i. An individual has the exact same set of chromosomes (and DNA) in every cell in its body.
c. DNA is made up of genes
d. Genes are made up of alleles

V. Passing of genetic material from parents to progeny

a. Sperm contains one chromosome from <u>each</u> of the ram's 27 pairs of chromosomes
b. Egg contains one chromosome from <u>each</u> of the ewe's 27 pairs of chromosomes
    i. Since only one pair is found in the sperm and egg, each sperm and egg contains one gene of each gene pair and one half of the DNA present in normal cells.
c. New lamb, formed when sperm and egg unite, has 54 chromosomes (27 pairs)

VI. Different types of gene action

a. Complete dominance
    i. Two alleles
    ii. One gene is completely dominant over another gene and there is no difference in appearance between the homozygous and heterozygous condition
    iii. Example: Genotypes and corresponding phenotypes for Spider Syndrome in which the alleles are S (normal) and s (spider).
        SS – normal Ss – normal ss – Spider
b. Partial or incomplete dominance
    i. Two or more alleles
    ii. Heterozygous condition is different from either homozygous one
    iii. Example: Genotypes and corresponding phenotypes for horn growth in <u>rams</u> in which the alleles are P, p', and p.

PP – polled	Pp' – scurred
Pp – scurred	pp' – horned
pp – horned	p'p' – horned

VII. Classification of traits

a. Qualitative
    i. Classified into discrete categories rather easily
        1. Examples include horn growth (an animal is either horned, polled, or scurred) and Spider Syndrome (an animal is either normal or a Spider).
    ii. Controlled by a few alleles
    iii. Influenced very little by environment
b. Quantitative
    i. Classification into discrete categories is impossible because of continuous expression
        1. Examples include average daily gain, birth weight, and weaning weight.
    ii. Influenced by many alleles at several loci
    iii. Affected by environment
    iv. Includes most of the economically important traits

VIII. Formulas associated with phenotype (Transparency #2)

a. Phenotype = Genotype + Environment
    i. Environment includes things like nutrition and climate.
b. Phenotype = Flock average ± Genotypic deviation ± Environmental deviation
    i. Genotypic and environmental deviations can be positive or negative depending on whether the genes and environment affecting the individual are above or below the average animal in the flock.
c. Genotypic deviation = Breeding Value
d. Phenotype = Flock average ± Breeding Value ± Environmental deviation

IX. Normal distribution for a quantitative trait (Transparency #3)

a. Very few sheep have low performance
b. Many sheep have performance near the flock average
c. Very few sheep have high performance

X. Important uses of variation

a. Measures of uniformity
b. Raw material for genetic improvement
    i. Genetic improvement is accomplished by selecting animals with superior performance to be the parents of the next generation. If there was no variation in performance, then there would be no opportunity for genetic change.

XI. Requirements for accurate estimation of genetic value

a. Accurate identification of the animal, its ancestors, and its descendants
    i. Most registered sheep will have two IDs (unique registration number and flock ID) while commercial flocks will have only the unique flock number.
b. Written record of measurements taken on traits of economic importance

XII. Pros and cons of commonly used methods of sheep identification

a. Metal or plastic tags
    i. Easily attached
    ii. Easily lost
    iii. Most registered sheep are provided with metal or plastic registration tag
b. Ear tattoos
    i. Permanent method of identification
    ii. Some difficulty in reading them
c. Paint brand

i. Short term use only
ii. Effective in some production systems

XIII. Guidelines for starting an effective record keeping system

a. Record meaningful ID for animal
   i. Five- to six-digit number
   ii. First two should correspond to birth year
   iii. Last three to four should correspond to order of birth
   iv. Example: The third lamb born in 1988 season would have the ID 880003.
b. Record sire and dam ID of animal
c. Record birth date of animal
d. Record trait of economic importance
e. Record exact date of measurement
f. Record known environmental and management effects
   i. Sex
   ii. Age of dam
   iii. Type of birth (single, twin, or triplet)
   iv. Type of rearing (single, twin, or triplet)
   v. Creep feeding (yes or no)
   vi. Contemporary group

XIV. Categorization of traits

a. Reproductive traits
   i. Date of lambing
   ii. Number of lambs born
   iii. Ease of lambing
b. Growth traits
   i. 30-d weight
   ii. 60-d weight
   iii. 90-d weight
      1. These traits are also used to measure maternal ability.
c. Wool traits
   i. Fleece weight (clean or grease)
   ii. Staple length
   iii. Fiber diameter
d. Carcass traits
   i. Carcass weight
   ii. Fatness
   iii. Quality grade
   iv. Loin eye area

XV. Methods of comparing animals within a contemporary group

a. Deviation – the difference between the performance of an individual and the average performance of its contemporaries
   i. Example: Lamb weighs 45 pounds at 60-d. Average of his contemporary group (CG) is 40 pounds.
      1. Deviation = lamb weight – CG average
         = (45 – 40)
         = 5 pounds
b. Ratio – involves dividing the animal's own performance by the average of its contemporaries and multiplying that result by 100

i. Example: Lamb weighs 45 pounds. Average of his contemporaries is 40 pounds.
    1. Ratio = Own performance/CG average X 100
        = (45/40 X 100)
        = 112.5

    Therefore, the lamb weighs 12.5% more than its contemporaries.

XVI. Important terms related to genetic value

a. Expected Progeny Difference (EPD) – an estimate of how much better or poorer an individual's progeny will perform compared to the average of all individuals in the flock
    i. EPD is expressed as a deviation
    ii. Average EPD in a population is zero
    iii. Example: If a has an EPD of +2.0 lbs for 30-d wt, then one would expect her lambs to weigh 2.0 lbs more than the average at 30-d.
b. Estimated Breeding Value (EBV) – also used to predict the expected performance of progeny; EBV is equal to twice the EPD
c. Accuracy (ACC) – a measure of reliability for EPDs and EBVs, which ranged from 0 to 1
    i. The higher the accuracy, the more reliable the EBV or EPD is.

XVII. Two types of selection

a. Natural – sheep that are best adapted to their environment produce offspring
    i. Also known as "survival of the fittest"
b. Artificial – imposed by man, results in genetic improvement of the economically important traits

XVIII. Factors affecting genetic improvement per year

a. Accuracy of selection
b. Intensity of selection
c. Variation
d. Generation interval

XIX. Methods of single-trait selection

a. Individual selection – selecting potential parents on their own performance record or phenotype
    i. If heritability of trait is high, a breeder can make good genetic progress by using individual selection.
b. Family selection – selecting or rejecting <u>entire</u> families according to the average performance or phenotypic value of the family
    i. Family selection is most useful when heritability of trait is low.
c. Pedigree selection – consideration is given to the breeding value of the animal's ancestors
    i. Pedigree selection is useful for traits that are only expressed in one sex, for traits that will not be expressed until later in life, or for traits measurable only after slaughter.
d. Progeny test – a form of pedigree selection in that an animal's breeding value is estimated using the performance or phenotype of its offspring
    i. The progeny test has some of the advantages of pedigree selection but cannot be done until the animal reaches sexual maturity and has offspring.
e. Combined selection – estimates an animal's breeding value by combining all the performance information available for the traits of interest and correlated traits, including the animal's own performance information as well as the information from relatives
    i. Combined selection is the optimum method of selection available today and results in the greatest rate of genetic response.

XX. Methods of multiple-trait selection

a. Tandem selection – focuses on one trait at a time by selecting for one trait until a satisfactory level of performance is reached, then a second trait is considered and so forth
    i. The success of tandem selection depends on the genetic correlations among the traits.
b. Independent culling levels – all individuals below any of the minimum standards set for each trait are culled
c. Selection index – ranks individual animals using the economic merit of two or more traits
    i. The selection index is the most efficient method of selecting animals when several traits are of interest.

XXI. Goals and benefits of genetic evaluation programs available

NOTE: The primary objective of genetic evaluation programs is to obtain fair comparisons among all animals being considered for selection.

a. On-farm testing
    i. Goal: Identify high producing ewes and rams within a producer's flock
    ii. Benefits
        1. Aid breeders in identifying poor producing ewes
        2. Help breeders improve their production management practices
b. National Sheep Improvement Program (NSIP)
    i. Goal: Provide both the purebred and commercial sheep producers with a performance recording and evaluation program
    ii. Benefits
        1. Provides both the purebred and commercial sheep producer with a performance recording and genetic evaluation program
        2. Minimizes amount of record keeping
        3. Utilizes state-of-the-art genetic evaluation procedures
c. Central ram test
    i. Goal: Facilitate the use of performance records among different flocks and evaluate growth traits in rams
    ii. Benefits
        1. Superior stud rams can be identified for use in seedstock flocks
        2. Male traits emphasizing growth are primarily evaluated

        NOTE: Ewe productivity and non-growth traits are not evaluated.

XXII. Traits to consider in reproductive selection

a. Fertility
b. Prolificacy
c. Lamb survival
d. Total ewe productivity

XXIII. Traits to consider when selecting for growth

a. Pre-weaning growth rate
b. Post-weaning weight or gain
c. Post-weaning rate of gain

NOTE: Pre and post weaning weights should be adjusted for age, sex, type of birth and weaning, and age of dam.

XXIV. Traits to consider in selection for carcass merit

NOTE: Selection for carcass merit can be difficult because obtaining carcass information on <u>live</u> animals is expensive, time-consuming, and often impractical.

a. USDA Yield Grade
    i. The carcass measurements needed to calculate yield grade are easily obtained and do not disfigure the carcass.

b. Loin eye area
    i. While loin eye area is highly heritable and economically important, it is difficult to obtain because lamb carcasses are not usually cut (ribbed) to expose the loin eye.
c. Subcutaneous fat thickness (over loin eye)
    i. Fairly accurate measurements can be obtained on live animals with ultrasound equipment.

XXV. Traits to consider when selecting for fleece characteristics

NOTE: The value of wool to the enterprise needs to be determined since some flocks receive little to no income from wool while for others it is a major portion of their income.

a. Fleece weight
    i. Clean
    ii. Grease

    NOTE: Within a particular grade, clean fleece weight is the best measure of fleece value.
b. Staple length
    i. A premium is paid for fine wool of approximately 3 inches in length.
c. Fiber diameter
    i. Finer wools (smaller diameter) generally sell at a higher price than coarser wools.

XXVI. Importance of genetic improvement in seedstock flocks

a. Commercial flocks generally produce their own replacement ewes but purchase rams from seedstock flocks
b. Genetic improvement in commercial flocks is largely dependent on the genetic improvement in the seedstock flocks from which rams are purchased
c. Selection goals of commercial flock must be the same as those of the seedstock flock from which they are buying rams
d. Genetic improvement of the national flock is dependent largely upon a relatively small number of seedstock flocks
e. Seedstock producers need to determine the use of their breed in commercial production and select for the few traits that will enhance the use of their breed in that role

XXVII. Purebreeding mating systems

a. Outbreeding – continuous use of unrelated rams
    i. Maintains greatest amount of genetic heterozygosity
    ii. Attains high level of performance
    iii. Utilized by a majority of purebred breeders
b. Inbreeding – mating of ram and ewe which are related
    i. Lamb's inbreeding depends on how closely ram and ewe are related
    ii. Homozygous gene pairs are increased
    iii. Detrimental effects are seen in all traits except prolificacy
    iv. Undesirable recessive genes are more likely to be expressed and detected
    v. Development of highly inbred flocks that are homozygous primarily for desirable genes is difficult
    vi. Greatest negative effect of inbreeding is on overall reproductive rate
    vii. Progeny testing a ram on his daughters will check ram for genetic defects

XXVIII. Reasons for crossbreeding

NOTE: Crossbreeding is generally used because the resulting progeny are considered superior to purebred type.

a. Grading up – repeated crossing of ewes and their female progeny to rams of a single breed
    i. Produces flock that is representative of the sire breed and will eventually be indistinguishable from purebred flock of that breed
    ii. Utilized when importing breeds where purebred females are limited or not available

    NOTE: Most of the registered Finnsheep in the U.S. were derived from grading up programs.

b. New or "composite" breed formation
    i. Meets the needs of a production system in which no existing breeds satisfy
    ii. Allows the blending of characteristics of several breeds into a single population
    iii. Requires considerable resources in terms of animals, capital, and management

    NOTE: New breed formation has been more successful in sheep than in most other livestock species.

c. Systematic crossbreeding – mating rams and ewes of specific breeds or crosses to produce offspring of a specified type

    NOTE: Crossbred individuals tend to be more vigorous, more fertile, and grow faster than the average of the purebreds that make up the cross.

    i. Utilizes heterosis
        1. Effects of heterosis tend to be large for traits that are lowly heritable and small for traits that are relatively highly heritable.
    ii. Takes advantage of complementarity
        1. Production is optimized when breeds are placed in roles that maximize their strengths and minimize their weaknesses.

XXIX. Types of crossbreeding systems

a. Terminal
    i. Maximum use of both heterosis and complementarity
    ii. Involves two, three, or four breeds
        1. A two-breed terminal cross fails to capitalize on potential crossbred ewe heterosis.
    iii. Maximum heterosis can be achieved by using a 4-way terminal cross with crossbred rams and ewes
b. Rotational
    i. Maintains high levels of heterosis
    ii. Allows convenient replacement ewe production from flock within
    iii. Based on alternating use of rams of two or more breeds within the flock
    iv. Requires one breeding pasture for each sire breed
    v. Fails to use breed complementarity
c. Roto-terminal
    i. Combines advantages of terminal and rotational systems
    ii. Utilizes the rotational system in the nucleus flock to produce replacement ewes

    NOTE: The feasibility of the various crossbreeding systems is a function of flock size.

XXX. Methods of eliminating undesirable recessive traits

a. Cull sire and dam of affected animal
b. Progeny test sire before use extensively

XXXI. Levels of defect

a. Carrier – animal does not exhibit traits but carries gene for it
b. Sublethal – animal exhibits trait and does not function normally
c. Lethal – animal exhibits trait and dies because of it

SHEEP HANDLING AND FACILITIES

I. Terms and definitions

a. Flight zone – minimum zone of comfort (security)
b. Cutting gate – see-through gate off a sorting chute used to sort sheep to different pens
c. Flap gate – small, self-closing gate that sheep can push open; used to "lead" sheep
d. Crowd gate – solid gate used to move sheep into a smaller area
e. Guard dog – dog that stays with and protects sheep
f. Working/herding dog – dog that works with shepherd to move and gather sheep
g. Gathering pen – fenced pen that will comfortably hold the largest number of sheep you expect to work at one time
h. Crowding pen – pen used to confine small group of animals prior to moving them into treatment chutes
i. Treatment chute – long narrow area that restricts movement so that treatment can be applied
j. Sorting chute – narrow area with tapering sides that allows animals to file through sorting gates after treatment
k. Holding pens – pens that are filled as sheep are sorted
l. Footbath – chemical and water mixture (that sheep stand in) used for prevention and treatment of footrot and/or footscald

II. Reasons for maintaining good handling facilities

a. Work and physical exertion required to care for sheep are reduced
b. Management jobs can be performed in a more timely and routine manner
c. Management jobs can be performed in a more humane manner with less risk of injury to shepherd and sheep
d. Wool stays cleaner

III. Factors that determine type of facility needed

a. Task to be performed
b. Time of year
c. Frequency task needs to be performed
d. Number of sheep handled at any one time
    i. This factor determines dimension of pens and chutes.

IV. Important sheep behavior and handling characteristics (Transparency 1)

a. Sheep have a wide field of vision
    i. Average sheep have a visual field of 270 degrees and can see behind themselves without turning their heads.
b. Solid fences should be used in chutes and crowd pens to prevent distractions
    i. Sheep respect a solid barrier.
c. Sheep have a tendency to move toward light
    i. Lights should not shine into eyes of sheep.
d. Shadows cause sheep to balk
e. Excessive noise is highly stressful
f. Different sheep breeds react to people and dogs differently
g. Sheep maintain a "flight zone"
h. Sheep have a strong instinct to follow the leader
i. Sheep will move more readily into the wind and uphill
j. Sheep move better through a curved chute
k. Sheep remember good and bad experiences for up to 12 months

V. Description of guard dog

a. Primary role is to stay with and protect sheep

b. Common breeds include Great Pyrenees, Hungarian Komondor, and Akbash from Turkey
c. Most make decisions and act independently

VI. Steps in training guard dogs

a. Buy pup from reputable breeder
b. Socialize very young puppies (7-8 weeks) with lambs
c. Maintain brief contact with handler
d. Acclimate sheep (especially range sheep) to guard dog

NOTE: Guard dogs can successfully reduce predation, but time, patience, and effort are required to manage them successfully.

VII. Job role of working dog

a. Primary role is to respond to human commands when working sheep
b. Common breeds include Border Collies, Australian Shepherds, and Queensland Heelers
c. Superior intelligence and instinct
d. Strong attachment to master with desire to please

VIII. Principles of facilities layout and location

a. Site
    i. Facilities should be centrally located for both sheep and shepherd.
b. Existing facilities
    i. If it will be only a working unit, one may want to attach it to an existing outbuilding.
c. Topography of the site and land
    i. Slope and orientation of the facility must be considered.
d. Drainage
    i. If built on a slope, natural drainage will be sufficient. If not, a light porous soil with gravel type subsoil or concrete is necessary.
e. Shelter and/or shade
    i. Use hill, patch of shrubs, or windbreak to break force of winds, dust, and snow. Trees for shade during warmer seasons are most valuable.
f. Water supply
    i. Reliable water supply is necessary for dips, showers, water troughs, and settling dust.
g. Accessibility to electricity
    i. Electricity may be needed for electrical dockers, scales, etc. as well as lights.
h. Economics/cost factor
    i. Economics is usually the limiting factor; therefore, one should use high quality building materials to reduce repair and replacement costs.

IX. Procedures for safe handling of sheep (Transparency 2)

a. Hold in gathering pen
b. Move to crowding pen
c. Force into treatment chutes
d. Walk single file through sorting gate
e. Cut into sorting pens
f. Move into holding pens

X. Characteristics of gathering pens

a. Large enough to hold greatest number of sheep you expect to work at one time
b. Often used for feeding and watering
c. Located to allow for easy movement from pastures or lots

d. Allow 5 to 6 square feet per ewe or 3 to 4 square feet for feeder lamb
    i. Too large a pen means too much time spent chasing sheep.
e. Long rectangular pens with slanted ends work best
    i. Sheep tend to huddle in sharp corners.
f. Fences and gates should be 40 to 42 inches tall and slatted to allow light in

XI. Characteristics of a crowding/forcing pen

NOTE: The forcing pen is the most neglected, overlooked part of most handling facilities.

NOTE: For very small flocks, the forcing pen and gathering pen are one and the same.

a. Outer walls should be solid with a 2 to 4-inch gap at bottom for air and water movement
b. Pen shape depends on flock size
c. Swing gates work best

XII. Types of gates

a. Sort gate – swings to form tapered area for sheep to slide through
    i. The most important moving gate in entire system. It must be easy to use, quick, safe, and effective.
b. Drop gate – lowered to stop flow or raised above chute to empty
c. Stop gate – same action as drop gate except that gate moves across chute
    i. Stop gate action is quicker than drop gates, so there is much less chance for animals to escape while the gate is being closed.
d. One-way gate – allows sheep to go forward by pushing while preventing them from backing up
e. Hinged swinging gate – simplest and cheapest gate that requires a lot of space and isn't very quick

XIII. Types of gated for semicircular pens (Transparency 3)

a. Swing-slide gate
    i. Continuously swings in one direction without a center post
    ii. Slides through itself in own frame (see Transparency 3)
b. Lift swing gate
    i. Lifts straight up and swings back <u>above</u> incoming sheep
    ii. Aided by counterbalances, cables, and a tall center post
c. Center post gate
    i. Operates like hands of a clock with 2 swing gates on center post
    ii. Forms a full circle

XIV. Characteristics of a treatment chute

a. Chutes are filled from forcing pens
    i. The larger the flock, the longer the chute.
b. Entrances are controlled with drop and/or stop gates
c. Chutes must be narrow enough so that animals can't turn around
    i. The most effective chutes have sloping (11 inches at bottom and 22 inches at top) or adjustable sides.
d. Chute is emptied through sorting gated after treatment has been given to all animals in chute
    i. Three feet is the normal height for treatment chutes.
e. Two chutes are placed side by side when flocks exceed 500 animals

XV. Components of shearing shed (Transparency 4)

NOTE: Any conveniently sized, empty building can be quickly converted into a shearing shed.

a. Holding pen for unshorn sheep
b. Catching pen for <u>each</u> shearer
c. Wooden shearing floor
d. Covered area adjacent to shearers for wool

XVI. Types of scales

NOTE: Few scales are built exclusively for sheep.

a. Portable hanging scale
    i. Useful for weighing lambs at birth.
b. Balance beam scale
    i. Must move weights until balance is achieved. Therefore, not the best for weighing more than 30 head per hour.
c. Clockface digital scale
    i. Weights read from clockface dial. Can weigh up to 500 head per hour.
d. Digital scale
    i. Weights are read from digital readout.

XVII. Restraining devices (Transparency 5)

a. Gambrel restrainer – placed over the top of the animal's neck, with clots on either side for both front legs
b. Sheep "deck" chair- steel frame that can be hooked over a gate or leaned against a building while it holds the sheep sitting on its rump
c. Turning cradle – sheep are squeezed from the front and rear until all feet leave the ground and then pivoted upside down, end over end
    i. Primary limitation is its inability to handle extremely tall, long, or horned breeds.
d. Tilt table – sheep are squeezed from the side by the ribs and chest and then turned upside down, side over side
    i. Primary limitation is its inability to handle extremely tall, long, or horned breeds.

XVIII. Advantages and disadvantages of different types of footbaths

a. Concrete
    i. Expensive and very permanent
        1. Filling the bath is expensive for small flock and draining and cleaning can be a problem.
    ii. Provides excellent footing
        1. Concrete must have textured surface to provide excellent footing.
    iii. Useful when soaking large numbers of animals at one time
b. Wood
    i. Portable and easy to use
    ii. Initially inexpensive but leaks easily
c. Fiberglass
    i. Durable and portable
    ii. Expensive and very slippery
d. Plastic
    i. Less durable than other materials
    ii. Less expensive than fiberglass with better footing

XIX. Methods of applying insecticidal solution

NOTE: Solution is applied to kill external parasites such as ticks, lice, and keds.

a. Jetters – inexpensive means of spraying sheep while they are restrained in chute
b. Showers and/or sprayers – commercially made devices that heavily soak 20 to 40 head of sheep for 30 to 60 seconds with high volume nozzles spraying down from above and up from below

XX. Common types of sheep corral fences

NOTE: Producers must consider what works best, how much it costs, and how much time it will take to install.

a. Wooden boards on wood posts

i. Posts should be at least 3 ½ inches in diameter of treated softwood and driven 24 to 30 inches in the soil.

b. Woven wire on wooden and/or steel posts
   i. Woven wire is generally not recommended due to possible injury to sheep. If used, it should have verticals every 6 inches, as sheep tend to catch their heads in it.
   ii. High tensile woven wire makes a much better fence.
c. High density polyethylene on wooden posts
   i. With an extra strand of high tensile wire, this fence has proven itself and offers several advantaged for sheep coral fencing.
d. Welded mesh panels on wooden posts
   i. Relatively common in the Midwest where 16- and 10-foot galvanized panels are less expensive to obtain. Look for panels made specifically for sheep since hog panels are not tall enough and often have sharp ends.
e. Wooden corn/cribbing or snow fencing on wooden or steel posts
   i. Common material in the western U.S. for making temporary corrals when stock pressure will not be excessive.

XXI. Pros and cons of sheep corral material

a. Wood
   i. Readily available and easily assembled
   ii. Excellent material for posts and solid sides of chutes
   iii. Movable gates tend to warp, sag, and creep out of line
   iv. Hardwoods or treated softwoods increase durability
b. Steel
   i. Welded metal gates and frames are rigid and will not warp
   ii. Properly made gates and panels take a lot more "knocking about" than wood
   iii. Fabrication requires skilled craftsman

   NOTE: Beware of panels made from light gauge steel. Additionally, zinc galvanizing is the only coating with proven longevity.
c. Aluminum
   i. Lighter than steel and requires no painting
   ii. More expensive than steel

   NOTE: Presently only available in panels and gates as part of a portable handling system.
d. Fiberglass
   i. Strong, tough, lightweight, and long-lasting
   ii. Expensive and provides poor footing for sheep

   NOTE: Fiberglass' use is limited to footbaths and dips.
e. Concrete
   i. Durable effective floor surface for high-use areas
   ii. More expensive than is usually necessary (except for high-use areas)
f. Polyethylene
   i. Lightweight, durable, and easy to clean
      1. Black color ensures adequate resistance to breakdown by UV light.
   ii. Less expensive than fiberglass and provides firmer footing
g. Canvas and cloth
   i. Useful for producers who nee to put together an instant handling setup
   ii. Useful during trial-and-error period when first setting up permanent sheep corrals
h. High density polyethylene
   i. High strength material that makes excellent fences for certain purposes

1. Not suitable for side of treatment, sorting or forcing pens as it is neither solid not rigid enough.

XXII. Advantages of portable equipment

NOTE: Portable sheep handling setups can be fully portable (mounted on their own trailer) or semipermanent (a kit of movable panels and gates.

a. Can be moved to the sheep
b. Easily altered as operation grows and changes
c. Often only option for producers who rent or lease land
d. Gates and panels can be used for other purposes during lambing, shearing, etc.
e. Can be moved inside in winter and outside in summer
f. Permits experimenting with different layouts
g. Can be sold if sheep operation is discontinued

XXIII. Disadvantages of portable equipment

a. Changing setup tends to confuse sheep
b. Continual loading, unloading, and setup increase wear and tear
c. More prone to movement during heavy use (especially if poorly designed)
d. Conditions underfoot at temporary sites are often poorer and tend to deteriorate rapidly in wet conditions

XXIV. Important considerations for a permanent facility

a. Cost
b. Land ownership versus leased/rented property
    i. A producer who leases his sheep land is far better off investing in a portable but well-made system.
c. Size of flock
d. Opportunity and flexibility for expansion
e. Year round use capability
    i. To maximize the investment, a permanent facility should be functional at any time work needs to be done.

MANAGEMENT

I. Terms and definitions

a. Integrated management – includes nutrition, health, genetics, reproduction, business, and marketing knowledge in management decisions
b. Ewe lamb – female sheep that is less than one year and usually not bred
c. Yearling ewe – one year old female sheep that should be bred
d. Mouthing – counting number of permanent incisor teeth to determine sheep's age
e. Extensive management system – sheep are grazed most (or all of) the year on pastures or range
f. Intensive management system – sheep are confined to drylots or buildings most of the year
g. Flushing – practice of increasing energy level of ewe flock two weeks prior to breeding in order to increase lambing rate
h. Teaser ram – surgically sterilized ram that is used to stimulate ewes to begin cycling
i. Crutching – shearing of wool from around the dock and udder
j. Lamb feeding – general term related to developing weaned lambs to sufficient weight and finish to produce acceptable carcasses
k. Self-feeding – lambs have free access to feed at all times
l. Hand feeding – lambs are fed a predetermined amount of feed once or twice a day
m. Selection – identification of animals to be kept for breeding that are above the average level of production in the flock
n. Culling – process of removing animals that are below average in production, or unsound
o. Stocking rate – number of animal units that are grazed on a certain area of land for a specific period of time
p. Animal unit month (AUM) – amount of forage required by an animal unit for one month

II. Reasons for starting a sheep flock

a. Utilizes a wide variety of feedstuffs
b. Complements other livestock enterprises
c. Requires minimum investment in facilities and equipment
d. Easy to handle

III. Information sources

a. Extension Service
b. Experiment stations
c. Local veterinarian
d. Successful sheep producers
e. Grower organizations
f. Breed associations
g. American Sheep Industry Association

IV. General factors to consider when choosing a breed of sheep

a. Environmental adaptability
b. Management goals
    i. The initial step in a management program is to set realistic goals and objectives.
c. Personal preference

V. Breeds used according to region

a. Southwestern range – Fine wool, Rambouillet
b. Northwestern range – Rambouillet, Columbia, Targhee, Corriedale, and Polypay ewes and black face rams
c. Midwest and East (fall lambing) – predominantly Rambouillet or Dorset along with ¼ to ½ Finnsheep ewes and black face rams

d. Midwest and East (winter or spring lambing) – Columbia, Rambouillet, Finnsheep, Targhee, Corriedale, Dorset, Polypay, Hampshire, Suffolk, or Shropshire ewes and black face rams

VI. Minimum requirements for ewes being purchased

a. Healthy and sound
b. Free of foot rot and other contagious diseases
c. Accurate age determined by mouthing
d. Soft, pliable udder that is free of lumps
e. Two functional teats

NOTE: Beware of buying other people's problems and culls.

VII. Characteristics of ewes at different ages

a. Ewe lambs
    i. Less expensive that yearling ewes
        1. Their wool, and possibly a lamb crop, will pay for their year's keep.
    ii. Lower fertility rates
    iii. Requires closer attention during first lambing
b. Yearling ewes
    i. Provide excellent foundation stock
    ii. Good conception rates
    iii. Smaller lamb crops
    iv. Require closer attention during first lambing
c. Two- to five-year-old ewes
    i. Most productive
    ii. Difficult to purchase
        1. Good ewes of this age are usually available only when a flock is being liquidated.
d. Five- and six-year-old ewes
    i. Require additional feed and care
    ii. Good mothers
    iii. More risk involved

NOTE: Beginning sheep producers should start with 50 to 100 head of 3- to 4-year-old ewes

VIII. Characteristics of extensive and intensive management programs

a. Extensive
    i. Sheep are grazed most or all of the year
    ii. Harvested feeds provide only a small part of diet
    iii. Minimal facilities are required
b. Intensive
    i. Sheep are confined to drylot or buildings
    ii. Harvested feeds make up all of diet
    iii. Higher levels of management required
    iv. Increased overall production and reproduction rates

NOTE: In certain situations, a combination of intensive and extensive management programs is appropriate. This increases the producer's flexibility to maximize utilization of available resources.

IX. Common prebreeding management practice for ewes

NOTE: Prebreeding management occurs about one month prior to mating. Unsound or poor producing ewes should already have been culled.

a. Treat for internal parasites and trim feet
b. Vaccinate for abortive diseases

c. Sort into breeding groups according to body condition
    i. Thin ewes should be turned in on good pasture and/or supplemented before flushing.
d. Flush ewes
e. Introduce teaser ram

X. Components of Breeding Soundness Examination

a. Physical examination
    i. Includes an observation of all conditions that might interfere with a ram's ability to locate and mate ewes.
b. Reproductive tract examination
    i. Evaluates reproductive tract for disease and abnormalities.
c. Semen evaluation
    i. Rams with poor semen quality generally have lower fertility.
    ii. The quality of semen is highly influenced by environmental changes; therefore, new rams should be purchased at least 60 days (preferably 90 days) prior to breeding season.
d. Mating desire evaluation
    i. Observing rams with ewes in heat will help identify rams with low mating desire or libido.

XI. Facts related to breeding ewes

a. Ewes should be gaining weight going into breeding season
b. Sheep are at the height of sexual activity and fertility during October and November
c. Sheep's sexual activity and fertility increases as days get shorter
d. Long periods of high temperatures (>90 degrees) have detrimental effects on estrual activity and embryo survival

XII. Types of ram management systems

NOTE: The type of system used depends upon location, season of year, labor availability, and size of operation.

a. Single sire – used in purebred production or small flocks that require only one ram
    i. To reduce the risk of a poor lamb crop, a clean-up ram should also be used.
b. Multiple sire – used by large sheep operators who use more than one ram in a breeding group at a time
    i. Ram lambs should not be placed in the same breeding group with mature rams.
c. Rotational breeding – placing rams with the breeding flock for a predetermined period of time
d. Hand breeding – monitored breeding of individual ewes to specific rams
    i. The major disadvantage of this system is the amount of labor required.
e. Night breeding – producers remove rams from the ewe flock on warm days to keep them cool

XIII. Preparation for lambing

a. Assemble one lambing pen for every 10 ewes
b. Cover bare ground with limestone and fresh bedding
c. Vaccinate ewes 4 to 6 weeks prior to lambing
d. Increase feed 2 to 6 weeks prior to lambing
e. Shear or crutch ewes prior to lambing
f. Assemble lambing equipment

XIV. Methods of grafting lambs

a. Slime graft – rub fetal fluids from ewe on lamb that is to be grafted
b. Wet graft – immerse lamb to be grafted as well as the ewe's on lamb in saturated salt solution
c. Stanchion – place ewe in stanchion so she can eat and drink while allowing lambs to nurse
d. Lamb pelt – skin pelt off dead lamb and tie the skin on the lamb to be grafted

e. Stocking graft – place stocking over ewe's lamb for 2 to 3 days; remove stocking, turn inside out and place on lamb to be grafted

NOTE: If attempts to graft lambs fail, it is sometimes necessary to place the newborn lamb on milk replacer.

XV. Reasons for docking

a. Lambs are cleaner
b. Long tails interfere with breeding and lambing
c. Docked lambs have a more uniform appearance
d. Carcasses from docked lambs are more attractive
e. Tails are non-marketable products

XVI. Reasons for castration

a. Increases gains in feedlots with ewes and rams
b. Decreases unwanted pregnancies in feedlots
c. Removes market discrimination of ram lambs

XVII. Factors to consider when weaning lambs

a. Milk production of the ewe declines rapidly after 40 days
b. Lambs can be weaned as early as 3 to 4 weeks of age
    i. Early weaning is economically feasible in many sheep enterprises but is essential in an accelerated program.
c. Lambs can be weaned as late as 5 to 6 months of age
    i. Under western range conditions, lambs are allowed to graze with their mothers on summer range and are marketed as heavy feeders or grass-finished lambs.
d. Lambs are usually weaned at 60 days or 45 pounds

XVIII. Types of lambing systems

a. Range lambing – ewes are left alone during the fall, later winter, and early spring lambing seasons
b. Drift lambing – ewes that have not lambed are moved to a new pasture or area while the ewes with newborn lambs are left behind
c. Pasture lambing – ewes are placed in fenced pastures where they are checked once or twice daily
d. Shed lambing – ewes are placed in a barn where they are checked once or twice daily; ewes and newborn lambs are moved to lambing pens for 24 to 72 hours after birth

XIX. Facts related to lamb feeding

a. Goal is to produce acceptable slaughter lambs and make a profit
b. Majority of lambs are fed by commercial lamb feeders
c. Becoming more concentrated near feeder lamb producing areas and slaughter facilities
d. Most feeder lambs are available in the fall
e. Lambs going on feed are usually 5 to 6 months old and weigh 65 to 90 pounds
f. Feeder lambs should be "preconditioned" prior to being shipped to a feedlot
    i. Preconditioning involves vaccination for enterotoxemia, drenching, starting on feed, and possibly shearing.

XX. Pasture and cropland grazing options

NOTE: A feeder can economically finish lambs or produce low-cost gains by utilizing pastures and field crops.

a. Native or improved pastures
b. Pre-harvest grazing of corn fields
    i. If stocked at a rate of 2 to 5 lambs per acre and removed when lower leaves have been consumed, there is no reduction in yields.
c. Post-harvest grazing of corn fields

i. Lambs should be vaccinated for enterotoxemia and conditioned on grain before being turned out.

d. Alfalfa regrowth in fall

e. Winter cereal crop pastures (wheat, barley, rye, oats)

i. If grazing is terminated early enough in spring, grain yields are not reduced.

XXI. Advantages of shearing feeder lambs

a. Less likely to pick up mud and tags in feedlot

b. Improves feed consumption

i. This is especially true in hot weather.

c. Lambs with Number 1 pelts have higher dressing percentages

i. A Number 1 pelt has ½ to 1 inch of wool and takes 60 to 75 days to grow.

d. Lambs with Number 1 pelts bring more money than full fleeced lambs

XXII. Important times to cull or select animal flock

NOTE: Sheep should be identified for selection and culling more than once a year since there is no one time when a ewe exhibits all of the important characteristics.

a. At lambing

i. Identify twins and ewes that are good milkers.

b. Before shearing

i. Evaluate fleece characteristics and mark wool blind and wrinkled ewes for culling.

c. After weaning

i. Cull ewes that are old, unsound or crippled, and those that have poor udders. Identify twin and triplet ewe lambs.

XXIII. Components of proper grazing management

a. Grazing intensity – number of animals grazing a certain area of rangeland or pasture

i. A good rule of thumb is to remove only half of the current year's growth during the growing season.

b. Distribution of livestock – how uniformly the different sections of the range are grazed

i. Areas close to water are often overgrazed, while areas as far from water are lightly grazed. Ranchers can use water, salt, fences, and herding to get more uniform grazing.

c. Season of use – plants are more susceptible to grazing damage at certain periods of the year

i. Grazing animals prefer plants that are actively growing. As grasses and forbs mature, their protein content and digestibility decrease.

d. Kind of livestock – operator should try to fit the species of animal to the range

i. Sheep eat more forbs and shrubs that cattle and make better use of rough, steep ranges.

XXIV. Types of grazing systems

a. Deferred rotation – grazing 3 or 4 pastures (rotating between years) when plants are flowering or have ripe seeds

b. Rest rotation – one pasture is given complete rest for an entire year

c. Short duration – rotate large herds quickly through a series of pastures when plants are actively growing

d. Strip – grazing pastures in strips using temporary electric fence to limit animals access to grass

REPRODUCTION

I. Terms and definitions

a. Reproductive efficiency – percent lamb crop raised and marketed
b. Ovulation rate – number of ova shed from the ovary at a given estrus
c. Estrus – period of time when the female is sexually receptive to the male; also known as "heat"
d. Anestrus – period in which the female does not experience estrus or estrous cycles; during anestrus, the female is not sexually receptive to the male
e. Puberty – stage of maturation when an animal first becomes capable of reproduction
f. Estrous cycle – period from the beginning of one heat to the beginning of the next heat
g. Breeding season – season of sexual activity
h. Gestation – period of pregnancy beginning at fertilization and ending with parturition
i. Parturition – the act of giving birth
j. Flushing – practice of increasing the nutrient intake of ewes two weeks prior to mating
k. Open – not pregnant
l. Ejaculate – semen sample of ram
m. Mating capacity – number of ewes that a ram can mate and still achieve high fertility
n. Ram effect – use of males to stimulate ewes in anestrus to cycle
o. Accelerated lambing – ewes lambing more frequently than once per year
p. Hormone – chemical substance produced by the body (or can be artificially introduced) which has a specific physiological effect
q. Artificial insemination- any method of placing semen in the female reproductive tract other than by natural service; can be used as a management tool which requires a person to collect semen from the male and deposit it into the female reproductive tract

II. Primary factors affecting lamb production efficiency

a. Percent lamb crop raised
b. Weight of lamb marketed relative to weight of ewe

III. Methods to improve lamb production

a. More lambs per lambing
b. More frequent lambing
c. Increase percentage of breeding animals in flock
d. Reduce death loss

IV. Important parts of the female reproductive tract (Transparency 1)

a. Ovary
b. Uterine horn
c. Uterus
d. Cervix
e. Vagina

V. Factors influencing puberty in ewes

a. Breed
    i. Finnsheep and Finn-crosses reach sexual maturity earlier than most other breeds.
b. Genetic selection
    i. Crossbreds tend to have earlier sexual maturity than purebreds.
c. Body size
    i. Heavier lambs will reach puberty at a younger age.
d. Date of birth

i. Older lambs will reach puberty at lighter weights.

VI. Characteristics of estrus (heat)

a. Heat lasts 24 to 36 hours
b. Estrous cycle is approximately 17 days long
c. Minimum age for estrus is 5 to 9 months
d. Minimum weight for estrus is 70 to 100 pounds

VII. Characteristics of the ewe's breeding season

a. Lasts approximately 5 to 7 months
b. Begins in the fall as day length decreases
    i. Some breeds begin earlier in the summer, while others cycle later in the winter or spring.
c. Affected by age
    i. Ewe lambs have shorter breeding seasons than mature ewes.
d. Affected by length and intensity of daylight
    i. Length of day appears to be the primary factor controlling the breeding season.

VIII. Phenomena associated with gestation length

NOTE: Average gestation length is 148 days.

a. Male lambs are carried longer than female lambs
b. Spring born lambs are carried longer than fall born lambs
c. Singles are carried longer than twins
d. Older ewes carry their lambs longer than younger ewes

IX. Types of lamb presentations at birth

a. Normal – lamb is in birth canal with its nose and both front feet toward the posterior of the ewe with the crown of its head up
b. Abnormal – lamb is in the birth canal with one or both legs back, its head back, or completely backwards
    i. Lamb should be moved to the correct position before giving the ewe assistance.

X. Techniques for grafting lambs

NOTE: At birth, ewes quickly associate a specific odor with their own lambs. Thus, one must transfer that odor to foster lamb(s).

a. Wetting orphan with fluids from after birth and wool of the newborn
b. Placing the pelf of the ewe's dead lamb on orphan
c. Restraining ewe for 2 to 3 days so she cannot identify the lamb

XI. Important factors affecting reproduction in the ewe

a. Heredity
b. Age
c. Photoperiod (season)
d. Temperature and humidity
e. Nutrition
f. Parturition and lactation
g. Disease and parasites
h. Association with the ram
i. Fertility of the ram

XII. Approaches to improve reproductive efficiency

a. Maximize or optimize the lamb crop from the existing genetic resources
b. Improve genetic potential through breed choices, mating systems, selection programs, or use of hormones

XIII. Breeds which are very prolific

a. Finnsheep
b. Booroola Merino
c. Romanov
    i. The Finnsheep, Romanov, and Booroola Merino in pure form should not be used for commercial programs.
d. Polypay

NOTE: A quarter or half of these breeds will usually result in lambing rates high enough for most producers.

XIV. Situations in which no crossbreeding (or only terminal sires) should be used

a. Environmental conditions would not support larger lamb crops
b. Only one breed or genotype is adapted to production conditions and produces a desirable fleece
c. Management that would be required is more than an individual breeder wishes to undertake

NOTE: Selection for reproductive efficiency can be done within a breed or flock, but response will be slow.

XV. Factors affecting age of first breeding in ewes

NOTE: Ewes which are successfully bred to lamb as yearlings have been shown to have a greater lifetime production than ewes bred to lamb as two-year-olds.

a. Nutrition
    i. Lambs should be fed to gain weight from weaning to time of breeding.
b. Breed
    i. Early maturing breeds have higher pregnancy rates (as lambs) then slow maturing breeds and crossbreeding greatly improves the percentage that lamb as yearlings.

XVI. Facts related to photoperiod and ewe reproduction

a. Ewe is a "short day" breeder
    i. Estrous cycle begins as the days become shorter.
b. Fertility is the highest and most effective in September, October, and November

XVII. Facts related to temperature, humidity, and ewe reproduction

a. Temperature stress can have an effect on fertility, embryo survival, and fetal development
    i. Cool nighttime temperatures tend to partially compensate for high afternoon temperatures.
b. Shearing reduces heat stress except for sheep which have no access to shade

XVIII. Effects of nutrition on ewe reproductive performance

a. Condition (or live weight) at breeding affects lambing rate
    i. Ewes in better condition will have a higher twinning rate.
b. Flushing may increase ovulation rate and percent showing estrus
    i. Flushing will have more of an effect on ewes in poor condition or at the extremes of the breeding season.
c. Legume pastures high in estrogen may delay breeding and/or reduce conception rate
    i. The is only a problem when over 50% of the pasture is made up of clovers, trefoil, and alfalfa with leaf spot.

XIX. Effect of parturition and lactation on ewe reproductive performance

a. Uterus cannot support another pregnancy until approximately 30 days after lambing
b. Ewes which lamb in the spring are more difficult to rebreed in the fall

NOTE: Since sheep are seasonal breeders this may be cofounded with lactation.

XX. Effect of disease and parasites on ewe reproductive performance

a. Reduces body condition of breeding ewe

i. Effect is similar to that of improper nutrition

b. Reduces lambing rate

XXI. Benefits of accurate pregnancy testing

a. Allows selection of replacement ewes on ability to conceive
   i. Lambs that conceive their first winter are more productive the rest of their lives.
b. Reduce costs by selling or managing the open ewes differently
   i. Sell cull ewes in late fall and early winter when supplies are low, and prices are high.
c. Diagnoses reproductive failure earlier
d. Optimizes use of buildings, labor, and equipment
e. Guarantees pregnant ewes for sale
f. Permits producers to feed ewes according to stage of production (pregnant or open)

NOTE: Pregnancy testing may not be recommended in flocks with high fertility because it isn't cost effective.

XXII. Methods of pregnancy evaluation

a. Breeding marks
   i. Earliest indicator of possible conception
   ii. Identifies ewes that have not been mated
b. Ultrasonic scanning
   i. Ultrasound
      1. Based on sound reflecting properties of tissue and fluid
      2. Works best between 70 and 120 days
   ii. Ultrasound imaging
      1. Reflects sound waves onto a screen
      2. Detects fetuses from 40 days to full term

      NOTE: Works best in the 40- to 70-day range. However, the equipment is very expensive.
   iii. Doppler principle
      1. Converts movement to audible sounds
      2. Utilizes a rectal probe
c. Bagging or udder palpation
   i. Evaluating udder development prior to lambing
   ii. Most widely used method of pregnancy detection

XXIII. Important parts of the ram's reproductive tract (Transparency 2)

a. Testis
b. Epididymis
c. Penis

XXIV. Effect of season on ram reproductive performance

a. Testicular growth is near maximum in late summer and fall as days shorten
b. Sperm production and quality follow a similar pattern

NOTE: Housing rams in barns under controlled light patterns can improve fertility and lamb production in out of season breeding.

XXV. Components of a ram's Breeding Soundness Exam (BSE)

a. Examine genital organs
   i. Testicles should be firm
   ii. Testicular circumference should be taken
      1. Rams with larger testes produce more sperm and daughters that mature earlier.
   iii. Epididymis should be slightly rounded and free of hard knots

b. Evaluate physical condition
    i. Physical condition of the ram is very important to his desire to mate.
c. Consider environmental conditions or diseases ram has been exposed to
    i. Heat stress (elevated body temperature) may affect semen quality for as long as 6 weeks.
d. Evaluate semen sample
    i. Abnormal sperm in the ejaculate is the best predictor of infertility.

XXVI. Reasons that serving capacity affects conception

a. Rams ejaculate fewer sperm than are needed for conception and therefore should breed ewes more than once
b. Rams show preference to certain females and may not breed all ewes showing estrus
c. Ovulation occurs after standing estrus and thus mating late in the estrus period is more likely to result in conception

XXVII. Recommended number of ewes per ram according to age

a. Well-matured ram lamb – 15 to 30 ewes
b. Yearling to 5 years of age – 25 to 30 ewes
    i. Depends on temperature, sex drive, topography, and area of pasture.
c. 6 years and older – variable depending on physical condition of ram

XXVIII. Factors affecting expression of a "ram effect"

a. Breed of ewe
b. Production phase of ewe
    i. Ewes appear to be more responsive 6 to 8 weeks after parturition.
c. Nutrition and body condition
d. Aggressiveness of teaser rams

NOTE: The ram effect does not stop anestrus in all ewes.

XXIX. Advantages and disadvantages of accelerated lambing

a. Produces lambs when growth rate and feed costs are more favorable
b. Markets lambs when supply is low, and prices are high
c. Lower fertility and prolificacy are encountered
d. Results in smaller birth weights

NOTE: Use of prolific, long-season breeds that have been selected for twinning and normal fall birth weights should help offset some of the problems.

XXX. Characteristics needed for a successful accelerated lambing system

a. Ewes that can successfully breed any season of the year
b. Ewes that can mate while lactating
c. Ewes that are capable of twinning throughout the year
d. Sires that produce a desirable market lamb ad have both the libido and fertility to bring about conception at any time of year

XXXI. Breeds which appear most adapted to accelerated lambing in the United States

a. Rambouillet
b. Dorset
c. Polypay
d. Barbados Blackbelly
e. Finnsheep crosses

NOTE: Increases in lambing frequencies from about 0.93 to 1.2 to 1.5 lambings per year per ewe have been reported.

XXXII. Factors controlling out-of-season breeding

a. Day length
    i. The closer one lives to the equator, the longer the breeding season and thus the shorter the anestrus period.
b. Level of nutrition
c. Ram exposure

XXXIII. Types of accelerated lambing systems

a. Three lamb crops in 2 years
    i. Fixed mating and lambing schedule
    ii. Staggered eight-month lambing interval schedule
    iii. Goal is 1.5 lambings/ewe/year
b. Five lamb crops in 3 years
    i. Star system developed by Cornell University
    ii. Goal is 1.67 lambings/ewe/year
c. Opportunistic lambing
    i. Breed for an extra lamb crop when conditions are favorable
    ii. Most widely used form of accelerated lambing
d. Continuous lambing
    i. Rams kept with ewes throughout the year
    ii. Replacements are selected from lambs born out of season from most productive ewes
e. Two lamb crops per year
    i. Maximizes number of lambings per year
    ii. Not recommended for commercial use

XXXIV. Advantages of using reproductive hormones

a. May permit more effective use of labor and facilities
b. Greater supervision of ewes and lambs at birth
c. More uniform management in flock health, nutrition, and marketing
d. Facilitates early breeding and out of season breeding
e. Facilitates artificial insemination

XXXV. Disadvantages of using reproductive hormones

a. Added cost
b. Extra rams needed for synchronized breeding
c. Fertility can be impaired
d. Sufficient facilities and equipment necessary
e. Increased labor at lambing
f. Most drugs have not been approved for sale in United States

XXXVI. Advantages of artificial insemination

a. Potential for genetic gains by using superior sires
b. Permits more ewes to be bred to a ram
c. Facilitates out-of-season breeding
d. Permits semen to be used from incapacitated males
e. Reduces disease transmission attributed to physical contact

XXXVII. Disadvantages of artificial insemination

a. Variations in pregnancy rates
b. Added costs associated with semen processing and storage

c. Poor freezing properties of ram semen
d. Difficult, if not impossible, to inseminate through the cervix

NOTE: Each producer must decide whether the additional costs of using artificial insemination can be justified.

XXXVIII. Methods of semen collection

NOTE: For optimum results, it is recommended that the ram not be stressed, especially by high temperatures, for 6 to 8 weeks prior to collection.

a. Artificial vagina
    i. Yields high quality semen sample
    ii. Least stressful on ram
    iii. Utilizes a teaser ewe
b. Electroejaculation
    i. Not normally used except when ram is unable or unwilling to serve an artificial vagina
    ii. Requires an electrical probe
    iii. Yields highly variable semen sample

XXXIX. Factors which decrease sperm fertilization capabilities

a. Temperature
    i. Temperatures greater than 113 F will kill sperm, while sudden changes (such as cooling) will cause a dramatic decrease in cell viability.
b. Exposure to high concentrations of oxygen
c. Exposure to sunlight
d. Contact with water, disinfectants, metal, or other bacterial contaminants

XL. Sperm handling process

a. Assess sperm concentration
b. Dilute sperm
    i. Most diluents contain an energy source, a chemical buffer to protect against temperature changes, antibiotics, and a cryoprotectant.
c. Slowly cool semen for short- or long-term storage
    i. Short-term stored semen should be within 8 hours of collection if cooled to 60 F and 12 hours if cooled to 40 F.
d. Freeze semen for long-term storage
    i. Semen may be frozen using dry ice (-110 F) or liquid nitrogen (-320 F).
e. Thaw sample to check semen quality
    i. Thawed semen with less than 40% motility is generally <u>not</u> worth the storage space.

XLI. Methods of inseminating ewes

a. Vaginal
    i. Quick and simple
    ii. Results in poor conception rates
    iii. Requires no special equipment

    NOTE: Vaginal insemination is not recommended but may be useful where time and resources are limited.
b. Cervical
    i. Most common method
    ii. Fertility rates with fresh semen may approach that of natural service
    iii. Fertility rates with frozen seme are poor (<20%)
    iv. Some skill and limited amount of equipment are needed

c. Uterine
    i. Utilizes a “laparoscope”
    ii. Fertility rates of 50% or more can be expected
    iii. Requires more skill and considerable investment

XLII. Factors affecting the time which ewes should be inseminated

a. Type of artificial insemination being used
    i. For uterine A.I., 24 to 36 hours after estrus is recommended, while for vaginal or cervical A.I., 12 to 18 hours after estrus is optimum.
b. Type of estrus synchronization used
c. Exposure to rams

HEALTH

I. Terms and definitions

a. Hypothermia - inability to keep warm, often caused by cold or wet weather
b. Necropsy – examination of dead lamb
c. Fetus – lamb during its development in the uterus
d. Abortion – fetus dies in the uterus and is expelled prematurely
e. Stillborn – fetus is fully developed but dead at birth
f. Acute disease – a disease which develops rapidly and is short in duration
g. Chronic disease – a disease which develops slowly and runs a prolonged course
h. Clinical signs – disease symptoms that you observe
i. Infectious disease – disease caused by bacteria and viruses
j. Non-infectious disease – disease caused by nutritional or metabolic problems; bacteria or viruses are not involved
k. Septicemia – infection of the blood stream
l. Meningitis – infection of the brain
m. Colostrum – first milk of ewe which contains antibodies necessary to protect lambs from bacteria and viruses
n. Vaccination – injection, given to healthy animals, that is used to stimulate prolonged immunity to specific diseases
o. Dystocia – difficult birth
p. Epididymitis – inflammation of the epididymis
q. Breeding Soundness Exam (BSE) – a physical examination with emphasis on the reproductive system of the ram
r. Mastitis – inflammation of the mammary gland caused by bacteria and results in reduced milk production
s. Parasite – an organism that lives off of a host
t. Keds – bloodsucking, wingless flies that pierce skin
u. Drenching – the oral administration of medication
v. Photosensitization – a severe skin reaction when the animal is exposed to sunlight
w. Castrating – process of removing testicles from male lambs
x. Docking – process of removing long tails
y. Subcutaneous injection – injection given just beneath the skin
z. Intramuscular injection – injection given directly into the muscle

II. Clinical signs of non-infectious diseases of newborn lambs

a. Starvation
    i. Lamb blats all of the time
    ii. Lamb does not gain as well as penmates

    NOTE: Secondary starvation can occur after a lamb loses body heat because or wet or cold weather.

    iii. Hypothermic lambs will not get up to nurse
    iv. Hypothermic lambs will feel cold to the touch
    v. Hypothermic lambs have little to no sucking reflex
b. Trauma
    i. Lamb has difficult time breathing
    ii. Lamb is found dead
        1. The abdomen or lung cavity will be filled with blood if trauma was the cause of death. In the case of suffocation, no signs are found in necropsy.

III. Infectious disease of unborn or newborn lambs

NOTE: Most infectious diseases result in abortion and are discussed in more detail under ewe and ram diseases.

a. Toxoplasmosis
    i. One of the most common causes of abortion.
b. Brucella Ovis
    i. Transmitted by ram.
c. Border disease (Hairy shakers)
    i. Visually affects no more than 1 to 2%.

IV. Signs and prevention of diseases related to the navel of newborn lambs

a. Clinical signs
    i. Sickly, poor-performing animals
    ii. Swollen, hot, painful, pus-filled joints
    iii. Meningitis
    iv. Lameness and reluctant to rise and move about
b. Prevention
    i. Treat the navel with tincture of iodine at birth
        1. Spray or dip navel in jar.
    ii. Clip the navel prior to applying iodine
    iii. Use dry, clean bedding in lambing areas
    iv. Re-apply iodine if navel doesn't dry up in 24 hours

V. Important facts related to colostrum

a. Contains antibodies necessary for lamb survival
b. Contains needed energy
c. Must be administered within 12 hours of birth
d. Lamb should consume 5% of its body weight
    i. This amounts to 8 ounces for a 10-pound lamb.

VI. Clinical signs of diseases caused by a colostrum deficiency

a. E. Coli scours
    i. Watery, yellow diarrhea
    ii. Rapid death
b. Enterotoxemia Type C (bloody scours)
    i. Sudden death (2 to 12 hours) with convulsions
    ii. Abdominal pain
    iii. Bloody diarrhea
c. Tetanus
    i. Stiffness of limbs and muscles
    ii. Response to sudden noises
    iii. Labored breathing
    iv. Eventual death

VII. Common names for diseases in young lambs

a. Enterotoxemia Type D
    i. Overeating disease
    ii. Pulpy kidney disease
b. Polyarthritis
    i. Chlamydial arthritis
    ii. Stiff lamb disease
c. White muscle disease
    i. Stiff lamb disease

ii. Muscular dystrophy
iii. Vitamin E and/or Selenium deficiency

VIII. Clinical signs of respiratory diseases in lambs

a. Severe depression
b. Labored breathing
c. Rapid death
d. Coughing
e. Reduced appetite

IX. Prevention of respiratory diseases in lambs

a. Provide adequate colostrum at birth
b. Provide adequate barn ventilation
c. Provide adequate shelter against winter
d. Treat ewes with chronic nose discharge prior to lambing

X. Description of diseases of feeder lambs

a. Acidosis – excess amounts of acid are produced by rumen when lambs overconsume concentrates causing depression and death
b. Polioencephalomalacia (polio) – disease of central nervous system caused by thiamine deficiency
c. Enterotoxemia of fattening lambs – overeating disease commonly found in high performing lambs on high concentrate rations
d. Salmonellosis – serious gastrointestinal disease associated with stressful events such as transportation, weather, and feed changes
e. Pneumonia – respiratory disease that occurs early in the feeding period when lambs have been exposed to stressful events
f. Rectal prolapse – condition associated with high concentrate feeding, short docking, and coughing that is characterized by protruding rectum
g. Internal parasites – worm or flukes that cause damage to the digestive tract, liver, or lungs
h. Coccidiosis – disease that erodes the intestinal wall causing bloody scours, dehydration, loss of weight, and weakness
i. Copper toxicity – condition caused by feeding too much copper, usually because one is feeding supplements formulated for cattle or swine; recommend copper concentration should be 8 to 11 ppm
j. Urolithiasis – condition characterized by calculi stones in the urinary tract and often associated with grain rations high in phosphorous; also known as urinary calculi

XI. Most common types of infectious abortions

a. Chlamydiosis (EAE, viral abortion)
b. Campylobacteriosis (vibriosis)
c. Toxoplasmosis

XII. Causes of diseases associated with pregnant ewes

a. Pregnancy toxemia – diet deficient in energy in late pregnancy when fetal growth is very rapid
b. Hypocalcemia – low blood calcium caused by sudden calcium demand placed on ewe by rapid fetal growth and onset of milk production

XIII. Synonyms of diseases associated with pregnant ewes

a. Pregnancy toxemia
    i. Pregnancy disease
    ii. Twin lamb disease
    iii. Lambing paralysis

iv. Ketosis

b. Hypocalcemia
    i. Lambing sickness
    ii. Milk fever
    iii. Parturient paresis

XIV. Common causes of dystocia

a. Abnormal position of unborn lamb
b. Unusually large lamb
c. Overly fat ewe
d. Small pelvic area
e. Partially dilated cervix
    i. This is a completely different type of dystocia because the ewe may drop water bag but not go into labor.

XV. Equipment necessary for delivering difficult lambs

CAUTION: A producer should have knowledge of reproductive tract anatomy before attempting to deliver lambs.

a. Clean bucket
b. Iodine based surgical scrub liquid soap
c. Obstetrical lubricant
    i. Grease or oil is not recommended.
d. Lamb puller
e. Intrauterine antimicrobial boluses
f. Systemic antibiotics

XVI. Components of Breeding Soundness Examination

a. Physical exam
    i. Examination includes evaluation of general condition and structural soundness as well as checking for internal and external parasites.
b. Reproductive exam
    i. Ram lambs should have a minimum scrotal circumference of 30 cm, while yearlings and older rams should have a minimum of 33 cm.
    ii. Semen should be free of white blood cells, have 85% or greater normal sperm cells, and have greater than 50% forward progressive motility.

XVII. Notes on prebreeding management of rams

a. Provide rams with proper care <u>at least 2 months</u> prior to breeding
    i. Sperm takes approximately 60 days to develop and mature.
b. Nutrition has a direct relationship with testicular function and semen quality
    i. Obese or thin rams may have lower fertility.

XVIII. Notes on breeding season management

a. Use teaser ram to synchronize ewes
b. Provide 1 mature ram per 100 ewes
c. Provide 3 ram lambs per 100 ewes
d. Observe rams to make certain they are functioning properly

XIX. Synonyms of Caseous Lymphadenitis

a. Boils
b. Abscesses
c. Cheesy gland disease

XX. Preventative measures for Caseous Lymphadenitis

a. Cull all sheep with enlarge lymph nodes
b. Shear young animals first
    i. Disease may be transmitted during shearing process.
c. Refrain from opening and draining abscesses
    i. Draining abscesses usually doesn't help. If necessary, do not drain them in areas frequented by other sheep.
d. Keep pens and equipment clean
e. Remove affected sheep immediately

XXI. General description of Scrapie

a. Attacks central nervous system
b. Progresses slowly, but increases in severity until death
c. Lacks effective treatment

NOTE: The state veterinarian should be notified if scrapie is suspected.

XXV. Management practice to prevent foot rot

a. Never buy sheep infected with foot rot
b. Avoid common-use trails or corrals
c. Clean and disinfect commercial vehicles prior to loading
d. Assume all new additions to flock are infected
    i. Always isolate new animals for at least 2 weeks, trim feet upon arrival, and treat feet following trimming.

XXVI. Symptoms of foot rot

a. Moist reddened area between toes
b. Lameness
    i. Not all lame sheep have foot rot!
c. Foul odor
d. Undermining of the hoof sole and wall

XXVII. Methods for properly treating foot rot

NOTE: The best control of foot rot can be obtained through the use of a combination of treatments.

a. Vaccination
    i. Vaccines are most beneficial when used in conjunction with other control measures.
b. Foot baths
    i. Foot baths containing 10% zinc sulfate, or 10% copper sulfate will reduce the spread of foot rot.
c. Foot soaks
    i. Prolonged (1 hour) soaking in a 10% zinc sulfate solution is a more effective treatment.
d. Dry chemicals
    i. 10% zinc sulfate mixed with lime is useful during cold weather when a liquid solution would freeze.
e. Trimming
    i. Foot must be trimmed to expose all infected tissue.
f. Dry pens
    i. Prolonged exposure of feet to moisture is necessary for foot rot to develop.
g. Topical medications
    i. Sprayed or painted on feet after trimming when footbath facilities are not available.
h. Antibiotics
    i. Expensive, with limited success.
i. Isolate all infected sheep

j. Cull all infected sheep that do not respond to treatment

XXVIII. Examples of internal parasites

a. Roundworms
b. Tapeworms
c. Liver flukes
d. Coccidiosis
e. Lungworms

XXIX. Management techniques to prevent internal parasites

a. Deworm regularly
b. Rotate pastures
    i. Rotating pastures will minimize egg build up.
    ii. Always put clean sheep on clean pastures.
c. Dispose of sheep carcasses
    i. Do not allow dogs or cats to feed on sheep scraps.
d. Remove sheep from marshy areas known to harbor flukes
e. Deworm cats and dogs regularly
    i. Some internal parasites develop in the gut or dogs and cats and are transmitted to sheep while grazing.

XXX. Dewormers approved for use by sheep producers

a. Levamisole
b. Thiabendazole

NOTE: The number available is limited, although there are recently approved and better ones for cattle.

XXXI. Types of external parasites

a. Flies
b. Keds
c. Lice
d. Mange mites
e. Ticks

XXXII. Guidelines for safe and effective drenching

NOTE: There are other methods of administering dewormers, but drenching is probably the most effective and least expensive.

a. Handle sheep without excitement
    i. The stresses of handling and drenching may be detrimental.
b. Drench during the coolest part of the day
c. Place sheep in a long chute
d. Insert the nozzle of drench gun into the side of the mouth and over tongue
    i. Small breeds are more difficult to drench than the larger, longer necked breeds.
e. Hold head in normal position
f. Refrain from drenching sheep that are down in the chute

XXXIII. Notes on plant poisoning

a. Sheep losses due to plant poisoning are 8 to 10% annually
b. Overgrazing encourages animals to eat any and all plants
c. Ruminants are more susceptible to cyanide poisoning than simple stomached animals
d. Almost all plants have the potential for accumulating toxic levels of nitrates
e. Young animals, especially the developing fetus, are more prone to poisoning
f. The first and only sign of poisoning may be sudden death

XXXIV. Situations which increase nitrate levels in plants

a. Growing in moist, highly organic soils
b. Growing in heavily fertilized soils
c. Spraying with herbicides

NOTE: Nitrate poisoning is more likely to be associated with the feeding of oat hay, corn stalks, and other cultivated fertilized forages.

XXXV. Basic steps to prevent plant poisoning

a. Learn to identify poisonous plants
b. Inspect pastures for poisonous plants prior to grazing
c. Don't allow hungry or thirsty animals to graze areas that are heavily infested with poisonous plants
d. Supplement animals with salt and phosphorous
e. Water animals daily

XXXVI. Tools for docking or castrating

a. Knife
b. Emasculator
c. Elastrator (with elastrator bands)
d. Burdizzo
e. Hot iron (docking only)

XXXVII. Essentials of a good vaccination program

a. Healthy animals
    i. Unthrifty, malnourished, stressed, or wormy animals do not respond well to vaccination.
b. Good vaccine
c. Vaccination plan
    i. The vaccination program should be tailored to fit the needs of your flock.
d. Proper handling and storage of vaccine
    i. Refrigerate until used and discard unused portion.
e. Administer properly with clean needles and syringes

NUTRITION

I. Terms and definitions

a. Gastrointestinal (GI) tract – responsible for the digestion and absorption of nutrients from the diet as well as the elimination of undigested dietary residues and excretion of waste products
b. Urea – source of protein synthesized from carbon dioxide and ammonia by ruminant
c. Cessation – temporary or final stopping of action
d. Rumen (paunch) – large, first compartment of a ruminant's stomach
e. Reticulum – second compartment of a ruminant's stomach
f. Omasum – the division between the reticulum and the abomasum in a ruminant's stomach
g. Abomasum – the fourth compartment, the true digestive part of a ruminant's stomach
h. Tetany – condition of mineral imbalance marked by muscle spasms
i. Rickets – disease characterized by soft and deformed bones
j. Hyperemia – excessive blood in a body part
k. Lacrimation – secretion of abnormal or excessive amount of tears
l. Emaciation – to waste away physically
m. Lethargy – quality or state of being lazy or indifferent
n. Ataxia – an inability to coordinate voluntary muscle movements
o. Dry matter – the portion of the feed that is not water
p. As fed basis – feed "as it is fed" containing both dry matter and water
q. Crude protein (CP) – includes both true protein and non-protein nitrogen content
r. Bypass protein – protein that passes through the rumen without being degraded by microorganisms
s. Total digestible nutrients – standard system for expressing the energy value of feeds
t. Crude fiber – measure of how digestible a feed is
u. Trace minerals – minerals that are required in very small amounts
v. Net energy – energy that is needed for maintenance and growth
w. Flushing – improving a ewe's body condition just prior to breeding season
x. Browse – broad-leafed, woody plant, shrub, bush, or tree of small stature
y. Forbs – broad-leafed, herbaceous plants, commonly referred to as "weeds"
z. Creep feeding – method of providing supplemental feed for lambs during the nursing period
aa. Tender wool – weak, brittle wool fibers caused by sudden or severe reduction in feed intake

II. Four compartments of the sheep stomach (Transparency 1)

a. Rumen
b. Reticulum
c. Omasum
d. Abomasum

III. Development of a newborn lamb stomach

a. At birth, the reticulo-rumen is nonfunctional
b. When a lamb nurses, milk passes directly into the abomasum
c. Development of the rumen takes place over a period of time; naturally suckled lambs require 1 ½ to 2 months
d. Development of the reticulo-rumen requires establishment of a microbial population

CAUTION: Prior to the time the reticulo-rumen becomes functional, the young lamb requires either ewe's milk or a high-quality milk replacer containing vitamins A, D, E, as well as the B vitamins.

IV. Nutrients of primary importance in sheep nutrition

a. Water
b. Energy

c. Protein
d. Minerals
e. Vitamins

V. Factors affecting water intake

a. Food intake
b. Nitrogen intake
c. Excessive mineral intake
d. Environmental temperature
e. Water temperature

VI. Major sources of energy

NOTE: Energy is usually the most limiting nutrient for ewes.

a. Hay
b. Silage
c. Grains
d. Pasture

VII. Possible results of inadequate energy intake

a. Slowing or cessation of growth
b. Loss of weight
c. Reproductive failure
d. Decreased milk production
e. Increased mortality
f. Reduced resistance to disease and parasites

VIII. Excellent protein supplements for sheep

NOTE: Quantity of protein is much more important than the quality.

a. Soybean meal
b. Cottonseed meal
c. Sunflower meal
d. Linseed meal
e. Peanut meal

IX. Techniques for providing protein supplements

a. Self-fed (hand-fed) – feed daily or at 2- to 3-day intervals; are fed most conveniently in the form of pellets or cake; intake may be limited by the addition of 10 to 25% salt
    i. Increased salt intake requires increased water consumption.
b. Protein blocks – more expensive but saves labor; are available in varying degrees of hardness to help regulate consumption

X. General recommendations for the use of urea in sheep feeds

CAUTION: Urea should not make up more than 1/3 of the total nitrogen in a ration.

a. Should not be used in rations for very young lambs or creep rations
    i. Death may result because rumen is not functioning and cannot utilize urea.
b. Should not be used in rations where sheep are on limited feed
c. Should be introduced into diet gradually to allow rumen microorganisms to adapt
d. Should be thoroughly mixed into the ration and fed regularly
    i. Sudden high intakes can cause toxicity and death.

XI. Mineral elements that have been classified as nutritionally sound

a. Sodium
b. Chlorine
c. Calcium
d. Phosphorous
e. Magnesium
f. Potassium
g. Sulfur
h. Cobalt
i. Copper
j. Iodine
k. Iron
l. Manganese
m. Molybdenum
n. Selenium
o. Zinc

XII. Factors that affect the mineral requirements of sheep

a. Breed
b. Age, sex, and growth rate
c. Nature and rate of reproduction
d. Lactation
e. Level and chemical form ingested
f. Overall balance and adequacy of diet
g. Hormonal and other physiological activities
h. Climate

XIII. Deficiency symptoms of essential minerals

a. Salt – feed consumption, water intake, milk production, and growth rate decrease; may chew on wood and/or lick dirt; may consume poisonous plants not normally eaten
b. Calcium and phosphorus – may result in abnormal boen growth, tetany, or urinary calculi problems, slow growth, depraved appetite, unthrifty appearance, listlessness
c. Magnesium – tetany is the classic deficiency sign, loss of appetite, hyperemia, and calcification of soft tissue
d. Potassium – decreased feed intake and weight gain; listlessness, stiffness, impaired response to sudden disturbances, convulsions, and death have also been reported
e. Sulfur – signs are similar to protein (loss of appetite, reduced weight gain and wool growth); excessive salivation, lacrimation and shedding of wool; in extreme cases, emaciation and death may occur
f. Cobalt – signs of deficiency are signs of B_{12} deficiency; lack of appetite and thrift, severe emaciation, weakness, anemia, decreased estrous activity, and decreased milk and wool production
g. Copper – "swayback" condition in young lambs; weak lambs at birth; older sheep may have "steely" or "stringy" wool that lacks crimp, strength, affinity for dyes, and elasticity, or wool of black sheep may lack pigment
h. Iodine – enlarged thyroid gland (big neck) in newborns; lambs born with weak, dead, or without wool; reduced wool yield and rate of conception in older sheep
i. Iron – poor growth, lethargy, anemia, increased respiration rate, decreased resistance to infection, and death in severe cases
j. Manganese – impaired growth, skeletal abnormalities, and ataxia in newborns; depressed or disturbed reproduction in older sheep
k. Molybdenum – high levels reduce the utilization of dietary copper and animals scour, their fleece becomes stained, and they lose weight rapidly
l. Selenium – degeneration of the cardiac and skeletal muscles (white muscle disease); unthriftiness, early embryonic death, and periodontal disease
m. Zinc – decrease in appetite and growth rate; brief periods of excessive salvation, wool loss, delayed wound healing, reduced testicular development (or atrophy), and poor semen; all phases of female reproduction are affected

XIV. Vitamins and their appropriate sources

a. Vitamin A – plants high in B-carotene (animals convert to Vitamin A) like dehydrated hay
b. Vitamin D – sun-cured hay
c. Vitamin E – wheat germ meal, dehydrated alfalfa, high quality legume hay, and some green feeds

d. Vitamin B complex – synthesized by microorganisms in rumen as long as cobalt is present
e. Vitamin K_1 and K_2 – green leafy materials of any kind are good sources of K_1 while K_2 is synthesized in the rumen

XV. Reasons for mineral supplementation

a. Correct mineral deficient feedstuffs, feeds, and rations
b. Correct mineral deficient pastures and range

CAUTION: Trace mineralized, and iodized salt should never be used as feed intake limiters.

XVI. Convert dry matter (DM) to an "as fed" basis

a. Convert by dividing DM values by the percentage of dry matter in the particular feed
b. Example: Animal requires 4.0 pounds of DM/d and is being fed Fresh Sagebrush which is 50% DM.
   4.0 lb / 0.50 = 8.0 pounds of Fresh Sagebrush on "as fed" basis

XVII. Expressions used to describe protein composition and their abbreviations

a. Crude protein (CP)
b. Digestible protein (DP)
c. Bypass protein

XVIII. Expressions used to describe energy composition and their abbreviations

a. Total digestible nutrients (TDN)
b. Digestible energy (DE)
   i. Animal performance can be equally predicted by either TDN or DE.
c. Net energy (NE)
   i. Net energy can be divided into that used for maintenance (NE_m) and growth (NE_g).
d. Metabolizable energy (ME)

XIX. Expressions used to describe fiber composition and their abbreviations

a. Crude fiber (CF)
b. Acid detergent fiber (ADF)
c. Neutral detergent fiber (NDF)

XX. Factors to consider when feeding ewes

a. Relative feed requirements for the production year (Transparency #2)
b. Nutrient requirements for optimum production

NOTE: An excellent information source is the Small Ruminant National Research Council (NRC)

XXI. Environmental and physiological factors influencing feed requirements of ewe

a. Climate
   i. Nutritional requirements vary with temperature, humidity, wind velocity, fleece length, density, and quality.
b. Age
c. Exercise
   i. Grazing sheep may have a 10 to 100% higher energy requirement then pen-fed sheep.
d. Body condition
e. Reproduction potential
   i. Nutritional requirements vary with flushing, number of lambs born, and birth weight of lambs.
f. Lactation
   i. Nutritional requirements vary with the number of lambs suckled, late gestation nutrition, dry period nutrition, postpartum interval to breeding, and feeding during drought or severe winter weather.

XXII. Procedures for body condition scoring sheep

a. Feel for fullness of muscle and fat cover
b. Feel for the spine (spinous process) in the center of the sheep's back behind the last rib and anterior to the hip bone
c. Feel for the tips of the transverse process

XXIII. Body condition scores

a. Condition zero
b. Condition one
c. Condition two
d. Condition three
e. Condition four
f. Condition five

XXIV. Steps in formulating ewe rations

a. Find the nutrient requirements of animal in the table
b. List proposed feed stuffs
c. Formulate ration from proposed feedstuffs
d. Determine nutrient content of ration from the feed composition table
e. Determine deficiencies of proposed ration by subtracting content of ration from requirements
f. Adjust ration to fulfill requirements

XXV. Three classes of range forages

a. Grass plants
    i. The protein and TDN content decreases, while lignin and cellulose increase with maturity.
b. Browse
    i. Protein content decreases only slightly with maturity, while the increase of lignin and cellulose is moderate.
c. Forbs
    i. Protein content declines only slightly with maturity, but phosphorous content declines more rapidly.

XXVI. Limiting nutrients for range animals and commonly used supplements

a. Energy – corn, barley, and milo
b. Protein – cottonseed meal, soybean meal

NOTE: Protein supplements increase digestibility of range forage and can be used for meeting both energy and protein requirements.

XXVII. Types of lambs that should be fed milk replacer

a. Orphaned at birth
b. Weakest in set of triplets (or more)
c. Twin from ewe lamb (in most but not all cases)
d. Weak due to inadequate milk
e. "Bummer" lamb at 1 to 2 weeks of age

XXVIII. Management guidelines for placing lambs on milk replaces

a. Give 6 to 8 ounces of colostrum (preferably from ewe)
b. Switch lamb(s) to milk replacer within 24 hours of birth
c. Place lambs in warm, dry area with other lambs on milk replacer
d. Keep lambs away from dams
e. Avoid mixing very young and older lambs
f. Give proper injections

NOTE: Milk replacer should contain a high level of antibiotics to avoid scours and other digestive disorders.

XXIX. Method of feeding milk replacer

a. Dilute replacer with water
    i. Use 1 ¾ to 2 pounds of milk replacer per gallon of water.
b. Use multiple nipple pail for self-feeding
c. Feed "cold" milk
    i. Warm milk may be used the first week until lamb nurses an adequate amount.
d. Keep utensils clean
e. Provide lamb with plenty of fresh water
f. Provide lamb with high quality, palatable solid feed to stimulate rumen development
g. Wean lamb from milk replacer at 3 weeks of age

XXX. Types of lambs that benefit from creep feeding

NOTE: Creep feeding is an essential part of intensive production systems but may be used in other situations.

a. Lambs that are weaned early
b. Twins and lambs that are dropped late in the season
c. Lambs subject to drought in range operations
d. Lambs that are marketed as slaughter lambs rather than feeders

XXXI. Desired characteristics of creep rations

a. Highly palatable
b. Nutritionally balanced
c. Economical

NOTE: Lambs should be started on creep feed about 10 days after birth.

XXXII. Factors to consider when determining an optimal feeding program for growing-finishing lambs

a. Performance level desired
b. Type of lamb being fed
    i. Age
    ii. Weight in relation to mature body size
c. Ingredients available for ration
    i. Grain
        1. Cost is the major consideration in deciding which grain(s) to use.
    ii. Protein
        1. Vegetable protein sources
        2. Urea
    iii. Roughages
        1. Energy value
        2. Physical characteristics
d. Nutrient levels and balances
    i. Refer to Small Ruminant NRC for nutritional requirements according to size, age, rate of gain, and mature weight.
e. Feed additives
    i. Be sure to check status of additive with the Feed Additive Compendium before using it.
f. Methods of feeding
    i. Self-feeding
    ii. Handfeeding

CAUTION: Regardless of feeding method, gradually change from a high-forage to a high-grain diet to avoid acidosis, diarrhea, and enterotoxemia.

XXXIII. Methods of formulating finishing diets

a. Percentage method – formulating diet by combining on a percentage basis to meet nutrient requirements
b. Fixed supplement method – formulating diet for lambs that are allowed to consume unlimited roughage; supplemental feed is provided to balance the ration

XXXIV. Diets for finishing lambs

a. High forage and silage
    i. Diets high in roughage are generally less but live weight gains are less than with high grain diets.
b. High grain
    i. CAUTION: Allow a 4- to 7-day adjustment period on each diet that is higher in energy (grain).

XXXV. Effect of nutrition on wool production during various phases

a. Growth
    i. Feed intake
    ii. Energy
        1. Insufficient energy is the most limiting nutritional factor in range sheep production.
    iii. Protein
        1. The critical protein level is near 80% of the recommended requirements. Below this level, production and quality are adversely affected.
b. Pregnancy and lactation
    i. Own wool production
    ii. Progeny wool production
        1. The major effect during prenatal life is a restriction of body size and total number of wool follicles.

WOOL

I. Terms and definitions

a. Epidermis – outer layer of sheep skin
b. Dermis – thick inner layer of sheep skin that extends down to the muscle
c. Trio group – group of three primary follicles with varying number of secondary follicles
d. Scales – protective layer of overlapping flattened cells that surround wool fiber
e. Crimp – degree of waviness found in fiber
f. Keratin – protein found in wool fiber
g. Yield – percentage of clean wool fibers present in a greasy sample
h. Grease wool – wool in its natural state
i. Clean wool fiber present – the portion of the wool that consists exclusively of wool free of all vegetable matter and other foreign material
j. Wool base – oven dried, scoured wool free from all impurities (vegetable matter, moisture, dirt, grease, etc.)
k. Fiber diameter – thickness of individual wool fibers
l. Vegetable matter – burrs, seeds, straw, chaff, and small pieces of stick and bark; organic matter
m. Staple length – length of wool fiber from tip to base
n. Broken wool – fiber pulls apart very easily in a specific position
o. Tender wool – the overall strength of fiber is low and the staple breaks over a wider area than a "break"
p. Break -
q. Coarse edge – presence of coarse fibers in a lot of fine wool; may ne the cause of "prickle"
r. Core sample – sample extracted from a bale of wool that is used to measure yield, mean fiber diameter, vegetable matter content, and clean color
s. Tags – trade term for dung locks, floor sweeping, or stained pieces of wool
t. Tagging – practice of shearing wool on udder and dock region
u. Skirting – practice of separating inferior wool from the bulk of the fleece at shearing
v. Grading – grouping fleeces according to measurable characteristics such as fineness, yield, vegetable matter, length, strength, and color; also known as "classing"
w. Sorting – process in which individual fleeces are subdivided according to "grading" characteristics
x. Scouring – the removal of grease, soil, and suint from wool by washing with water, soap, and alkali
y. Virgin wool – wool that has not been previously manufactured
z. Carding – process that draws the fibers parallel while removing burrs and seeds
aa. Combing – process that separates short fibers, entangled fibers, and vegetable matter from the long fibers
bb. Noil – the short and tangled fibers removed in combing
cc. Top – raw material for worsted wool processing; strand of combed wool with no short fibers (noil)
dd. Sliver – a rope like strand of fiber produced by carding
ee. Felt – fibers that are physically interlocked by mechanical work, chemical action, and moisture not by weaving, knitting, stitching, thermal bonding, or adhesives
ff. Shrinkage – percentage of non-fiber components removed from a fleece; yield plus shrinkage equals 100 percent
gg. Hair – fiber found in wool that is only slightly wavy, inelastic, and glossy
hh. Curing – process that uses salt to preserve pelt by creating an environment in which protein-destroying organisms cannot function
ii. Keds – sheep ticks that puncture the skin causing serious damage to the pelt and stain the wool

II. Types of follicles that produce fiber

a. Primary
    i. Largest follicle
    ii. Formed in groups of 3

iii. Contains sweat gland
iv. Formed first in fetus

NOTE: Primary follicles are growing fibers by the time the lamb is born.

b. Secondary
   i. More numerous than primary follicles
   ii. Located to one side of primaries
   iii. Smallest follicle
   iv. Produces finer fibers

NOTE: More follicles are producing fibers by about 1 month after birth.

III. Period of follicle development (Transparencies #1, #2, #3, and #4)

a. Pre-trio
   i. Initiation of central primary wool follicles
   ii. Completed by 60 days after conception
b. Trio
   i. Initiation of small lateral primary follicles on each side of central primary follicle
   ii. Development of sweat glands
   iii. Completed by 90 days after conception
c. Post-trio
   i. Initiation of secondary follicles
   ii. Maturation of primary follicles
d. After birth
   i. Maturation of secondary follicles
   ii. Decrease in primary follicle density
   iii. Increase in secondary/primary follicle ratio
      1. The ratio of secondary to primary follicles has been found to be an excellent measure of the quality of wool fiber.

IV. Structural components of wool fiber

a. Epicuticle
   i. Covers cuticle with thin outer membrane
   ii. Protects fiber from deterioration and abrasion
   iii. Gives wool its water-repellent property
b. Cuticle
   i. Consists of protective layer of overlapping cells (scales)
   ii. Surrounds wool fiber

NOTE: Scales or overlapping cells on fine wools are more prominent than on coarse wools.

c. Cortex
   i. Major component of wool fiber
   ii. Gives wool elasticity, resiliency, and durability
d. Medulla
   i. Contains central core
   ii. Prevalent in medium and coarse wools

V. Three types of fiber producing sheep

a. True wool – distinguishing feature is presence of "crimp"
b. Medium wool – finer than kemp, longer than true wool, and lacks crimp
c. Kemp – short, chalky white and brittle fibers that are the coarsest grown by sheep

VI. Physical properties of wool fiber (transparency #5)

a. Elasticity
    i. Elasticity is a result of crimp and beta keratin structural properties.
b. Strength
    i. Strength is influenced by health, nutrition, and other environmental factors.
c. Low specific gravity (density)
    i. Wool is among the least dense of textile fibers.
d. Moisture relationship
    i. Water is not absorbed into the cellular portion of the fiber, but rather is absorbed on the surface.
e. Electrical properties
    i. Wool is a poor conductor of electricity but an excellent producer of static electricity in low humidity.
f. Thermal qualities
    i. Wool is an excellent insulator because of its crimp, bulk, and resilience.

VII. Value determining characteristics

a. Average fiber diameter
    i. Most important wool fiber property in terms of value; the basis of United States wool grades.
    ii. In general, as diameter increases, prices decrease because wool is coarser.
b. Yield
    i. Yield is related to fiber diameter and greatly affects the price paid to producers for grease wool.
c. Quantity and type of vegetable matter
    i. The presence of an excessive amount of vegetable matter in raw wool is regarded as a defect, and the wool is discounted accordingly.
d. Average staple length
    i. Staple length of wool is categorized into 3 classes: staple, French combing, and clothing (longest to shortest).
e. Staple length
    i. Wool is discounted when buyer determines subjectively that is contains a break or is tender.
f. Color
    i. The lack of color is important because white wools offer a broad dyeing range.
g. Colored fibers
    i. The presence of colored fibers (naturally pigmented, urine, or fecal stained) is extremely detrimental to value.
h. Variability of diameter
    i. A lot of variability in diameter will require wool to be downgraded.
i. Variability of staple length
    i. Staple length is related to staple strength, weak or tender wool.
j. Cotted or felted fleeces
    i. Cotted and matted fleeces are discounted because they are wasty.
k. Crimp
    i. Low crimp wools tend to entangle and felt during the scouring process.

VIII. Wool traits that can be objectively measured

a. Yield
    i. Laboratory procedures involve scouring wool and then determining residual grease, inorganic ash, and vegetable content of dried scoured wool.
b. Diameter and variability
    i. New airflow methods which measure the resistance to airflow of a plug of clean well-blended wool are much faster.

c. Length and variability
    i. Requires only a rule for measurement and a pencil for recording.
d. Strength
    i. Current methods are not able to give an indication of where the weakness occurs in a staple.

IX. Terms associated with wool price quotes in market reports (Transparency #6)

a. Original bag wools – wool of relatively uniform grade and length packaged in bags by the producer
b. Graded wool – wool that has been classified visually according to fiber diameter, length, and other processing characteristics such as vegetable content and strength

NOTE: Defective fleeces (excessive black fibers or vegetable material) will usually be discounted from published prices.

X. Methods of making wool improvement

a. Selection
    i. Emphasize traits important to income
        1. Fleece weight is the most important wool trait.
    ii. Select superior wool producing individuals
        1. Ram tests or NSIP are two good methods.
    iii. Select rams between 10 and 12 months of age
b. Nutrition
    i. Quantity and quality of feed significantly affects average fiber diameter and clean wool production
    ii. Number of lambs born and weaned affects nutrients available for wool production in a ewe
    iii. Level of nutrition affects initiation of secondary follicles in late gestation
c. Management
    i. Vegetable matter lowers the price of fleece
    ii. Colored fibers and tags lower the price
    iii. Pre-lambing shearing reduces disease and the amount of tags
    iv. External and internal parasites decrease wool production
    v. Paint branding lowers price

XI. Steps in harvesting and preparing wool for market

a. Shearing
    i. The relative value of the wool crop in relation to other income has an effect on the extent of the equipment, facilities, shearing methods, and crew involved.
b. Skirting and grading
    i. All skirts (product of skirting) do not have equal value and should be packaged separately.
    ii. Normal quality control requires that wool be graded and sorted prior to scouring.
c. Packaging
    i. Fleeces should be rolled, flesh side out, and tied with a paper fleece tie.
    ii. Wool should be sacked in new burlap or nylon sacks

XII. Sources of wool contamination

NOTE: Fleece contamination either is acquired from the environment or occurs naturally. Acquired contaminants pose the most serious problem to the manufacturer.

a. Vegetable matter
    i. Material ranges from burrs and seeds picked up in pastures to hay from overhead feeders and straw used as bedding.
b. Paint brand
    i. Any colored substance which hardens (or dyes) the fiber and cannot be removed in the normal scouring process gives endless trouble to the processor. A scourable lanolin-based branding fluid is available.

c. Polypropylene (common hay bailing twine)
    i. Small pieces that become entangled in wool cannot be removed mechanically or chemically. They must be removed from the fabric by hand and can ruin the fabric is exposed to heat.
d. Colored fibers
    i. Colored fibers can occur naturally, can be caused by natural (urine) or synthetic (ink) stains, or can be transferred from other sheep or livestock.

XIII. Methods of marketing wool in the United States

a. Wool pools – cooperative that accumulated members' wool to sell and ship in quantity
    i. There is generally only a small price difference between the best clips and the worst.
b. Sealed bid – method of selling used by wool pools in which bids are solicited from individual buyers and buying firms
c. Warehouses – private of cooperative organization that consigns wool for preparation and sale from individuals and wool pools
    i. Location and size of warehouses are determined primarily by wool production patterns of the area.
    ii. Warehouses can purchase wool prior to shearing, at the farm, at the warehouse door, or at the warehouse after consignment.
d. Direct – selling wool directly to order buyers, warehouses, or mill representatives

XIV. Systems used to manufacture apparel wool fabrics

a. NOTE: The two systems differ with respect to raw materials used, manufacturing process, and the types of yarn and cloth produced.
b. Worsted
    i. Uses only virgin wool
    ii. Parallelizes fibers by carding and combing
    iii. Yields a compact and smooth yarn
    iv. Used in men's suits
c. Woolen
    i. Uses virgin wool, noils, wool waste, and recycled wools
    ii. Randomly places fibers
    iii. Yields a soft and fluffy yarn
    iv. Used in softer types of clothes
        1. Uses include women's suits, men's overcoats and sportscoats, and blankets.

XV. Steps in yarn manufacturing (Transparency #7)

a. Scouring – removes impurities from grease wool
    i. Most scouring mills recover a crude greasy mixture that is sold to pharmaceutical companies and refined into lanolin.
b. Carbonizing – removes vegetable matter by converting it to carbon with acid and heat
    i. Carbonizing is an expensive process that results in weaker, more brittle, and shorter fibers. Therefore, it is only done on wool that has an excessive amount of vegetable material.
c. Drying – removes excess moisture in the freshly scoured wool with hot, dry air
    i. Moisture content is reduced from 50% to below 15%.
d. Carding – disentangles and separated scoured wool fibers
    i. A worsted or a woolen card can be used, depending on the manufacturing process.
e. Gilling – opens and straightens wool fibers in sliver in a worsted system prior to combing
f. Combing – removes vegetable matter as well as short and tangle fibers from sliver of wool
    i. Combed fibers are drawn through rollers and coiled in a can. Finished product is known as "top".

XVI. Steps in yarn weaving

a. Roving – reduces the size of "top" in first step of converting top to yarn
b. Spinning – inserts predetermined amount and direction of twist to top in the second step of converting top to yarn
c. Weaving – interlacing two sets of yarn to form fabric
    i. Weaving can be done with all worsted, all woolen, or a combination of these yarns.
d. Knitting – interlacing of a yarn in a series of connected loops by needles to form a fabric
    i. Hand knitting yarns have less strength than those for machine knitting.

XVII. Steps in yarn finishing

a. Scouring of cloth
b. piece of dyeing
c. fulling – permanently shrink and felt material in a controlled uniform manner
    i. This process is commonly used on woolen fabric and on 60 to 70% of worsted fabric.
d. Drying
e. Brushing – created a nap
f. Mechanical and chemical finishes – make fabric machine-washable and dryable, shrink-proof, moth-proof, stain-proof, rain-proof, and fire retardant

XVIII. Techniques to produce carpets from worsted yarns

a. Weaving
b. Tufting
    i. Process involves tufting loops of yarn through primary backings of jute, polypropylene or cotton.
c. Fusion bonding
    i. Process involving setting the pile yarns in molten plastic that solidifies and binds the yarn. Similar in appearance to tufted carpet.
d. Specialized knitting equipment

XIX. International trends in wool production

a. World production is at its highest level in recorded history
b. Australia produces more wool than any other nation
c. China is a major importer of Australian wool and is developing a textile industry
d. Quantity of wool products being manufactured in developing countries is increasing because f the low cost of production
e. Wool-producing countries are processing more of their own products
f. Consumer demand for wool has never been higher

XX. Types of wool payments

a. Shorn – payment producer receives for wool shorn and marketed
b. Unshorn – payment producer receives for lambs marketed unshorn
    i. Payments are made on each 100 pounds of unshorn lamb produced and provide essentially the same net return that would have been received if the producer sheared the lambs.

XXI. Types of wool logos (Transparency #8)

a. American Wool Logo
    i. Product is at least 20% American Wool if blended with natural fibers
    ii. Product is at least 30% American Wool if blended with manmade fibers
b. Woolmark
    i. Product contains 100% wool
    ii. Internationally recognized symbol

c. Woolblend Mark
    i. Products contain at least 60% wool
    ii. Product meets standards for performance and workmanship
    iii. Internationally recognized symbol

XXII. Components of wool judging

a. Evaluation of grade
    i. Estimate the average diameter of the fibers in the fleece
    ii. Estimate the uniformity of fineness in a fleece
b. Evaluation of length
    i. Determine if wool has long, intermediate, or short fibers
        1. Length classes vary with fineness grade.
    ii. Determine relative "strength" of fiber
c. Evaluation of yield
    i. Estimate amount of clean fiber in fleece
        1. Determined by the relationship between bulk (volume) and weight.
    ii. Evaluate character
        1. Character is associated with crimp, color, staple formation, and handle (feel) of fleece.
d. Evaluation of purity
    i. Estimate amount of black or brown fibers
    ii. Estimate amount of kemp and hair

XXIII. Factors determining value of naturally colored fleeces

a. Color preference
b. Spinning characteristics
    i. Hand spinners prefer uniform fleeces coarser than 58 with adequate length.
c. Quality of fleece
    i. Fibers nee to be strong, soft, and free of stains and contaminations.

XXIV. Types of lambskins (pelts) and their by-products

a. Shearling or wooled skins – fine coats and footwear
b. Pulled or wool-free skins – garments, coats, and purses

MARKETING

I. Terms and definitions

a. Price spread – the difference between the farm price and the retail price
b. Lamb feeding – production process in which lambs are fed from weaning weight to slaughter weight
c. Fabrication – cutting lamb carcasses into wholesale or primal cuts in the slaughter plant
d. Retailer – those who sell directly to consumers, usually through supermarkets
e. Breaker – those who cut carcasses into primal, sub-primal, and individual cuts for resale to retail stores and food service outlets
f. Purveyors – those who process large cuts of meat into portion-controlled cuts for food service outlets
g. Marketing functions – those activities that must be performed while moving sheep and lambs from producers to consumers
h. Grading – process of classifying live animals or carcasses into similar groups to facilitate the buying and selling process
i. Quality grading – reflects palatability differences based on flank streaking in relation to maturity
j. Yield grading – reflects differences in proportion of trimmed meat
k. Price discovery – two-step process that buyers and sellers use to arrive at a sale price
l. Guaranteed yield – method by which packers buy a considerable number of lambs at a certain yield
m. Cut-out value – the value of lamb products and by-products from slaughtering and processing
n. Breakeven price – the selling price needed to cover all costs
o. Dressing percentage – carcass weight divided by live weight
p. Hot boning – removing muscles prior to chilling carcass

II. Factors affecting sheep and lamb inventories in the United States

a. Profitability compared to other agricultural enterprises
b. Weather
c. Feedstuff availability

III. Factors related to sheep and lamb supplies in the United States

a. 80% of the sheep and lambs are produced in 17 Western states
b. Lamb production is seasonal
c. Imports comprise 5-15% of the total lamb and mutton supplies

IV. Facts related to sheep and lamb demand in the United States

a. Consumption is greatest in the spring and early summer
    i. This is in response to holiday traditions and consumer preference for spring lamb.
b. Consumption is mainly in Northeast and mid-Atlantic regions
    i. New York state accounts for 30% of consumption.

V. Facts related to lamb prices (Transparency #1 and #2)

a. Farm level prices tend to be inverse to lamb production patterns
    i. Prices adjust to the level that will clear the market of all lamb produced.
b. Lamb prices have a fairly consistent seasonal pattern over a 3- to 5-year period
c. Retail prices decrease when other meat supplies increase
d. Retail prices increase as disposable income increases

VI. Reasons for price spreads

a. Cost of converting live animals to retail meat cuts
b. Cost of moving live animals from the farm/ranch to packers
c. Cost of moving meat to consumer

i. It takes 3.3 pounds of live lamb to equal 1 pound of a boneless trimmed retail cut.

VII. Primary stages of sheep industry's vertical marketing system

a. Sheep raising
b. Lamb feeding
c. Sheep and lamb slaughtering and processing
d. Lamb distribution

VIII. Geographic characteristics of the United States sheep flocks (Transparency #3)

a. Larger flocks are usually in western rangelands
b. Smaller flocks are often in crop areas

IX. Characteristics associated with lamb feeding

a. Most feeder lambs come directly from producers
b. Seasonal in some areas
c. Declined over past few decades
    i. Decrease is due to decline in total sheep production.
d. Becoming more geographically concentrated
    i. In 1986, there were only 4 states with more than 100,000 lambs on feed.

X. Trends in marketing slaughter lambs

a. Terminal and auction markets have declined in number
b. Marketing directly from feedlot to slaughter plants have increased
c. Electronic marketing has increased
d. Forward contracts between lamb feeders and parkers are more common in some areas
e. Packers are feeding more lambs

NOTE: Packer feeding is more efficient and profitable for the packer and provides a more consistent supply to consumers. However, it reduces the need for lambs from other feeders and may depress prices.

XI. Trends in slaughtering lambs

a. Number slaughtered has decreased
b. Number of companies slaughtering sheep and lamb has decreased
c. Slaughter plants have become more concentrated
d. Fabrication of carcasses is increasing
e. "Boxed Lamb" sales are increasing
    i. Boxed lamb can be processed and shipped more economically while decreasing product deterioration and thus has greatly enhanced the merchandising capabilities of lamb.

XII. Secondary stages of the sheep industry's marketing system

a. Transportation
    i. Moving feeder lambs from dispersed sheep raising operations to geographically concentrated feedlots
    ii. Moving fed lambs to geographically more concentrated packing plants
    iii. Moving lamb to geographically dispersed lamb consumers

    NOTE: Some of the leading sheep-producing states have little or no lamb feeding facilities, while some leading lamb feeding states have very few slaughter facilities.
b. Quality grading
    i. Grades are prime, choice, good, utility, and cull
    ii. Criteria are flank streaking and maturity
c. Yield grade
    i. Grades range from 1 (leanest) to 5 (fattest)
    ii. Criteria include amount of external fat, kidney and pelvic fat, and conformation grade of leg

d. Risk
    i. Production risk
        1. Includes possible death and morbidity losses to sheep and lambs plus losses to feedstuffs.
    ii. Market risk
        1. Includes possible price declines.
    iii. Financial risk
        1. Includes possible loss of equity that may occur from production or market risks.
e. Market information
    i. Local market prices
        1. Local prices may, at times, be several dollar/cwt below process in major feeding and slaughter areas.
    ii. Lamb supplies and retail demand

XIII. Factors influencing the sale price for slaughter lambs

a. Wholesale carcass price
b. Pelt prices
c. Slaughter and processing costs
d. Freight costs from feedlot to packer and from packer to retailer
e. Weight, grade, and yield of slaughter lambs
f. Supply and demand relationships
g. Competition among buyers

NOTE: Research has found that wholesale carcass lamb prices are most important in determining slaughter lamb prices.

XIV. Methods of discounting heavier lamb carcasses

a. Percentage method – attaches a price discount to the proportion of lambs estimated to produce heavier carcasses
b. Sliding scale – a discount per pound is applied to each pound of average weight over a set amount
c. Stop weight pricing – packers quote prices for a maximum weight and pay only on the weight limit, not the actual weight

XV. Marketing outlets

a. Public markets
    i. Provide central supply and demand point
    ii. Enable buyers to locate centrally and bid on feeder lambs

    NOTE: Public markets have declined in number and relative importance, while direct marketing has increased.
b. Electronic markets
    i. Include both telephone and computer auctions
    ii. Allow producers to expose their product to more potential buyers
    iii. Enable buyers to gain low-cost access to a good many lambs
c. Direct markets

    NOTE: Includes several types of direct-to0consumer and direct-to-retail marketing methods.
    i. Eliminate costly hauling, unloading, standing, and reloading of lambs
    ii. Eliminate commission and order buying fees
    iii. Require more time and effort at certain times
    iv. Confusing price structure
    v. Emphasize service and quality more than price

XVI. Factors to consider in selecting a public or electronic market

a. Hauling distance and shrink
b. Marketing services offered
c. Fees charged
d. Buyer competition

XVII. How computer auctions differ from telephone auctions

a. Computer terminals are used by the buyers to communicate
b. Buyers cannot determine which other buyers are bidding
c. Buyers see a description of lambs rather than hear it
d. Computer is programmed to conduct the sale

XVIII. Questions to answer when trying to decide if you should sell or feed your feeder lambs

a. Can I get financing?
b. What are the feeder lambs worth now?
c. What is the market outlook for finished lambs?
d. What are my feeding costs?
e. What is my breakeven point?
f. Is it worth the risk?

XIX. General provisions of the Packers and Stockyards Act

a. Ensure fair and open competition in the trading of livestock, poultry, and meat
b. Supervise transactions involving the sale of livestock in large terminal markets, country auction markets, and direct purchases by packers
c. Provide financial protection to those who sell livestock to packers, market agencies, and dealers
    i. Require prompt payment for livestock purchased on cash basis
    ii. Create statutory trust for the cash sellers of livestock to packers

XX. Disadvantages of heavier slaughter weight of lambs

NOTE: Lamb slaughter weight shave been increasing over the last few decades.

a. Seasonal price discounts
b. Decreased feed efficiency and rates of gain
c. Not included in some buying specifications
d. Some heavier lambs are fatter

XXI. Advantages of heavier slaughter weight of lambs

a. More pounds of lamb per ewe
b. Less cost per pound to slaughter and process
c. Less carcass shrink
d. Larger rib and loin chops

NOTE: Even though advantages outweigh the disadvantages, producers must strive to market heavier, meatier lambs rather than heavier, fatter lambs.

XXII. Reasons for selling lamb on a hot carcass weight basis

a. Less fat cover
    i. The incentive to increase dressing percentage by producing excessively fat lambs would disappear if producers were paid on a carcass weight and yield grade basis.
b. Decreases feed per pound of gain required
c. Fewer arguments on weighing conditions and pencil shrink for live lambs
d. Eliminate price fluctuations due to differences in dressing percentage
e. Easier to price lambs

f. Pays feeder for true meat value of lambs

XXIII. Places to evaluate the amount of fat cover on live lambs

a. Ribs
b. Edge of loin
c. Hip bones
d. Dock
e. Rear flank

XXIV. Questions concerning the concentration of sheep packing plants

a. Can a few large firms depress prices paid to producers?
b. Is regional and national concentration harmful to the sheep industry?

XXV. Keys to selling more lamb to consumers

a. Consumers must be made aware of lamb and its desirable qualities
b. Lamb must be available throughout the year
c. Lamb must be of a consistent quality
d. Lamb must be priced competitively

XXVI. New production processes being considered in the lamb industry

a. Mechanical pelt remover
b. Mechanical deboning
    i. Reduces labor costs, increases lean yield, and produces products that are more highly palatable.
c. Ionizing radiation
    i. Reduces bacteria on meat surface and thus may increase shelf life.
d. Electrical stimulation
    i. Increases the feasibility of "hot boning."
e. Restructured meats

PREDATOR CONTROL

I. Terms and definitions

a. USDA – acronym for United States Department of Agriculture
b. ADC - acronym for Animal Damage Control
c. APHIS - acronym for Animal and Plant Health Inspection Service
d. Extension service – educational arm of the USDA located in each state and most counties
e. Predator – an animal that satisfies some or all of its nutritional requirements by killing and feeding on other animals
f. Coyote – major predator of sheep in the western U.S.
g. Integrated predation management – the practice of including good husbandry practices with effective control methods
h. Carrion – rotten meat associated with dead animals
i. Propane exploder – frightening device that produces loud explosions at timed intervals to temporarily repel coyoted from sheep
j. Repellent – compound applied to sheep that prevents coyotes from killing them; deterrents include smell, taste, and sound
k. Aversive conditioning – practice of feeding a coyote prey-like bait laced with agent (like lithium chloride) that causes coyote to become ill and avoid subsequent contact with prey
l. Livestock guard dog – dog that generally stays with sheep without harming them and aggressively repels predators
m. Calling – imitating the sound of an injured animal in distress to lure predators to a certain location
n. Denning – locating the den and removing the pups and/or the adult pair of coyotes responsible for predation
o. Draw stations – natural area or places set up intentionally to draw coyotes or red foxes to a particular location
p. Snaring – technique of setting a steel-cable loop in an animal's movement path to capture it by the neck, body, or leg
q. Toxicant – poison substance used to kill predators
r. M-44 – spring activated device used to propel sodium cyanide into animal's mouth
s. 1080 livestock protection collar – tool used to selectively kill coyotes that attack sheep or goats
t. DRC-1339 – bird toxicant used for control of ravens

II. Role of the federal ADC program in predator control

a. Control damage to agriculture by wildlife species which are owned by the public
b. Work at request of and in cooperation with public and governmental entities
c. Oversee actions that are designed to alleviate the damage, not necessarily to kill the offending animal

III. Predators of sheep

a. Coyote
    i. Coyotes are the major predator of sheep in the western U.S.
b. Domestic dog
    i. Dogs may disrupt more sheep then coyotes but do not <u>need</u> to feed on sheep to survive. Their acts of predation are usually carried out as play behavior.
c. Feral (wild) dog
    i. Feral dogs prey on sheep for reasons similar to those of coyotes.
d. Bears
    i. Bears will prey less on livestock when vegetation is plentiful.
e. Mountain lions and bobcats
f. Foxes
g. Feral (wild) hogs

h. Eagles and ravens

IV. Characteristics of predation

a. Take prey that is easiest to secure
b. Select prey based on opportunity and several behavioral cues
c. Increases during spring and summer months
d. Occurs most often during evening and early morning hours

NOTE: Predators are generally secretive animals and avoid contact with humans and human activity.

V. Important steps in identifying predation and predators

a. Observe flock and count animals periodically
    i. Sheep that have been repeatedly attacked are more alert, nervous, and may be scattered.
    ii. Lambs can be carried off by predators and there may be no evidence of predation other than that an animal is missing.
b. Examine evidence around site of predation
    i. The mere presence of predator tracks or droppings near carcass is not sufficient evidence. Look for signs of a struggle, such as scrapes, drag marks, broken vegetation, or blood.
    ii. Take note of the amount of sheep carcass that is left. It will vary with how recently the kill was made, the weather, size of animal killed, and the number of species of predators.
c. Examine sheep carcass
    i. One key in determining how a sheep was killed is the presence or absence of subcutaneous (just under skin) hemorrhage at the point of attack. Bites to a live animal will produce hemorrhage, but bites to a dead animal will not. Each predator species has its own method and pattern of killing and feeding that may aid in identification.

VI. Predators and common methods or patterns of killing and feeding

a. Coyotes, foxes, mountain lions, and bobcats usually feed on a carcass at the flanks or behind the ribs, and first consume viscera such as body fat, liver, heart, and lungs
b. Mountain lions, and occasionally bobcats, often cover a carcass with debris after feeding
c. Bears generally prefer meat to viscera and often first eat the udder from lactating ewes
d. Eagles skin out carcasses and leave much of the skeleton intact on larger animals

VII. Laws and regulations that protect predators

NOTE: Most wildlife, including predators, are protected by federal or state laws.

NOTE: It is critical for producers to become familiar with federal, state, and local laws governing predators that may prey on their sheep.

a. Eagles – protected by Bald and Gold Eagle Protection Act and may not be controlled except by specific authority from the U.S. Fish and Wildlife Service
b. Bobcats and foxes – generally classified as furbearers and are protected by state laws except during specific seasons
c. Black bears and mountain lions – if killing livestock, they may be taken in some states while other states require special permits or ADC specialists to control them
d. Grizzly bears – protected by the Endangered Species Act

VIII. Costs associated with predation

a. Loss of income from sale of animals killed or maimed
    i. Costs may be higher if loss in terms of future offspring to sell, cost of purebred sheep, and loss of important genetic resources are included.
b. Inability to utilize particular grazing areas
c. Money required to implement predator control

i. How much to invest depends on the cause and degree of loss anticipated.

IX. Important concepts related to predators and their control

a. It is not practical to kill all coyotes or other predators
b. Domestic sheep are dependent upon humans for protection

X. Methods of prevention

a. Livestock husbandry practices
b. Frightening tactics
c. Aversion
d. Fencing
e. Guard animals

XI. Types of husbandry practice related to the prevention of predation

a. Predisposing factors
    i. Predation may begin because sheep are weakened by poor management practices such as nutrition, disease, parasites, and weather.
b. Flock health
    i. Coyotes often prey on weak or small lambs.
c. Recordkeeping
    i. A good identification system and up to date records help producers identify loss patterns and trends. Counting cheep on a regular basis can help identify a predator loss before many animals are lost.
d. Breeds of sheep
    i. Generally, breeds with stronger flocking behaviors are less vulnerable to predators.
e. Season and location of lambing
    i. Highest predation losses typically occur late spring through September. The use of lambing sheds/pens and the presence of humans lowers losses.
f. Corrals
    i. Confining sheep at night reduces losses. The addition of corral lights tends to further reduce predator losses.
g. Carrion removal
    i. Carrion tends to attract coyotes, stray dogs, and other predators. This may encourage a habit for them to feed on livestock.
h. Habitat changes
    i. Habitats change with the season; it is best to clear away weeds, brush, and junk piles. Generally, the more open the area where the sheep are kept, the lower the predator losses.
i. Pasture selection
    i. Lambing pastures should be chosen with potential predator problems in mind. Additionally, hilly, or rugged areas as well as pastures adjacent to water tend to have more coyote problems.
j. Herders
    i. Increasing costs and a shortage of competent herders have limited their use. If herders aren't used, one should check his sheep frequently.

XII. Frightening tactics used to reduce predator losses

a. Lights
    i. Lighted corrals reduce coyote losses more than any other method. Revolving or flashing the lights may increase their effectiveness.
b. Bells and radios
    i. Placing bells on some or all sheep may reduce losses. Some producers tune in an all-night radio station near the corral to temporarily deter coyotes, dogs, and other predator species.

c. Vehicles
    i. Parking a vehicle in the area where losses are occurring often reduces predation temporarily.
d. Propane exploders
    i. Because of their temporary effectiveness, exploders are best used to reduce losses until a more permanent method is found.
e. Strobe lights and sirens
    i. This strobe light-siren combination was developed by the USDA and is available through the APHIS-ADC Pocatello Supply Depot.

XIII. Methods of aversions

a. Repellents
    i. Since coyoted rely heavily on visual cues when stalking and killing prey, some of the repellents only prevented them from consuming their killed prey.
b. Aversive conditioning
    i. In order for this method to be successful, the coyote must eat the bait, become sick enough that he'll avoid other baits, relate that sickness to live sheep and continue to avoid live sheep without further bait. This technique has not been demonstrated to be consistently effective.

XIV. Types of fencing used to reduce coyote predation

a. Net-wire
    i. The addition of barb wire at ground level or a buried wire apron will discourage digging, and climbing can be prevented by adding a charged wire at the top of the fence. Because of high construction and materials' costs, fences of this type are rarely used except around corrals, feedlots, and areas used for temporary confinement.
b. Electric fencing
    i. The introduction of "high tensile" fence has made electric fence a possible option.
c. Electric modification of existing fences
    i. If existing fence is in good condition, the addition of one or several charged wires can significantly increase its ability to keep predators out. The addition of a charged trip wire 6 to 8 inches above the ground about 8 to 10 inches outside the fence is often effective in preventing coyotes from digging and crawling under.
d. Portable electric fencing
    i. The use of safe, high-energy chargers and polywire (thin strands of wire running through polyethylene) allows one to construct temporary corrals or grazing areas.

XV. Factors related to fencing and predation management

a. Fencing is most likely to be cost-effective when the potential for predation is high
b. Fencing is effective when incorporated with other means of predation control (especially with guard dog)
c. Fencing can be used to concentrate predator activity in specific areas where predators try to gain access
d. Fencing is one of the most beneficial investments in predator damage control and livestock management if practicality allows its use
e. Fences can pose problems with wildlife especially if fencing intersects migration paths

XVI. Types of guarding animals used to reduce predation

a. Livestock guarding dogs
b. Donkeys

XVII. Breeds commonly used as guard dogs

a. Great Pyrenees
b. Komondor

c. Anatolian shepherd
d. Akbash
e. Maremma
f. Sharplaninetz
g. Kuvasz

XVIII. General characteristics of livestock guard dogs

a. Properly reared from puppyhood with sheep
b. Protective behavior is mostly instinct
c. Very little formal training required
d. Very little, if any, herding instinct
e. Slow to mature and may display juvenile behavior up to age two
f. Very likely to exhibit independent behavior

XIX. Method of rearing for potential guard dogs

a. Purchase pup from reputable breeder
    i. First time users of guard dogs should begin with a single pup.
b. Begin training at seven to eight weeks
c. Separate pup from litter mates and place with sheep (preferably lambs) in corral or pen so that it can't escape
d. Check pup daily until 16 weeks of age
    i. Daily checks do not mean petting the pup. The dog should be bonded to the sheep, not necessarily to man. However, the owner should be able to catch and handle the dog.
e. Release dog into large pasture to mingle with sheep at four months of age

XX. Potential benefits associated with using a guard dog

a. Reduced predation
b. Reduced labor
c. Increased utilization of acres where predators had made grazing prohibitive
d. Possible reduction in fencing costs
e. Alerting of owner when predators are near flock
f. Possible protection for family members and property

XXI. Potential problems associated with guard dogs

a. Dog harasses sheep (usually play behavior)
b. Dog does not guard sheep
c. Dog is overly aggressive to people
d. Dog harasses other livetsok or wildlife
e. Costs to rear, train, and supervise dog are high
f. Dog destroys property (chewing and digging)
g. Dog roams beyond boundaries and causes problems with neighbors
h. Dog interferes when sheep are being moved or herded
i. Dog affects the use of other predation control
    i. Toxicants should not be used when a guard dog is present unless the dog is chained or confined during control.

XXII. Advantages of using donkeys as guard animals

a. Friendly to people
b. Dislike dogs, coyotes, and foxes
c. Cheaper to obtain and care for
d. Less prone to accidental death

e. May live longer than guard dog
f. Can be used along with snares, traps, and toxicants

XXIII. Guidelines for using donkeys for predator control

a. Use only jenny or gelded jack
b. Use only one donkey per group of sheep
c. Allow 4 to 6 weeks for donkey to bond to sheep
d. Avoid feeds or supplements containing monensin or lasalocid
e. Remove donkey during lambing
f. Use only donkeys that show aggression to an intruding dog
g. Use donkeys in smaller (less then 600 acres), open pastures with no more than 200 to 300 head of sheep

XXIV. Other animals that may be used to protect sheep

NOTE: Any animal that displays aggressive behavior to intruding predators may be an option.

a. Cattle
b. Llamas
c. Goats
d. Mules
e. Ostriches

XXV. Methods of predator removal

a. Shooting
b. Denning
c. Hunting dogs
d. Trapping
e. Snaring
f. Toxicants

XXVI. Factors to consider when selecting predator removal technique

a. Species responsible
b. Frequency, extent, and amount of damage
c. Status of target and potential non-target species
d. Local environmental conditions
e. Environmental impact
f. Social and legal concerns

XXVII. Types of "shooting" associated with predator removal

NOTE: Shooting is legal in most situations and rans highly among the choices for removing predators.

a. Shooting from ground vehicles
    i. While it can be effective and provide immediate results, under most circumstances it is not practical and is illegal in many states.
b. Calling and shooting coyote
c. Hunting at night
    i. Calling and shooting predators at night is illegal in many states.
d. Aerial hunting
    i. Aerial hunting requires special permit and is not recommended for most livestock producers.

XXVIII. Types of hunting dogs

a. Trail hounds
    i. Trail hounds follow scent left by predator and run it to a tree or corner it on the ground. Coyotes are seldom caught and killed by trail hounds.

b. Sight hounds
    i. Sight hounds depend on their ability to see the prey.
c. Farm and ranch dogs
    i. Producers who do not have farm and ranch dogs may be at a higher risk from predator attacks then those who do have dogs.

XXIX. General steps for trapping coyotes

a. Locate a good place to set traps
    i. Coyotes follow regular paths and crossing places, and they prefer high hills from which to view the terrain. They establish regular scent posts along their paths, and they depend upon their ears, noses, and eyes to protect them from danger.
b. Make the set
    i. Three to five traps should be placed near the area of losses.
c. Anchor traps
    i. Chain swivels, chains, and a stake or drag should be used.
d. Check and reset traps
    i. Traps must be checked once every 24 hours. Sets should be left out for at least two weeks before moving them to new locations. Traps should be rescented every 4 days, using 8 to 10 drops of coyote urine.
e. Kill trapped coyote
    i. As soon as you get at close range, shoot the coyote quickly in the head using a .2 rifle.

XXX. Advantages of snares over steel foothold traps

a. Lightweight and compact
b. Easy to set and low in cost
c. Affected little by weather
d. Offer high degree of human safety

XXXI. Good locations for snaring coyotes

a. Along trails in thickets or heavy vegetation leading to a carcass
b. On trails under fences
c. On livestock trails in vacant pastures and in the bottom of ravines
d. On narrow paths inside weeds or brush

XXXII. Places snares should <u>not</u> be placed

a. In pastures with livestock
b. Withing 25 yards of animal carcasses
c. Within major deer, elk, or antelope wintering areas
d. On any trails being used by livestock, deer, elk, or nontarget animals
e. Under fences where livestock, antelope, deer, or nontarget dogs are using the “crawl space”
f. Where people can readily view captured animals

XXXIII. Toxicants allowed for predator control

NOTE: These toxicants are restricted-use pesticides and may not be registered for use in all states. Information on restrictions and availability may be obtained from state departments of agriculture.

a. Sodium cyanide in M-44s
b. 1080 livestock protection collars
c. DRC-1339

XXXIV. Advantages and disadvantages of toxicants

a. Sodium cyanide in M-44s
    i. Death results in a few seconds

ii. Can be used with relative safety in pastures where other livestock is present
iii. Not as effective in warmer weather when natural foods are abundant
iv. Subject to a variety of mechanical malfunctions
v. Cyanide in capsule tends to absorb moisture over time, cake and become ineffective

b. 1080 livestock protection collar
i. Does not attract coyotes but coyotes will puncture them during attack
ii. 1080 is a slow-acting toxicant
iii. Sheep that are attacked are usually killed
iv. Eliminates individual coyotes that are responsible for killing livestock
v. Expensive and can be lost
vi. Expensive to comply with use restrictions
vii. Cannot be used on open range
viii. Not widely available because they are registered for use only in a few states

XXXV. Control methods for domestic dogs

NOTE: In terms of sheep operation affected, free-ranging or wild dogs may be the most common predator problem.

a. Large foothold traps for larger dogs (50 to 150 lbs)
i. A trapped dog can be vicious and should be approached slowly; if it is to be removed alive, the best method is to use a long-handled hog choker.
b. Shooting (a practical method of removing a wild dog)
c. Snares
d. Live traps

XXXVI. Control methods for foxes

NOTE: Red foxes attack sheep most frequently, generally only lambs.

a. Trapping
b. Snaring

XXXVII. Control method for bobcats

a. Hunting with trail hounds during winter
b. Calling
c. Trapping with leghold traps
d. Snaring
e. Trapping with box traps

XXXVIII. Protected predators

NOTE: if these species are causing sheep losses, the state wildlife agency or the nearest agency with state or federal responsibilities for animal damage control should be notified.

a. Wolves
b. Eagles
c. Mountain lions
d. Bears
e. Ravens

NOTE: Bobcats are afforded some level of protection as furbearers in most states, and coyotes are actually protected in very few states.