

Applied Sheep Behavior

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Introduction, The Basics and Sheep Senses

Sheep have evolved a unique and fascinating array of behavioral characteristics which have contributed to their survival and proliferation in a unique environmental niche. The successful sheep producer learns to understand sheep behavior, and applies this knowledge to practically all facets of flock management.

The scientific study of animal behavior is called ethology. This publication will cover many aspects of sheep ethology from mating behavior to behavior at lambing time and feeding behavior. This will not be an exhaustive review of sheep ethology because such a project would require at least a couple of large books. Instead, we will focus on particular sheep behavioral characteristics that have management implications for sheep producers in the farm and youth club flocks.

The Basics of Sheep Behavior

In recent years, ethologists have generated a considerable body of literature related to sheep behavior. The following review of research shows that the work which has been done provides evidence for existing sheep management recommendations. There is also, however, behavioral information that may challenge sheep producers to examine their management practices in a different light.

Before discussing the various components of applied sheep behavioral research, some basics should be covered. This includes a few definitions and a brief overview of sheep senses because these are the tools which sheep use to interact with their environment. The senses are also the essence of what makes sheep behaviorally distinct in the animal kingdom.

Behavior can be defined as the animal's response to its environment. Domestic sheep exist in a relatively controlled environment and their response to that environment is a fairly predictable composite of innate (inherited) and acquired (learned) components.

Behavior is an important part of what makes a sheep a sheep, so an important question to answer is "What is a sheep?" One of the world's foremost sheep ethologists, Dr. R. Kilgour, defines a sheep as a "defenseless, wary, tight-flocking, visual, wool-covered ruminant (cud-chewing animal) evolved from a desert or a mountain grassland habitat with low water needs and displaying a 'follower-type' dam precocial offspring relationship with strong imitation between young and old in establishing range systems; showing seasonal breeding and a separate male sub-group structure at certain times of the year." Others have pointed out that the sheep is a strongly social animal requiring the presence of at least 4 or 5 sheep which, when grazing, maintain a visual link with each other.

Much of what makes a sheep behaviorally unique is related to being a ruminating herbivore (plant-eating animal). For example, contrast sheep feeding behavior with carnivorous (meat-eating) feeding patterns. Carnivores spend a much smaller proportion of their time consuming food and a considerable amount of time stalking. Sheep normally spend more time consuming food and ruminating (cud-chewing) and little time in searching for food. Carnivores typically must attack and subdue their food before consuming it. Sheep merely graze. These and many other feeding behavioral traits can be logically assumed to provide a basis for much of what makes sheep different from carnivores. Carnivores are aggressive, sheep passive. Carnivores are anatomically suited for killing other animals while sheep are anatomically ideal for grazing. Carnivores kill sheep. Sheep never kill carnivores.

Ethologists have considered the time spent ruminating as an indicator of the basic nature of the sheep. Ruminating can take several hours a day and requires that the animal be comfortable and relaxed. Sudden stresses will cause rumination to abruptly cease. During rumination, sheep and cattle often acquire a pensive, sleepy expression. The cud-chewing time is usually spent in groups and may be accompanied by mutual and self-grooming activity. In established flocks there is reduced aggression with little or no stressful isolation of individuals under normal conditions. It has been speculated that rumination and accompanying behavioral activities are an important facet of the genesis of the strong flock instinct of sheep. It is also suggested that rumination serve as an "anti-boredom" activity.

Sheep Senses

Sheep and other animals share the five basic senses: vision, audition (hearing), olfaction (smell), gustation (taste), and touch. The senses are the tools that an animal uses to interact with its environment. As such, the senses can be considered initiators and/or mediators of behavioral response.

It is difficult to evaluate sheep senses. There is a temptation to allot human sense capabilities to sheep, but a simple evaluation of anatomy shows that sheep and people must have certain basic differences in how they see, feel, taste, smell and hear the world.

However, it would be a mistake to base judgement of sheep perceptions solely on anatomical evaluations. The problem being that our understanding of the relationship between anatomy and actual perception is too primitive to make confident assessments. The point is that we do not completely understand sheep senses, but the things we have learned in recent years have added greatly to our store of sheep knowledge. And a review of this information can be helpful in sheep management.

Vision. Did you ever look a sheep eye to eye? If you have you probably noticed a few things. For one thing, they have a very large pupil, and the sheep pupil is differently shaped than the human pupil. The sheep pupil is somewhat rectangular in shape. And the eyeball is placed more to the side of the head, which gives them a wider field of vision.

Behavioral scientists believe that the placement and structure of the sheep's eyes are due to nature's designation of sheep as a prey species. Predator species, such as dogs and coyotes, have eyes placed toward the front of their head. This narrows their total field of vision but it increases their binocular visual field. This gives the predators better depth perception and a more concentrated field of vision.

Prey species, like sheep and cattle, have a much wider visual field. With only slight head movement, sheep can scan their entire surroundings. If there is a threat, the sheep is likely to perceive it and the behavioral response is generally to flee.

The shape of the pupil further enhances the ability of sheep to pick up movement. The rectangular shape provides a built-in wide angle lens effect which is further enhanced by the placement of the visual receptors in the retina. The total effect is enhanced peripheral vision. It is speculated that a certain amount of vertical vision is sacrificed, i.e., sheep may not be able to easily observe objects that are overhead, such as a predator in a tree. A similar phenomenon is noted in deer, hence the popularity of hunting from overhead stands by deer hunters.

Does the sheep sacrifice visual acuity to obtain a wide visual field of vision? The answer to this question is not clear, but current thought is that sheep vision is relatively keen. Consider the advantages of good close-range vision for efficiently obtaining the best selection of pasture species. Evidence to support this is obtained by comparing the number of cones and rods in sheep versus humans, and the difference is not substantial.

What about color vision? For many years it was believed that both cattle and sheep were color blind, but apparently this is not true. Current evidence is that all common livestock have the cones necessary for color vision. In addition, research with sheep trained to discriminate between colors has led investigators to conclude that sheep are not color blind. It is, however, likely that sheep's color acuity is not equal to other species, such as humans.

Hearing. There is limited research information about the auditory sense of sheep. However, there is evidence that sheep are sensitive to high pitched noises. Researchers have also documented an increased release of stress-related hormones in response to sudden loud noises such as firecrackers or barking dogs. Sheep become nervous and difficult to handle when stress hormones are elevated, so it may be useful to avoid loud or shrill noises when handling or moving sheep.

The sheep can amplify and pinpoint sound with its ears. Sound arrives at each ear at slightly different times with a small difference in amplitude which the auditory system can process into a directional signal. This can be further refined by moving the ears, head or the entire body. This skill is probably almost as important as sight and smell for keeping the sheep, as a prey species, alive.

Smell. The olfactory sense of sheep may be the most difficult for humans to comprehend. Sheep have more highly developed olfactory systems than humans and probably incorporate olfaction more completely in their interaction with their environment.

In spite of the inability of humans to understand the full scope of the sheep's sense of smell, perhaps we get a hint when an odor triggers some long-buried memory or even an emotion. The sense of smell is linked in some mysterious way to the core of both human and ovine sensibilities.

Sheep use smell in a number of ways. One way that is often observed is when smell is used to identify other sheep, particularly when a ewe uses smell to pick out her lamb.

Another common use of smell is during mating. The ram constantly moves from ewe to ewe to detect the ones in heat (estrus). The classic head-raised, lip-curling behavior of the ram (bulls and stallions, also) as he smells estrus females is called the Flehmen response. This trait, which may be occasionally seen in females, is due to a special organ above the roof of the mouth which humans do not have. It is called the vomeronasal organ.

A well-documented ewe response to the presence of males is the onset of cycling when previously absent males are introduced into the flock. The vomeronasal organ has been implicated as a mediator of this response, probably due to a release of androgen-derived pheromones by the males.

Sheep probably use their olfactory sense to locate water and to identify subtle or major differences between pastures and feeds. For example, sheep prefer to avoid grazing near where other sheep have defecated. Cattle are even more persnickety than sheep in this regard. An olfactory stimulus is probably the trigger of this behavioral response which can have a significant effect in grazing patterns over a grazing season.

Sheep will select fresh feed in preference to spoiled feed. The next time you are tempted to dispose of moldy feed or hay by feeding it to sheep, try smelling it yourself. Then remember that, if it smells bad to you, it may smell worse to the sheep. This may not always work, however, because some molds, such as highly poisonous aflatoxin, cannot be detected by humans. There are also feeds, such as silage, which many people find objectionable to smell which sheep readily accept.

Taste. The sense of taste in sheep is probably not as important as the sense of smell and it is difficult to separate behavioral responses that are due to taste from responses caused by the olfactory sense.

Sheep have the ability to differentiate feedstuffs and taste may play a role in this behavior. When presented with a variety of feeds, sheep will select certain feeds over others. In practical situations, such as under grazing conditions with multiple forage species present, the sheep will select different types and species than goats or cattle.

There have been experiments to determine if sheep have "nutritional wisdom." This is based on the premise that sheep will attempt to eat feeds that provide them with the nutrients they require. In most cases, sheep are unlikely to balance their own ration when provided a variety of feeds. If possible, they will consume feeds at a level far higher than necessary to provide essential nutrients.

Salt is a good example. Salt is provided to meet the requirement for sodium but sheep will often consume many times the amount of salt needed to meet the requirement. Luckily, there is no evidence that over consumption of salt will cause health problems if there is adequate water available.

Touch. Most of the sheep's body is covered with wool or coarse hair. The hooves are certainly not designed for maximum tactile stimulation. Only the nose, lips, mouth and maybe the ears readily lend themselves to feeling behavior. This certainly does not mean that the skin under the wool has no sensitivity. In fact, it is probably extremely sensitive, but protected. Similarly, the hoof pad is probably also sensitive, as anyone who has trimmed hooves can relate to.

The sense of touch is undoubtedly important in interaction between animals. Lambs seek bodily contact with their dams and ewes probably respond to the touching behavior in various ways, including milk let-down in response to the nuzzling/suckling stimulus of lambs.

A practical touch situation is related to electric fences. Anyone who has used electric fences with a variety of grazing animal species knows that sheep are the least sensitive to electricity. This is probably due to the insulating property of the wool. To use electric fences with sheep, multiple hot wires should be placed with one being approximately at nose height.

High-quality, well-grounded chargers should be used, and sheep should be trained to the fence by introducing them to a well-constructed permanent electric fence for their first experience. Extension agents or fence companies can supply plans for electric fences that not only effectively confine sheep, but also deter predators.

The Domestication of Sheep

Sheep and humans have been closely associated for a long time. Studies have shown that sheep were probably the second or third species to be domesticated. Man's "best friend," the dog, was the first species to be domesticated, with sheep and goats approximately tied for second in the domestication race.

It is difficult to know exactly when domestication occurred, but domesticated sheep remains have been dated some 9000 years ago in Iraq. Some experts suspect that sheep domestication may have been fairly advanced as long as twelve to fifteen thousand years ago.

Assessing behavioral modifications that occurred during domestication is difficult because the evidence is slim. Skeletal remains can be tracked and even fleece changes can be charted, but behavioral changes are more elusive. Even so, certain important inferences can be drawn that can assist the modern sheep producer in understanding the behavior of these fascinating, docile animals.

The basics of Domestication

"Domestication" is defined in Webster's Dictionary (2nd Edition, 1976) as "to cause (animals and plants) to be no longer wild..." Scientists who study domestication are careful to differentiate domestication from taming. One expert ©. A. Reed) sums up this difference by stating: "Although taming was or is necessarily a pathway toward domestication, a tamed animal is not a domestic one."

Sheep, with few exceptions, are a thoroughly domesticated species. The sheep that we work with each day are descended through thousands of generations of human contact. In all probability, domestic sheep would not survive for long in most "wild" situations; certainly the sheep would be quickly destroyed if significant predator pressure were present.

Sheep are an almost perfect example of the symbiosis (mutual benefit) that is necessary for domestication. Sheep contribute wool, meat and milk in return for protection, shelter, feed and health management. Interestingly, the sheep also have a profound symbiotic relationship with the gut micro-organisms that digest the fibrous material (grass and hay) that makes these animals economically efficient human partners. More simply, sheep convert forages that humans cannot use into valuable products that we can use, and it is the gut microbes that allow them to do this. Considering the numerous other factors, such as soil fertility, forage combinations, grain supplementation, climate, etc., it becomes clear that domestication is a complicated story about the development of complex, elegant relationship.

Experts have proposed the following stages in the process of domestication of sheep:

- Loose ties of animals with man, but no control of breeding;
 - Confinement and breeding in captivity, with separation from wild sheep allowing a distinct domestic race to develop;
 - Selective breeding by man for certain features with occasional mating to wild forms;
- and,

- The gradual intensification of the development of different breeds with desirable economic characteristics.

These steps occurred over thousands of years with the bond between man and sheep being gradually strengthened with each generation. A closer examination of certain aspects of the domestication process may help sheep producers understand their animals better.

Early Domestication

Much of what we understand about the earliest history of domestication is speculation based on studies of early man as a hunter-gatherer and sheep as a prey species.

Sheep must have been an attractive quarry for early human hunters. Although pre-domesticated sheep were undoubtedly nimble and swift, and difficult to trap, they must have been relatively simple for a skilled hunter to subdue after the sheep was cornered. The reward to the hunter was enough meat to feed several people in a package that was small enough to be conveniently carried home. After the family was fed, there was leather for clothing and shelter, bladder for liquid storage and bones for tools and other uses.

The most commonly offered scenario about the beginnings of the domestication process begins when a very young lamb is orphaned and adopted by humans. This process will be understood by anyone who has raised an orphan lamb or calf. The lamb bonds with humans and the younger the lamb, the more complete the bond. Modern behaviorists have proven that, if the process begins within a few hours of birth, the attachment is especially strong and called "imprinting." An orphan lamb which "imprints" to a human will have a bond with that person as powerful as the attachment between a lamb and its dam. It will attempt to follow the person, sleep near her and seek protection from the person if a threat is perceived.

Most speculation begins when the father\hunter kills a wild ewe with newborn lambs. The hunter takes the lamb(s) home and gives them to his children who raise them as pets. Some behaviorists speculate that very young orphan lambs could have survived only if they obtained milk from source. Previously tamed goat dams might fit this theory but, according to one theory, the most logical source of milk was a woman who would suckle the orphan lamb with her own children.

Whatever the exact genesis of domestication, the sheep apparently adapted to the process remarkably well. At least part of the reason for the success of the domestication of sheep must lie in the strong "flocking instinct" of sheep. The "flocking instinct" is scientific shorthand for explaining that sheep are social animals. Humans are also social animals and both sheep and humans have the capacity to expand their social group to include members of other species.

For example, it is typical in many parts of the world to see humans, dogs and sheep working together as an economic-social entity. Humans, in effect, serve as the catalyst to meld themselves with pack-forming animals (dogs) and flock-forming animals (sheep) into an extended, interdependent pack/flock. As Alice said of Wonderland, "Curiouser and curiouser!"

Advances in Domestication

As the millennia passed, the relationship between sheep and humans passed beyond "tamed companion" to "domestic partnership."

This was a symbiotic relationship, i.e., both species benefitted, or it would probably not have proceeded as well as it did.

One of the key elements in the advancement of the relationship must have been actions by humans that changed the breeding pattern. Charles Darwin was the great teacher who most

clearly explained the difference between "natural selection" in which man's role was no more than another competing species and "methodical selection" in which man actively applied selection pressure to achieve desired genetic results.

An early possible behavior-related example of Darwin's methodical selection may have been the elimination of aggressive animals before breeding age which would result in selection pressure in favor of gentle, more submissive, animals in the breeding flock. This could be done by killing the aggressive animals or, in the case of rams, they may have been castrated. It is unknown when it was discovered that castration causes desirable changes in behavior, but there is evidence that it was practiced as early as the Neolithic period. Perhaps castration was first done to improve behavior, then continued as the most effective available method for selective breeding.

As domestication advanced, the sheep were changed. The physical changes in body structure and wool have been documented, but behavioral changes are not as clear. According to M. L. Ryder, "Modification of behavior was important in the adaptation of wild sheep to the new environment, and this ability to change behavior may have made sheep amenable to domestication."

There are no other common livestock species, except dairy animals, which demand as much physical contact with their keeper. Beef cows, for example, may only be worked once or twice per year, and it may take only a few moments to administer management procedures. Sheep may be worked as many as six times a year. Cows typically calve and raise the calf with little direct participation by humans. Lambs will more commonly be born in confinement with considerable direct contact. Cows rarely need shearing. Sheep require considerable direct contact during shearing time. (Horses, of course, may have more direct contact with humans, but it is not a requirement for survival in most modern situations, and is more likely to be used for recreational activities than as a source of necessary work.)

The extreme level of animal/man contact required for successful sheep raising is probably one reason for the remarkable docility of sheep. If you are in the sheep business, ask yourself how long you would keep a sheep that was aggressive, independent and had the ability of creatively think of ways to escape. Probably not long and Neolithic shepherds were probably no different. Therefore, as domestication advanced, sheep became more docile.

The docility of sheep is not without problems. These gentle animals are, unfortunately, easy prey to free-ranging dogs, coyotes and other predators. The avoidance of predator loss is yet another reason why sheep producers will typically have more contact with their animals than managers of beef cattle.

The practice of "methodical selection" by shepherds during the process of domestication led inevitably to the development of breeds. The origin and development of the various breeds of sheep is a huge and interesting topic, but beyond the scope of the series, except as related to behavior. There is considerable variability in behavioral traits between breed. For example, certain breeds tend to be more gregarious, i.e., they "flock" better. The Rambouillet, for example, is known as a breed with a strong tendency to "flock." Other breeds, notably the Blackbelly Barbados, are known for being "flighty."

Modern Behavioral Implications

Over a century ago, Charles Darwin offered an excellent explanation for the human tendency to select toward extremes in animal breeding. He stated:

"...in the process of selection man almost invariably wishes to go to an extreme point."

We have seen modern parallels to the tendencies that Darwin observed. Extremely tall "show-ring sheep" are an example. Behavioral extremes, such as nervous attitude (flightiness), aggressiveness, weak mothering ability or low libido are behavioral traits that should generally be avoided in sheep and which may, to some degree, be affected by the selection process.

Mothering ability is an interesting example of a behavioral trait which has many facets and implications. The importance of mothering ability varies widely according to management conditions. In farm flocks, the birth process is often closely monitored and human assistance is readily available. Twins and triplets are desired and common. Under range conditions, the dam may have to fend for herself. Twins and certainly triplets are not preferred. Mothering ability is probably more important in the range flock, but if the farm flock managers place little or no importance on mothering ability they may develop sheep that are more difficult to manage during the lambing period.

Sheep generally present few behavioral problems. In fact, sheep are so gentle that they are routinely recommended as "starter" animals to introduce boys and girls to 4-H and FFA livestock projects. Thousands of young people show sheep each year with almost zero probability that they will be injured by an aggressive animal. Sheep are easily trained to lead with or without a halter and are cooperative with even inexperienced youth. They are probably the most readily observed "proof" of the high degree to which the sheep has been behaviorally domesticated.

Mating Behavior

One of the most important factors in determining the success of a sheep operation is the rate of reproduction. Reproductive efficiency is influenced by a number of variables, including environment, nutrition and genetics. Behavior is also an important aspect of reproduction, and an understanding of the basics of reproductive behavior can lead to management applications that can improve reproductive success.

Puberty

Puberty is the attainment of sexual maturity. In sheep, this can be as early as 6 months but it more commonly occurs at 7 to 12 months. Behaviorists have noted that both ram and ewe lambs may perform mating activity before the reproductive tract is physiologically mature. Therefore, pregnancy does not occur. Conversely, some ewe lambs may cycle, but not exhibit estrus.

A common goal of the flock manager is to breed ewe lambs to lamb as yearlings. This requires that they be bred when they are approximately 7 to 9 months old. Research has shown that ewe lambs which are bred during their first year will be more productive over their lifetime.

Ewe lambs will not normally cycle as many times as mature ewes, and will often start cycling later in the season. These facts may contribute to the difficulties that many sheep producers report when trying to breed ewe lambs.

Seasonal Breeding Behavior

Sheep exhibit seasonal breeding patterns. In general, they are referred to as being seasonally anestrous (non-cycling) or short-light breeders. This means that they are more likely to breed in the fall, when day length is shorter and temperatures are cooler.

The onset of the breeding season is controlled by the pineal gland which is located in the brain. This gland secretes a hormone, called melatonin, which acts on the hypothalamus to initiate the breeding cycle. The stimulus for the secretion of melatonin is shorter photoperiod, or shorter day length.

Interestingly, the further away from the equator that a sheep breed originated, the more likely they will exhibit seasonal breeding patterns. Conversely, sheep developed in the tropics or subtropical regions are likely to exhibit estrus behavior throughout the year.

Successful attempts to alter breeding cycles have been conducted. One method for accomplishing this is to house sheep in environments in which the length of the light/dark periods can be artificially controlled. Most researchers who have reported success in using this method have stressed the need for absolute darkness during the simulated night portions of the period. The light/dark hours most commonly mentioned in the literature is 8 hours of light and 16 hours of darkness. This effect has been enhanced by the administration of certain hormones.

Another approach has been to use a synthetic form of melatonin. This method has proven successful in other countries, but has not been approved for use in the United States.

The onset of cycling behavior in ewes may be stimulated by the introduction of a ram. Various researchers have demonstrated that a high proportion of ewes will come into heat (estrus) within a few days after a ram is introduced. This effect is more pronounced if the rams and ewes have been completely separated during the non-breeding period. This phenomenon tends to result in a synchronized breeding period, with multiple ewes exhibiting estrus behavior at the same time.

Seasonal breeding behavior is generally regarded as being more in the realm of the ewe, but rams are also affected. Researchers have reported decreased levels of testosterone production and decreased testicular size in rams during the off-season. The off-season for breeding in the farm flock states, including Tennessee, is generally regarded as the late spring and summer months.

Courtship and Mating

Ewes will cycle several times during the breeding season if they are not bred or if they fail to become pregnant. The reproductive cycle of the ewe is about 16 days (range = 14 to 20 days). The actual period of estrus when the ewe is sexually receptive to the ram is about 30 to 36 hours.

Ewes in heat may actively seek out and attempt to stay in the vicinity of the rams. There may be little other sign of estrus early in the heat period, but as the heat period progresses, the ewe may become more active in her courtship behavior. During the peak of estrus the ewe may sniff, lick or nuzzle the ram.

The estrus ewe is likely to urinate frequently, particularly if the ram is investigating. A ewe may exhibit the urination response to the ram whether she is in heat or not, but if she is not in heat, she will usually leave the vicinity of the ram. If she is in heat she may passively accept the attention of the ram, occasionally turning her head to observe the ram's activities. Sometimes the ewe fans or wriggles her tail.

The classic behavioral response of the ram when it detects an estrus ewe is to lift its nose into air and curl its upper lip. This is called the Flehmen response. The Flehmen response is generally exhibited after smelling freshly excreted urine. Although the Flehmen response is visually graphic, it is not considered to be a means of sexual communication. Instead, the

primary purpose of Flehmen is generally regarded to expose the vomeronasal organ. This organ is in the nasal cavity and is connected to the roof of the mouth. Its purpose is to detect the pheromones (sexual odor compounds) in the urine.

Rams exhibit certain additional stereotypical display patterns. There will often be impatient appearing foot-stomping behavior. The ram may lick the ewe's genitalia and will frequently nudge the ewe. There may be some grunting vocalization.

The ram may fail in several initial attempts to mount the ewe. Teasing behavior has been reported to last about 3 hours in one study. When the tip of the penis achieve contact with the vulval mucosa, insertion and ejaculation quickly follow. The breeding may be repeated a number of times. The volume of each ejaculate is comparatively small (one milliliter or less) which may partially account for the ram's ability to repeatedly mount and ejaculate within a relatively short period.

If more than one ewe is in heat at once, competition for the ram may occur and ewes may be seen to mill around the ram.

Rams may repeatedly mount one ewe, but will exhibit apparent exhaustion after about 3 to 6 mountings. The ram may exhibit rapid recovery if a new estrus ewe is introduced. One study noted that a ram mated three times as much when placed with 4 estrus ewes than when placed with one ewe in heat.

Rams will tend to select older ewes over ewe lambs. Rams have also been reported to select ewes of their own breed over ewes of another breed.

Dominance Effects

If multiple rams are used in a breeding flock, it is likely that a dominance hierarchy will develop. In some situations, this may have serious management implications. For example, the dominant ram may be genetically inferior, in which case the lambs which result would be likely to be of inferior quality. Another potentially serious problem that may occur is when the dominant ram is infertile or sub-fertile. This could easily cause a drastic decrease in lambing percentage.

Mature rams will almost always dominate over yearling rams. All other things being equal, larger rams will tend to dominate smaller rams. Sometimes smaller rams are more aggressive, however, and may breed more ewes.

Rams will normally display agonistic (fighting) behavior when introduced into the ewe flock. In some cases this can result in injury or exhaustion. Rams will tend to fight longer if they are evenly matched. Fewer problems may occur when three rams are used instead of two.

It has been observed that subordinate rams may exhibit considerable sniffing/Flehmen activity with ewes in early estrus while giving way to dominant males for mating during peak estrus.

Libido

Libido is the term which is used to denote sexual drive or the degree of sexual urge of animals. A ram with a high libido will exhibit an eagerness to mount and attempt to breed a ewe. Some might characterize a ram with high libido as a "worker," or a ram that "goes about his business."

Rams exhibit a wide range of libido levels, from zero activity to the extremely aggressive ram that sacrifices all other pursuits in favor of searching for and breeding estrus females. Either

extreme may cause problems, and ram lambs are more likely to exhibit extremely low or high libido.

A number of tests have been developed to measure the libido levels of rams. These have included measurements of reaction time when introduced to estrus females and ratios of successful mountings to attempted mountings. Probably the most useful are serving capacity tests where ram performance is assessed in a number of categories over a period of 2 weeks or more.

At present, there is no reliable, widely used test of ram libido. Producers can assess the practical libido of a ram by placing a marking harness on the ram(s) so that a colored spot is left on the ewe's rump after breeding. By keeping a record of breeding activity, an assessment of the ram's breeding activity can be made. In addition, this type of record can provide a means for monitoring the degree of success or failure of the ram's breeding efforts and allows prediction of lambing dates.

Unusual Mating Behavior

Most of the preceding has been devoted to the "typical" or "average" sexual behavior. There are a number of situations which are not typical, however, and some of these have important management implications.

Probably the most commonly noted example is failure to breed by a young ram. Rams are often raised in monosexual groups. Sometimes they are isolated and raised alone. Either of these situations is likely to result in a certain percentage (estimates range from 20 to 60 percent) that will experience initial difficulty with mating. One study found the 17 percent had not mated after 9 days of exposure to estrus ewes. One study noted that rams raised in isolation were more successful in initial matings than rams raised in single-sex groups. It has been postulated that rams reared together have to "unlearn" the response that was experienced in sexual/fighting situations with other males. Then the correct response to the female could be expressed. Rams reared alone also have difficulty, but maybe not as much as rams raised in groups because the rams reared alone did not have to "unlearn" behavioral patterns.

Homosexual behavior has been reported in sheep but is usually noted in groups of males grouped together, as in the previous paragraph. Homosexual behavior has been implicated as a causative factor of reduced ram libido in flock situations. The cause of reduced libido is probably less important than recognizing that a problem exists and taking appropriate action, which usually means replacing the ram.

Behavior at Lambing Time

This is the third in a series of articles about sheep ethology (behavior). In this segment, the behavior of sheep at lambing time will be addressed.

Behavioral traits associated with the birth process (parturition) are deeply rooted in the ancient development of animals. The basic assumption is that animals have evolved behavioral strategies that insure their survival to the greatest possible degree. During the birth process, both the dam and her offspring are in a weakened state, and are susceptible to attack by predators. It is, therefore, important that steps be taken to minimize the susceptibility. In general, these steps may include location of safe sites for the birthing process, quickening the process, protecting the process, minimizing evidence of the process and achieving rapid recovery.

A recent survey showed that 9.2 percent of lambs born in Tennessee do not live to weaning time. This is in agreement with other surveys which show typical losses ranging from 5

to 15 percent. Most of these losses occur during or shortly after parturition (birth). Many of the causes of young lamb death are related to behavior.

Researchers have studied many aspects of sheep behavior before, during and after parturition. The serious student of sheep ethology, for example, can find studies that detail behavioral traits of the fetus. For the purposes of assisting the shepherd by explaining applied behavioral tendencies or traits, there are four basic areas which will be considered in this paper. These include the behavior of the pre-parturient ewe, the behavior of the ewe at lambing time, ewe behavior after lambing and behavior of the lamb after lambing.

The Behavior of the Pre-Parturient Ewe

Any shepherd who wishes to succeed in managing a reproductive flock should learn to recognize the behavioral patterns that are characteristic of the ewe which is about to give birth.

The first sign that is usually seen is the tendency for the ewe to separate from the rest of the flock, but this behavior is not always seen. Researchers who have studied pre-parturient separation have reported widely differing results. Studies on wild Bighorn Sheep showed that they all seek isolation, while another study with Merinos found that 90 percent lamb wherever they happen to be. Another study with Merinos and British breed ewes found that two-thirds of the ewes were isolated from the flock, and that most of these actively sought isolation. Ewes lambing in pens or barns will often seek a corner. Other ewes will often follow the ewe as she seeks isolation.

Shelter seeking behavior before lambing, like isolation behavior, has not always been observed. The advantage of shelter seeking is to improve the birthing environment, particularly during harsh weather. Studies in Australia, with Merino ewes, showed little tendency by the ewes to seek shelter, even in cold weather. Studies with Welsh Mountain ewes and Laucaune ewes showed that cold, windy conditions increased the probability that ewes would seek shelter during lambing.

Studies have shown that shorn ewes are more likely to seek shelter at lambing time than ewes in full fleece. This finding has led to adaptation of the practice of shearing ewes about 6 to 8 weeks before parturition, particularly in the farm flock regions of the United States where medium wool breeds predominate. It has been observed that ewes under this type of management are more likely to lamb inside and are more attentive dams. There is also a significant reduction in space requirements. The disadvantages of twice-a-year shearing include additional labor requirements and a decrease in wool length, which decreases fleece value.

Ewe Behavior at Lambing Time

Ewes may lamb at any time of the day or night, but various studies have indicated that lambing may become concentrated at certain times. One study noted two peak lambing times from 9:00 am to noon and between 3:00 pm and 6:00 pm. Another study linked lambing time to feeding time, showing that an early evening feeding tended to increase night-time lambings which is inconsistent with what has been generally noted in cattle.

As lambing time draws near, the ewes may become more restless. Such expressions as pawing or stamping, vocalization and circling are common at 60 to 90 minutes. Feed consumption and cud-chewing will normally cease. The restless period will usually be shorter for older ewes. Some ewes (21.0 percent in one study) may show increased interest in other lambs in the flock during this period, including cleaning behavior and occasional attempts to "steal" the lambs.

Labor is usually short in sheep, often less than an hour from the first protrusion of the vulva. First lamb ewes are more likely to have labor that extends over an hour, and older ewes may be in labor only one-half an hour. If labor continues for over an hour with mature ewes or two hours with first-lamb ewes, assistance is often appropriate.

Ewes are often interested in the amniotic fluid that drips from their vagina onto the ground. They will repeatedly sniff and lick the area that is contaminated with this fluid. It has been postulated that this behavior serves as a means to keep the ewe near her "nest" site during the birth of her lamb(s). One report noted that the ewe's attraction to the "nest" area may be strong enough to keep her near it despite the removal of a lamb. This has practical implications if the ewe fails to provide adequate "mothering" merely because the lamb accidentally wanders away. This is not considered to be a major difficulty.

The ewe usually lies down during the latter stages of labor, but may stand during the actual birth.

Ewe Behavior After Lambing

If there has been a normal birth, ewes will stand during or shortly after the birth of the lamb and begin to nuzzle and lick. This period, referred to as the "critical period" by behaviorists, is an important time for establishing the maternal/offspring bond. The licking/cleaning behavior, which usually starts at the head, serves to stimulate the lamb while also drying it. The cleaning is probably also part of the initial bonding process, and is typically accompanied by low-pitched, gurgling vocalizations. Experiments have shown that lambs learn to recognize the characteristic voice of its dam.

The ewe is normally attracted to her newborn offspring, but researchers are not certain of the exact nature of the attraction. It has been noted that post-parturient ewes are strongly attracted to the fluids associated with the birth process. For example, researchers found that ewes are even attracted to a rag, if the rag is soaked in placental fluid. It is also well-recognized that it is normal for the ewe to consume the birth membranes (but not the actual placenta, usually) during the cleaning process. These facts have led sheep behaviorists to conclude that "the initiation of cleaning is probably an innate form of behavior which may be augmented by olfactory and gustatory stimuli from the birth fluids" (from "Ethology of Farm Animals").

This type of research has led to practical applications. For example, the knowledge that ewes are attracted their own birth fluids has led to successful attempts to include these fluids in orphan lamb grafting procedures. For example, success has been achieved by tying the skin of the ewe's own dead lamb around the lamb to be adopted. The olfactory clues can frequently convince the ewe to accept the substitute, particularly if initiated shortly after parturition.

Ewes can identify her lamb within hours of birth. Odor is the primary recognition stimulus. The most significant identification is usually made when the ewe smells the genital area of the lamb.

The frequency with which ewes have multiple births complicates behavioral analysis. One researcher noted that a ewe exhibiting normal post-parturient cleaning behavior can be distracted by the pain of a second birth and wander away from the first lamb. Conversely, this author has noted that during normal birth procedures, in which discomfort to the ewe is minimal, the ewe will clean the lambs in the order in which they are born. The ewe will complete the cleaning of the first lamb before initiating the cleaning of the second. Similarly, the cleaning of the second lamb will be finished before commencing the cleaning of the third, and so on. This

can lead to serious consequences if the births occur during inclement weather and the shepherd is not available to assist the ewe.

The cleaning/licking action of the ewe is an important first step in preparing the neonatal lamb for its new environment. The cleaning and licking also dries the lamb. The drying is particularly important during cold or windy weather. The cleaning/licking is also accompanied by nuzzling which appears to assist the lamb in learning to stand. The ewe usually starts the licking at the head, so that by the time she has reached the rear, she is able to assist the standing process by the nuzzling. The lamb may stand as soon as 30 minutes. If the lamb attempts to stand too quickly, before the cleaning is over, the ewe may actually impede the lamb with her front leg. The ewe, especially the experienced ewe, will orient her body so that her udder is available to the lamb. She may even lift her hind leg to further assist the lamb.

The cleaning/licking process is also important to the bonding process. If the lamb is removed before she has licked it, the ewe is more likely to accept another in its place, but she is less likely to accept a substitute after the licking has bonded her to the lamb.

Occasionally, there is abnormal maternal behavior which may result in management problems. One relatively common problem is mismothering, in which a ewe "steals" another ewe's lamb. This may happen when one ewe's lamb is born dead and she takes another, or it may occur prior to parturition, as mentioned previously. Sometimes, it is merely the result of confusion due to two ewes lambing in the same area at near the same time. Two studies noted that this happened at a rate of about 3 percent, but one report noted a 15 percent rate of mismothering. Unless the shepherd is extremely careful and observant, mismothering may occur without their knowledge. This could result in record-keeping errors and faulty management decisions.

Occasionally, a ewe will exhibit poor maternal behavior. Butting the lamb or moving away to prevent suckling are examples. The manager should make certain that there is not a physical cause, such as udder infection. Often it is simply desertion, where the ewe shows no interest in the lamb and wanders away from the birth site. It may be a temporary or permanent desertion, but it is a management problem either way. Researchers have noted that desertion normally occurs at a rate of 4 percent or less, but instances have been reported as high as 22 percent. If there is no physical cause for these poor mothering practices, they may be often be corrected by placing the ewe and her lamb(s) in lambing pens for 24 to 72 hours. More difficult cases may require that the ewe be placed in a restraining stanchion.

Post-parturient Lamb Behavior

The lamb is helpless at birth, but is able to stand within a half hour in most instances. The next order of business is to nurse. The visual clue to assist the lamb in finding its first meal is the underline of the ewe, but it does not know whether to nurse to the front or to the rear. As previously explained, an experienced ewe will assist the lamb in correct orientation. Lambs nursing stanchioned ewes may take longer to find the udder than lambs nursing unstanchioned ewes.

The lamb sometimes has difficulty in finding the udder, often taking as long as 2 to 3 hours, if unassisted. One study, however, suggested that 60 to 80 percent of lambs will suckle within an hour of birth. Sometimes the lamb encounters teat-like objects, such as tufts of wool or other protrusions, and will suckle these with a natural lack of successful results. In fact, starvation due to the lamb's failure to find the teat is not unusual. The shepherd is advised to

shear the vicinity of the udder before lambing to provide an unobstructed area for the lamb. It may also be wise to assist the lamb in the initial nursing. Sometimes a waxy deposit on the nipple may need removal for successful nursing. These efforts will assure that the newborn lamb obtains the colostrum (first milk) as soon as possible, which is desirable because the antibodies which are contained therein are absorbed only during the first hours of life.

Lambs suckle frequently during the first few weeks. Estimates range from one to two times per hour, with each session lasting as long as three minutes. As anyone who has ever bottle-fed a healthy lamb will testify, a lamb can suckle with considerable vigor. As they grow older, the frequency and duration of suckling sessions decreases, probably because they become more adept at suckling and depend on the ewe to a decreased degree for their nutritional sustenance. By the fifth week, lambs will only be suckling once every two hours.

Twins provide a suckling management problem for the ewe. It is not particularly difficult when they are under 2 weeks, because she can usually provide enough milk to meet the demands of both lambs. After they get older, the ewe may have difficulty meeting demands, and will generally not allow one to suckle without the other.

Lambs that wish to nurse will nudge the mammary area. If the ewe is recumbent, the lambs will not only nudge, but will also climb upon her and paw her.

Lambs will stay close to the ewe in the first weeks of life, but will gradually begin exploring and developing social groups. By the end of the first month, they will spend approximately 60 percent of their time with other lambs. They will also start consuming feed or pasture at an early age, as early as two weeks. By the time they are 4 to 6 weeks of age, they may be obtaining as much as 50 percent of their nutrient intake from sources other than their dam. By 8 to 10 weeks, over 75 percent of their nutrients may come from non-milk sources. This is part of the reason that it is generally recommended in many farm flock situations that lambs be weaned at about 10 weeks of age.

Feeding Behavior

In the first article of this series, it was pointed out that the behavioral definition of a sheep includes reference to the fact that the sheep is a ruminant. In other words, the way the sheep eats is an integral part of what makes a sheep a sheep.

Since the sheep is a ruminant, it is predictable that much of the behavior that is demonstrated is related to the consumption of forages.

The general study of feeds and feeding has been historically relegated to nutritionists rather than to behaviorists. However, behavior has direct effects on consumption patterns, feedstuff availability and selection of feeds. Sheep devote more time to eating than to any other behavioral activity. Feed and forage are generally the most expensive items in the shepherd's budget. There is probably no other single factor as important to the well-being and productivity of the sheep than the feed and forage it consumes.

Much of the study of feeding behavior is concerned with pasture grazing. This is understandable because grazing, under most production systems, is the predominant form of consumption. Confinement feeding behavior has received less attention, yet can be of greater importance to shepherds who utilize some form of this system as all or part of their operation.

Basic Feeding Behavior

Sheep have to consume feed and water in order to survive. Beyond survival, consumption of the correct amounts and proportions of feedstuffs allow sheep to thrive and be productive. In this section we will review the relationships between nutrition and behavior as well as feeding/grazing patterns and feedstuff selection by sheep.

Relationship Between Nutrition and Behavior. Feed consumption is motivated by hunger, which is, in turn, motivated by nutritional demand, but the methods and patterns of feeding are governed by behavior. For example, sheep nutrient requirements increase during late pregnancy and lactation, so the demand for consumption of feed is higher (assuming there is no change on nutrient density of the ration). The sheep behaviorally compensates for this increase in demand by increasing the rate of eating (27 percent in late pregnancy and 20 percent during lactation in one study). Sometimes, however, if the quality of available feed is low, the sheep cannot adequately increase rate of consumption enough to meet demand. This is where the shepherd plays an important role, by supplying supplemental feed to assist the ewe in meeting nutritional needs.

It would be a mistake to oversimplify the relationship between nutrition and behavior. For example, there have been numerous attempts over the years to attribute "nutritional wisdom" to sheep. This is based on the supposition that, given a choice of various feedstuffs, the sheep will select a diet that is more nutritionally correct. Unfortunately, this is often not the case, with the sheep tending to select diets based upon a variety of factors (discussed in a later section), with nutritional value, per se, being of little or no importance to the sheep in the selection process.

Time allotment for ingestive behavior. The time that sheep spend consuming pasture or grain is governed by a number of factors. Grazing time depends primarily on: (1) type and availability of forage; (2) consumption behavior; and, (3) the level of nutrient demand.

If feed is limited, such as during periods of drought or when sheep are fed a restricted feed allowance, the sheep will eat when feed is present or can be found. When abundant feed is available, sheep will develop patterns of consumption behavior. These patterns of eating are part of the circadian pattern of life that animals develop in response to daylight/darkness cycles and other environmental cycles.

Sheep consume ad libitum (free-choice) feed or pasture on a predominantly diurnal (daylight) pattern. Most of the studies have been done on pasture, and most of the studies conducted in temperate climates indicate that heaviest grazing will occur in the hours around dawn and in the late afternoon, near sunset. Temperature can alter grazing times, such as when daylight temperatures become extremely warm. This results in sheep starting and stopping their grazing earlier in the morning on hot days. Cold weather alone apparently has little effect on diurnal grazing patterns, but heavy rain, wind and/or snow cover may significantly alter grazing patterns.

Researchers have recorded a wide range of grazing times for sheep (4.5 to 14.5 hours), but most estimates fall between 5 and 10 hours per day. Grazing time is inversely proportional to the quality of pasture, but this relationship is not extremely predictable. For example, although sheep may graze longer to obtain adequate intake of a poor quality forage to meet nutritional requirements, researchers have also noted that sheep on high quality pastures may consume forage for much longer than is necessary to meet requirements. This may lead to a practical problem because sheep may become over-conditioned (fat) on pasture simply because

they consume more than is needed to meet their nutrient requirements. This problem is most likely to occur when nutritional demands are lowest, such as during the period after the weaning of the lamb and before breeding or in early pregnancy. The shepherd is advised to attempt to restrict access to pasture if ewes are becoming over-conditioned.

Other factors influence grazing time. Feeding concentrate supplements, for example, may reduce grazing time. This is typically observed at intakes above approximately 0.5 percent of body weight. Thin sheep have been shown to consume more than fat sheep, and this is at least partially explained by increased grazing time. Another study showed that shorn sheep will reduce grazing time during cold weather.

The two other major time consuming activities of sheep are sleeping and ruminating (cud-chewing). Sheep are awake about 16 hours a day and drowsy another 4 or 5 hours. They will sleep only about 3 or 4 hours. The time devoted to ruminating is about equal to, or slightly less than, the time spent grazing. Sheep consuming low-forage diets will decrease ruminating time accordingly.

Selectivity. Sheep have a relatively small mouth and a remarkably dexterous lips. They either bite off the portion of the pasture plant that they are interested in consuming or grip it between their lower teeth and the dental pad and tear it off by a backward/forward head action. They are able to graze closely to the ground and are also able to comfortably adapt to browsing (picking the leafy material from bushes or other plants).

These anatomical/behavioral combinations result in the ability of sheep to be extremely selective about what they consume. Again, much of the research related to selectivity of feeds has been done in pastures, but selectivity is often demonstrated in confinement feeding of concentrates. Any shepherd who has attempted to feed a mixture of concentrate feeds of differing particle sizes has probably observed that the sheep can select among them. The sheep will select the most palatable particles, but these may not be the most nutritious feeds. To prevent this problem, combinations of feedstuffs should usually be ground to a similar particle size and mixed, or pelleted.

If an abundance of pasture is available, sheep will be very selective. As the amount of available forage decreases, the degree of selectivity will decrease. If a number of different varieties of forages are available, sheep are more likely to demonstrate marked selectivity. Conversely, if only one forage is available, or if there are only a few species available and these are of similar acceptability to the sheep, there will be little selectivity. On pastures, sheep can be more selective than cattle or horses.

It is interesting, and has management implications, that some excellent forages are not preferred by sheep, and may be the last to be selected when others are available. An example is alfalfa. Numerous reports indicate that sheep turned into a mixed stand of grass and alfalfa will almost invariably select the grass first, despite the nutritional superiority of the alfalfa. However, when other forages are exhausted, the sheep will quickly adapt to the alfalfa, and production parameters indicate excellent utilization.

Researchers have demonstrated that sight, touch, taste and smell are used by the sheep in selecting the forage species it will consume. Studies utilizing sheep with a variety of surgically-induced sensory impairments indicate that taste is the sense that is most likely to influence selection. Indications are that odor plays a relatively minor role. Sight is probably used

primarily to recognize conspicuous forage species and to orient the approach to those species, but sight is not apparently important in influencing selectivity.

Sheep eat leaves in preference to stems and green, succulent material in preference to dry, coarse material. Sheep prefer to avoid grazing near sheep feces, but this behavior is not as pronounced in sheep as in cattle. Hunger tends to decrease selectivity.

Boredom, or a desire for change, has been speculated by some researchers as an explanation for why sheep are occasionally observed to select a clearly inferior forage in the presence of abundant superior forage.

Grazing Patterns. A number of factors can affect the grazing pattern. Water, for example, can have an important effect on grazing patterns. In arid zones, the water source is the center of grazing activity and the primary determinant of grazing the grazing area. The area near the water may become over-grazed, even damaged and eroded, because of the influence of the water source on grazing pattern.

Social factors, such as the development of a home or territorial area can inhibit movement of sheep on large ranges. The social rank of the sheep can determine which sheep obtain the choicest grazing sites or best access to supplemental feed or water.

In confinement, isolated lambs and calves will eat less than animals which are fed as a group. This may be due to the fact that sheep are a social animal with a strong herd (flock) instinct. There may also be a competition component to this phenomenon. A common example of where this comes into play is in youth lamb projects. Occasionally, inexperienced adults advise youth to start their project with only one lamb. The result is likely to be a lethargic lamb with little appetite. It is much better to start with two lambs, and three is better yet. There is an element of truth to the statement that "it is easier to feed a thousand lambs than one or two."

Sheep, in general, will seek higher ground for grazing than cattle. They will also tend to browse more, but researchers have had difficulty in establishing a clear basis for making consistent predictions about the exact nature of the differences between sheep and cattle grazing patterns. Neither sheep nor cattle prefer to graze near their own feces, but there is no apparent reluctance to graze near the other feces of other species. In general, sheep parasites do not harm cattle and vice versa. These are a few of the factors that have led sheep producers to develop companion grazing systems utilizing sheep and cattle. A large body of research is available attesting to the value of grazing sheep and cattle together. Other species, such as goats and equines, have also received attention in these systems.

Pasture Management. It is clear that the sheep manager can affect the grazing patterns of sheep. There is ancient precedent for the role that the shepherd plays in controlling grazing patterns. In the Bible, for example, there are numerous citations of the shepherd's role in managing the movement of sheep, presumably to gain production advantages.

In modern times, numerous scientific disciplines, from forage science to animal nutrition science, have fused with practical experience to bring us to a potentially high degree of sophistication in controlling the grazing patterns of ruminants in order to achieve a high degree of production efficiency. Much of this knowledge grew out of research with rotational grazing systems in the early and middle part of our century. In recent years, progress has led to the development of controlled, intensive grazing systems which generally utilize advanced electric fencing techniques to precisely control the grazing patterns of sheep so that forages are grazed at

the optimal stage of maturity and animals consume the correct ration to match their production requirements.

A full discussion of controlled, intensive grazing is beyond the scope of this article. County Extension agents can provide more details. From the behavioral standpoint, there is abundant evidence that the competent sheep manager is more capable of selecting the correct diet for sheep than the sheep themselves. This has been proven many times in confinement (refer to preceding discussion of "nutritional wisdom" of sheep). Now, thanks to the development of controlled, intensive grazing systems, the same can be said for sheep on pasture.

Sheep devote more time to eating than to any other behavioral activity. Feed consumption is motivated by hunger, but the methods and patterns of feeding are governed by behavior. Sheep are adept at feed and pasture selectivity. However, the diets that sheep select are often not nutritionally superior, and may be inferior. The time allotted to feeding will vary depending on a number of factors, including feed/forage availability, quality of feed/forage and production stage of the animal. Grazing patterns depend on factors such as availability of water and social rank. The sheep producer can alter the grazing patterns of sheep in controlled, intensive grazing systems to achieve a high degree of production efficiency.

Behavior in Sickness and Health

It is too often said that "a sick sheep is a dead sheep". This saying has been repeated often enough that many people, even sheep producers, accept it as truth. In reality, perceptive shepherds with a working knowledge of sheep behavior, can often discern subtle early signs of sickness and successfully treat most sick sheep.

Sheep are tough animals. Thousands of years of both natural and human selection have yielded an animal that is often unlikely to show obvious symptoms until late in the course of a disease. By the time symptoms are obvious, it may be too late.

The sheep producer who makes it a priority to discover sickness in early stages is likely to be more successful in disease treatment. This requires routine observation and a dedicated effort to develop the ability to tell the difference between a sick sheep and a healthy sheep.

There are three general ways to determine well-being of sheep. There are measures of production, biochemical testing, and observation of behavior. The most commonly used method is observation of behavior which is why this topic is important in practical sheep management.

Behavior of Healthy Sheep

The first step in recognizing behavior patterns associated with illness is to become familiar with how sheep act when they are healthy.

Most of this series has been devoted to the behavior of healthy sheep. Healthy sheep, in the course of a year, exhibit a wide array of behavioral traits which complicate the recognition of unhealthy behavior. For example, healthy sheep normally exhibit a hearty appetite but rams at the peak of the breeding season may lose interest in eating in favor of breeding. In this situation the animals are "off their feed", but are not sick.

The challenge is to know when normal behavior becomes abnormal and to recognize it quickly. The example of the ram can be continued. A high libido ram may ignore feed for so long that he may lose considerable weight and may even endanger his health. The flock manager needs to learn to recognize when healthy libido has become health-threatening behavior that calls for management decisions (often removal from flock for some period or hand-feeding of rams).

Recognizing a healthy sheep depends on a thorough evaluation of physical and behavioral characteristics. Since behavior is the focus of this series, the behavior of the healthy animal is our primary interest.

Feeding time is an excellent time for the flock manager to observe for normal and abnormal behavior. A healthy mature sheep will follow normal eating and cud-chewing patterns. Healthy sheep are eager to consume feed and hunger increases this eagerness.

Healthy sheep will often bleat in anticipation of being fed and will rapidly approach the feeding site. Dominant sheep will tend to approach first and submissive sheep last. Satiety (lack of hunger) may change this pattern. For example, if sheep are leaving a pasture after grazing, animals in the middle of the "pecking order" may exit first, followed by dominant ewes with submissive animals last.

Healthy, mature sheep ruminates (chew their cud) several hours each day. They will also defecate and tend to "stretch" upon rising after a period of ruminating and/or napping. Mature sheep spend only about 15% of their time asleep, but may lie down and rest at other times.

Healthy ewes will exhibit normal sexual behavior in accord with the estrus cycle (see section on reproduction behavior). Healthy rams are likely to lose weight during the breeding season because of mating behavior (see earlier discussion).

Healthy lambs will typically be very active when awake. Group play behavior is common with considerable jumping and running. Lambs love to climb and will seek wood piles, small hills or even their own dams to reach higher ground. Healthy lambs will nurse frequently (see lambing behavior article) and eagerly. Older lambs may nurse so aggressively that they may actually lift the dams back quarter from the ground, however, most managers wean before this stage is reached.

Lambs are curious and will explore their living area very thoroughly. This trait is the reason that young lambs generally have little difficulty on locating properly placed creep feeders. Healthy lambs will sleep approximately 8 to 12 hours a day. They seek their dams at nap time and will sleep as close to her as possible. Lambs can start nibbling on solid feed as early as 10 days and are likely to be consuming a substantial portion of their diet as solid feed by 8 weeks.

A final important observation is body condition. While loss of body weight is not a strictly behavioral trait, thin animals often show signs of lethargy and weakness. Animals in poor body condition or which are losing weight may have a health problem or may be more

susceptible to developing disease. Sometimes the wool covering makes it difficult to observe weight loss in sheep, which is why occasional handling of sheep to feel for lack of fat covering over ribs and spinal bones is desirable.

Behavioral Evidence of Illness

Following are behavioral signs for flock managers may consider as indicators of problems. These are mostly "early-warning" symptoms which should cause a lot of flock managers to suspect that a problem exists and to take steps to diagnose the problem based upon both behavioral and physical symptoms.

In many cases early detection greatly improves the chances for successful treatment. Work with your veterinarian for best results.

Table 1. Behavioral Signs of Possible Health Problems

<u>Behavior</u>	<u>Comments</u>
Isolation	Sheep are strongly influenced by the flocking instinct. An isolated sheep or lamb is often showing early signs of sickness.
Disinterest in Feed or Water, Off-feed	May indicate any of a number of forms of gastric upset or other illness.
Lagging	The last sheep through the gate or barn door should be suspected of illness, particularly if that animal is normally one of the first through.
Lethargy, Depression	An unresponsive sheep with head hung low and dull eyes is probably quite ill.
Excessive time lying down; Reluctance to move about	May indicate fever, mastitis or other illness that makes it painful for the sheep to stand or walk.
Restlessness, Anxiety	Animals under stress may have difficulty in relaxing.
Depraved Appetite	Sheep sometimes eat unusual things, such as wood, dirt, acorns, paint, bones, wool and hair (from cattle or horse tails). This may indicated a dietary deficiency (example: iron deficiency can cause dirt eating and phosphorus deficient sheep may eat bones or wood) or may be a behavioral problem (boredom or stress may lead to depraved appetite.
Vocalization	Bleating is a common method for a lamb to express its needs. Extended or weakened bleating may indicate a problem such as starvation, which the dam is unable to

correct. Throaty, moaning noises are indicative of severe stress (hardware disease, trauma due to injury).

Rapid Breathing

In lambs, may indicate pneumonia

Manure

Sheep droppings are normally firm and pelleted. Watery manure and/or droppings with blood indicates a problem.

The best advice for learning the behavior of healthy sheep is to observe healthy sheep. Spend time each day watching the flock, both to learn normal behavior, and to observe unusual behavior that may indicate problems. Early detection of health problems often improves the chances for successful treatment and recovery.

Sheep Behavior Questions

The preceding sections have been focused on certain broad areas of behavior (basic behavior, mating, lambing and feeding behavior). Attempts have been made to link behavioral aspects with management applications whenever possible. However, there have been several behavioral phenomena with management applications which have been left out. In this final section, additional behavioral traits of sheep will be presented with appropriate management applications.

This section will be different. It will consist of a series of questions and answers, because this has often been the way that the author was introduced to the topic.

Why are some people, such as experienced sheep shearers, able to handle sheep with such ease? It is a combination of experience and an understanding of sheep behavior. The Australian method of sheep shearing is based on the behavioral principle that sheep will cease struggling if they cannot push against something. The shearer, by careful placement of feet, knees and various other body parts, moves the sheep through a series of positions, none of which allows the sheep to push against anything. This, coupled with the shearer's experience, skill and confidence, allows them to remove wool with deceptive ease.

Are sheep dumb animals? It depends on how you define intelligence. It is doubtful that there has ever been a sheep that would score very well on an intelligence test that was designed for humans. On the other hand, sheep have survived as a species when others have disappeared. The sheep has precisely the correct amount of intelligence it needs to allow it to function within the grazing/ruminating niche that it inhabits (Ruminants don't need to be Einstein). Therefore, when the question is examined as the amount of intelligence present relative to the amount needed, it would be unfair to characterize them as "dumb."

The pejorative use of "dumb" or "stupid" as applied to sheep implies "dull," and sheep have too many interesting facets to their behavior to deserve being labeled as dull.

Sometimes the shepherd is tempted to call sheep stupid because the sheep do not react in the manner the shepherd thinks they should. However, sheep react in a very predictable manner, and the failure of the sheep to behave according to the shepherd's desires may, in fact, reflect the shepherd's lack of intelligence rather than the sheep's.

I have sometimes facetiously stated that it is a basic rule of animal husbandry that one shouldn't own an animal that is smarter than oneself. Some would think that this rule would only rarely be applied to the shepherd, but, because it depends on the relation between two components (the sheep's cleverness and the human's), perhaps it has wider application than one might think.

Why do sheep flock together? First, the degree of flocking or herding instinct is not uniform. Some breeds are noted for having particularly strong flocking instinct while others are less likely to have this behavioral bonding. Part of the explanation for the flocking instinct is that it is a protective mechanism. The sheep is not equipped with the tools that allow it to effectively fight predators, so they will normally flee an attack. The odds of successful escape are directly proportional to the ability to detect the attack as quickly as possible. Increasing the number of individuals in the group increases the opportunity of early detection and successful escape. Also, it is more likely that older or crippled sheep will be apprehended by a predator in a flock attack. These happen to be the ones that are less important to the survival of the flock.

There are also social benefits to the flocking instinct. By being a part of a flock, sheep are guaranteed access to mates. They are also supplied with companionship and a defined social hierarchy. There is, of course, a requirement for the sheep to sacrifice a large portion of their individuality in return for the advantages of being part of the flock, but individuality is not a highly valued trait in sheep.

What is wool-eating? The name describes this behavioral disorder. It is most commonly observed with sheep in confinement, and has occasionally been linked with a deficiency of certain nutrients, such as phosphorus or fiber. Wool-eating is observed in both adult sheep and lambs. Adult sheep usually start by picking the dung-soiled wool from the rear of another member of the flock, and may later expand this unfortunate browsing to other members of the flock. There are usually no health problems which are associated with this problem in adult sheep, but the habit is annoying and results in the loss of salable fleece.

Wool-eating by lambs may have serious health consequences. They typically start grazing wool from their dam at two or three weeks of age. Unlike the adult wool-picker, the lamb's system cannot handle the wool. Hairballs (woolballs?) form in the stomach and prevent passage of digestive matter. Colic, anemia and even death are among the consequences. The most common symptoms observed by the shepherd are a lamb which stands still with a hunched back and distended stomach.

Do sheep prefer running water or still water? They will pick still water when they have a choice. In fact, based on field reports, they may cut back on water consumption if running water is all that is available.

How do sheep stay cool in the summer? Sheep will often seek shelter from the sun in dark places. A cool barn, a rock overhang or a grove of trees will provide the relative cool that the sheep are seeking. Keeping sheep comfortable in the summer is important to the manager who is attempting to breed ewes during this time. Turning rams with the ewes during the heat of summer offers the clear advantage of earlier lambs, but sometimes it is difficult for the ram to maintain his stamina. Good managers will make certain that efforts are made to provide cool, shady areas for sheep to retreat to when the sun becomes too hot. Several other things may also

be important. Some shepherds prefer to shear rams at this time. Others turn rams with ewes only at night, and keep them in a cool shelter during the day. Plenty of cool, clean water also helps.

Will sheep choose fight or flight when confronted with a threat? First, let me define "flight zone." This is the space around the sheep which, if entered by a perceived threat, will cause the sheep to react (Grandin and Deesing, 1998). If the sheep have a choice, they will choose flight. If they are penned, and cannot escape by flight, and a dog or a person penetrates their "flight zone," they will become nervous or even highly agitated. They may run in circles and become difficult to handle. Panic can cause them to leap fences or stampede. Usually, simply removing the threat from the flight zone will calm the sheep.

Sheep that are handled more frequently are not as sensitive about their flight zone. Loud noises or frenetic activity can increase the effective size of the flight zone. This is why someone with a calm, confident manner is more effective as a sheep handler than a nervous, noisy person.

Sheep will attempt to escape from a person or dog who enters their flight zone, therefore, an understanding of the sheep's flight zone allows people or dogs to effectively move sheep. For example, if sheep are being moved down an alley and one or two sheep attempt to turn back, the driver should back up because the flight zone is being violated enough to make the sheep nervous enough to overcome their instinct to follow the other sheep. Of course, there is no better demonstration of the use of the flight zone to herd sheep than that shown by the teaming of an experienced sheep dog trainer/handler and an intelligent border collie.

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Note to interested readers: Dr. Temple Grandin, Associate Professor of Animal Science with Colorado State University, has an excellent website that can serve as a resource for additional study of Animal Behavior. Web address is: www.grandin.com