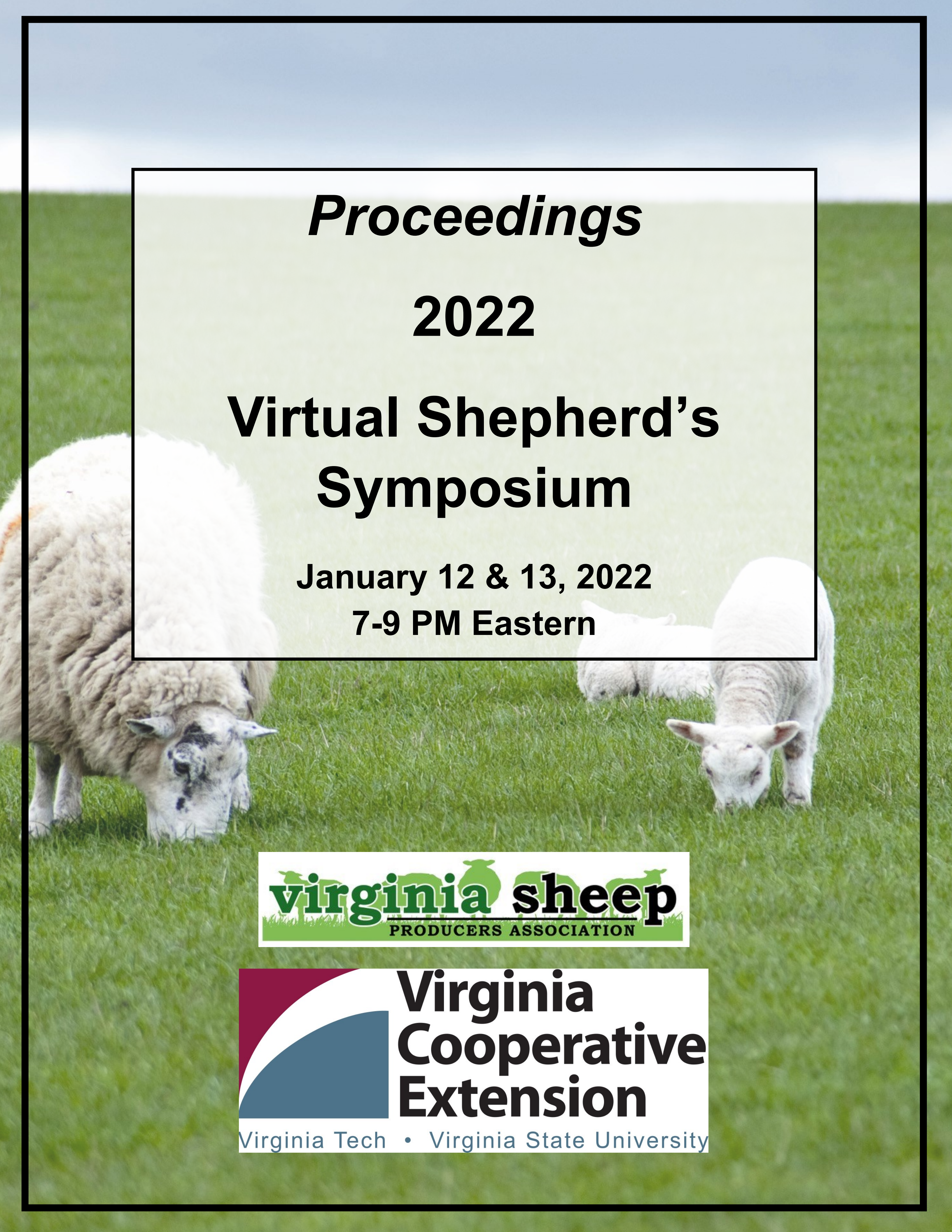

Proceedings

2022

Virtual Shepherd's Symposium

January 12 & 13, 2022
7-9 PM Eastern

virginia sheep
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SYMPOSIUM PROGRAM

Wednesday, January 12th, 7 - 9 PM

- **Reproduction in Sheep– Key Components -** *Dr. Jamie Stewart, Virginia-Maryland College of Veterinary Medicine*

- **Using Reproductive Technologies– Synchronization, AI and ET–** *Dr. Daniel Poole, Department of Animal Science, North Carolina State University*

- **Saving Baby Lambs -** *Dr. Kevin Pelzer, Virginia-Maryland College of Veterinary Medicine*

-

Thursday, January 13th, 7 - 9 PM

- **Applying Genetics and Genomics to Enhance the Flock** - *Dr. Andrew Weaver, Department of Animal Science, North Carolina State University*

- **Successfully Using Guardian Animals: Producer Perspective** - *Producer Panel moderated by Larry Weeks*
  - *Lee Wright- Rolling Spring Farm*
  - *Mandy Fletcher- Beyond Blessed Farm*
  - *Jennifer McClellan- Nolley Wood Farm*

- **Update from ASI** - *Lisa Weeks, ASI Executive Board- Region II Director, Virginia*

- **Virginia Sheep Industry Updates -** *Virginia Dept. of Agriculture and Consumer Services- Dan Hadacek, DVM; Virginia Sheep Industry Board- Matthew Sponaugle; and Virginia Sheep Producers Association- Mandy Fletcher*

- **VSPA Director Elections** - *Mandy Fletcher, President*

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Dr. Jamie Stewart
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Dr. Stewart is a veterinarian with a specialty in Theriogenology (veterinary reproduction). She completed a B.S. in Animal Sciences and a D.V.M. at the University of Illinois. Upon graduation, Dr. Stewart remained at UofI to complete a joint M.S. program and food animal medicine & surgery internship; after which she transitioned into a joint Ph.D. program and Theriogenology residency. Dr. Stewart worked predominantly in the large animal clinic at UofI's veterinary hospital and helped to establish laparoscopic AI and semen freezing services for local small ruminant clients. She also saw many small ruminants on a referral basis for issues with infertility. Her research interests during her internship and residency were focused on improving reproductive management in cervids, as well as studying the role of certain factors in the seminal plasma of ruminants.

In 2018, Dr. Stewart came to the Virginia-Maryland College of Veterinary Medicine as an Assistant Professor in Production Management Medicine. Her appointment consists of a combination of clinical medicine, research, teaching, and extension. Dr. Stewart is currently working on getting laparoscopic AI services established for local small ruminant clients, but also routinely performs reproductive assessments in males and female ruminants. Her research focus has shifted towards sheep and goats, with a variety of projects focused on improving late gestational management, male/female breeding evaluations, and synchronization protocols.

Dr. Daniel H. Poole
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Dr. Daniel H. Poole currently serves as an associate professor of reproductive physiology in the Department of Animal Science at North Carolina State University in Raleigh, North Carolina. Dr. Poole earned a B.S. in Animal and Veterinary Science followed by his Masters in Reproductive Physiology at WVU and a Ph.D. in Animal Science from the Ohio State University. At NC State, Dr. Poole teaches a variety of reproduction and management courses and looks forward to educating future generations of veterinarians, producers, and animal scientists to meet the industry's growing needs and address global food security.

Dr. Poole's current research explores how environmental and management practices such as endophyte-infected fescue and heat stress impact growth and reproductive performance in ruminants. Infertility and/or fertility-related deficiencies in livestock species, such as those caused by these factors, are a major source of economic loss for producers. While the characteristics of the fescue toxicosis syndrome have been extensively studied in an attempt to find remedies for, or offset the symptoms of this syndrome, its complex etiology has hindered an exploration of specific mechanisms of action of ergovaline on specific tissues. Therefore, the potential exists to address and improve reproductive issues in today's livestock industry through innovative research combining basic and applied experimental models.

Outside of NCSU, Dan and his wife own and operate a small farm east of Raleigh. Our two daughters and son enjoy showing livestock with lambing and calving seasons are their favorite time of the year. Dan enjoys working around the farm, playing with my children and teaching them about the world around them and restoring old John Deere tractors when time permits.

Dr. Kevin Pelzer
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Dr. Pelzer received a BS from the University of Kentucky and his DVM in 1980 from Tuskegee University. He completed a residency in Food Animal Herd Health and Reproduction and a Masters in Preventive Veterinary Medicine from the University of California, Davis. He is boarded in the American College of Veterinary Preventive Medicine. Dr. Pelzer is currently professor and interim Department Head of the Large Animal Clinical Sciences at the Virginia Maryland College of Veterinary Medicine and his interests are small ruminants and public health. He has been active in continuing education and outreach giving more than 100 presentations to professional and lay groups in Virginia as well as other states and internationally.

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Dr. Andrew Weaver is an Assistant Professor and Extension Small Ruminant Specialist in the Department of Animal Science at North Carolina State University. Dr. Weaver grew up in central Michigan and attended Michigan State University where he earned his B.S. in Animal Science in 2015. He completed his M.S. at Virginia Tech in 2017 studying terminal sire options for hair sheep producers. That research led him to West Virginia University where he completed his Ph.D. studying immune mechanisms related to parasite resistance in sheep. Dr. Weaver started at NC State in the summer of 2020. Dr. Weaver's research and extension interests focus on utilization of genetic tools and management practices to improve parasite resistance, performance, and end-product value of small ruminants in the Southeast US.

Lee Wright
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Lee and his wife Cindy are owners and operators of Rolling Spring Farm, in Glade Spring, VA. They have been raising a registered Katahdin flock enrolled in NSIP since 2004. They have also raised Great Pyrenees guard dog pups since 2005.

Mandy Fletcher
Beyond Blessed Farm, Abingdon, VA
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Mandy and her husband Dr. Chris Fletcher are owners and operators of Beyond Blessed Farm in Abingdon, VA. They produce registered Katahdins with an emphasis on parasite resistance and growth, using NSIP for genetic selections since 2014. Their operation has used guardian dogs and donkeys since its start.

Jennifer McClellan
Nolley Wood Farm, Riner, VA
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Established in 2006, our farm is Nolley Wood Farm in Riner, VA. We run around 60 head of Katahdin ewes and half a dozen Boer goats. Currently we have four llamas as guardian animals and are planning to add a few more.

Lisa Weeks
Triple L Farms, Waynesboro, VA
Region II ASI Director
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Lisa along with husband, Larry, and daughters, Lexi and Laryn are first-generation shepherds raising Katahdins since 1990. Growing up on a crop farm in Dighton, Kan., agriculture was something that simply could not be left behind. After graduating from Kansas State University in 1988 with a bachelors degree in Textile Science, Lisa moved to Waynesboro, Va., to begin a career in quality assurance and eventually supply chain and data analyst at a company that manufactures polypropylene nonwoven roll goods. She and her husband purchased a 30-acre farm and manage a 50-ewe flock while continuing to work full time off the farm. The Weeks' have been members and supporters of ASI since 1994 and Lisa has served as the Virginia director at the ASI Annual Convention and as a producer member of the Production, Education and Research Council for numerous years. She and her husband have been long time members of the Virginia Sheep Producers Association and were awarded the Roy A. Meek Outstanding Sheep Producer Award in 2016. At the local level, their farm annually hosts students from the veterinary technician program of Blue Ridge Community College for some hands-on field trips for first- and second-year students. The family flock has been enrolled in the National Sheep Improvement Program since 2001 and Lisa is currently serving as NSIP secretary. She is also serving as a board member to the newly formed Eastern Alliance for Production Katahdins.

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Daniel G. Hadacek, DVM, has been the VDACS Regional Veterinary Supervisor for the Northern (Harrisonburg) Region since 2018. He supervises five livestock inspectors, a field veterinarian, and a poultry specialist. Before coming to work for VDACS, Dan was in private food-animal practice for 30 years in Iowa and Virginia. He and his wife, Sarah (also a DVM) have two sons and live on a farm in Mount Solon where they raise sheep, cattle, and row crops.

Reproduction in Sheep – Key Components

Jamie Stewart, DVM, PhD, Dipl.ACT
Assistant Professor in Production Management Medicine
Virginia-Maryland College of Veterinary Medicine

Overview

"You can't have production without *re*production." This has been my mantra for a few years now as a food animal veterinarian with a specialty in reproduction medicine. This is true for all aspects of food animal production, but these proceedings will focus on the key components of reproduction in sheep. You can do all the right things – select for good genetics, parasite control, parasite control (wait- did I say that twice?), neonate management, nutrition, etc. However, if you can't get your animals to reproduce, you won't make any money. In the most simplistic of concepts, it all starts with the sperm and the egg… but in reality, it requires much more than that.

I like to use the Cornell STAR® System as an example of the most efficient production scheme that can be utilized in small ruminants. I refer you to their webpage (https://blogs.cornell.edu/newsheep/management/reproduction/star-management/) to read more in depth about this accelerated lambing program and its implementation. However, my main point in mentioning this program is that this whole system would collapse with one bad breeding season. Additionally, programs such as these rely on the ability to breed ewes outside of their natural breeding season. These proceedings will focus on the most important factors that you as a producer should be focused on to maximum production within your flock's reproduction programs.

Sheep Estrous Cycle

To be able to manage a flock's reproduction, you must have a basic understanding of the reproductive physiology of sheep. Firstly, it is important to be aware that ewes are a seasonally polyestrous species. This means that they exhibit multiple estrous cycles back-to-back ("poly"-estrous), but also that they rely on the season to dictate when they cycle. Sheep are known as "short day" breeders, which means that their natural breeding season is in the fall when the number of day light hours are decreasing. This phenomenon is regulated through the production of melatonin, a hormone that is produced in increasing amounts in response to shorter days (you might also recognize it as a pill that some people take to help them to sleep at night). In the ewe, increasing melatonin production triggers the release of the gonadotropin-releasing hormone (**GnRH**) from the hypothalamus in the brain… essentially "waking up" the reproductive system from its anestrous slumber. The GnRH produced will stimulate the production of two other important reproductive hormones, luteinizing hormone (**LH**) and follicle stimulating hormone (**FSH**), that are secreted systemically and act on the ovary to stimulate it to grow and ovulate follicles. After the ovulation of one or more follicles, corpora lutea (**CL**) will develop and put the ewe into a luteal phase. If the ewe is not bred, the CL will have a finite lifespan and eventually regress, which allows a pre-ovulatory follicle to emerge again… triggering what you may recognize as *behavioral estrus* or "heat". It is important to understand this cycle so that we can manipulate and control it. The estrous cycle is measured from one behavioral estrus to the next and lasts 14 to 19 days (average 17 days) in the ewe. The duration of behavioral estrus in the ewe lasts 30 to 36 hours and is the optimum time for breeding since it immediately precedes ovulation.

The onset and duration of the sheep breeding season varies based on a number of factors. As discussed above, photoperiod and the production of melatonin appears to be one of the most crucial factors. However, there are other components, some of which can be controlled, that contribute to seasonality of sheep. Most notably is breed selection, as there are some breeds that are notoriously difficult to breed out-of-season no matter what management strategy you try. Therefore, it is recommended that you stick with breeds known to have extended breeding seasons if you wish to pursue lambing outside of the natural breeding periods. Common breeds used in the United States include the Dorset, Polypay, Merino, and haired sheep breeds (Katahdin, St. Croix, etc.). Food availability is another factor that can contribute to breeding season length, though it doesn't usually affect producers in the U.S. since we have access to supplemental hay and grain year-round. The latitude and climate that you are raising sheep in will also affect seasonality, as those living in more temperate regions will be more likely to have shorter breeding seasons than those living in more tropical regions (no one wants to be lambing in the middle of a blizzard!). The last contributing factor of seasonality is the individual breeding system employed by producers, which will be discussed more in depth in the next section.

Estrous Cycle Manipulation

There are several reasons why producers may want to do some form of estrous cycle manipulation. As already discussed, one reason would be to extend the breeding season to allow for distribution of milk and meat products throughout the year. This concept includes both those who want to breed during the spring anestrous period and those who want to extend the natural breeding season (usually by starting the breeding season earlier). Within the breeding season, estrus and breeding can be synched simply to save money on labor for breeding and lambing. Regardless as to whether you are ram breeding or using artificial insemination (**AI**), by having control over the breeding dates, you can better predict when lambing will occur. Therefore, you will have a distinct period in which to closely monitor the ewes for lambing, rather than having them sporadically lamb throughout the spring, which will decrease neonatal mortality due to dystocia and illness.

Photoperiod manipulation is one means to perform out-of-season breeding and/or extend the natural breeding season. The biggest disadvantage to this method is that it requires you to have indoor facilities where you can manipulate the length of daylight that the flock is continuously exposed to. Usually, this method works best coming out of the spring when the ewes have been in a deep anestrus and exposed to long day lengths for at least 60 days. It can also be used to initiate the breeding season earlier, but doesn't work well to extend the breeding season later because the ewes will become photo-refractory to the short-day effects. This mechanism works by triggering the melatonin release that stimulates cycling as described above and can be combined with hormonal methods to increase success rates. Likewise, administration of melatonin implants, especially in conjunction with progestin administration, has also been shown to improve fertility outside of the breeding season. It is worthwhile to note that melatonin implants are difficult to find in the U.S. and are not FDA approved for use in sheep.

The use of a technique called the "ram effect" can be extremely beneficial for a successful spring-breeding/fall-lambing season. This technique requires the abrupt introduction of a ram to a group of anestrous ewes (no sight/smell/sound exposure to the ram for at least 30 days prior). Within 48 hours, some of the ewes will be triggered to undergo a "silent" ovulation where no estrus is observed. This ovulation is typically not fertile, so breeding is not necessary at this point. However, the ewe will ovulate and form a CL. The progesterone produced by this CL is crucial for "priming" the hypothalamus to be able to respond to estrogen being produced by the follicular waves so that the next ovulation will have an accompanying behavioral estrus. Approximately half of these ewes will experience a “short” cycle and come into estrus at around 1 week after introduction of the male. The rest of the ewes may experience a normal cycle and will come into estrus at 18 to 25 days after male introduction. The number of ewes that respond to this protocol can vary based on the ram used. Ram breed influences its effectiveness with mature, Dorset rams being one of the most preferred breeds for inducing a ram effect. If AI is to be performed rather than natural breeding, then the use of teaser rams (those that have been surgically vasectomized or epididectomized, rendering them sterile) will also allow produce a “ram effect” without the concern that mating will occur. The “dormitory effect” is another similar management technique that can be used on its own during the transitional period (late summer/early fall) to stimulate an earlier beginning of the breeding season. This technique simply requires the introduction of one ewe in estrus to the anestrous flock (the ewe will have had to been synchronized with hormones prior to introduction, which will be discussed later). Approximately 25% of ewes will respond and come into estrus right away; whereas the remaining 80% will respond within a few weeks. This is a good technique to utilize for a producer who wants to advance the breeding season without the expense of using hormonal manipulation on the entire flock or does not have a way to separate out the ram for 30 days (or if no ram is available). The dormitory effect also plays into the “ram effect” by helping to bring the ewes that didn’t respond initially into estrus.

Appropriate nutrition year-round is crucial to maintaining good fertility within a flock. Adapted nutrition (also known as “flushing”) is a technique that can be used within the breeding season to increase twinning rates. At approximately 2 to 3 weeks before and after breeding, feeding 1 lb of a high-energy supplement (such as corn, oats, or barley) per day can provide the extra energy and protein needed to increase ovulation rates at breeding, which will increase the lambing crop. One of the most important factors for a successful flushing is the body condition of the ewes. Flushing will not work in ewes that are already overconditioned, simply because they will not respond to the extra energy boost. Therefore, ewes need to be maintained in a marginal body condition at breeding (2 to 3 out of 5). Ewes also need to be healthy with appropriate parasite control programs and hoof health.

Exogenous hormone administration is a common and effective means for manipulating the estrous cycle of sheep. Please note that these drugs need to be purchased from a veterinarian and used under their guidance, so make sure that you establish an appropriate veterinarian-client-patient relationship when developing a reproductive protocol for your flock. For ewes that are in season, the use of a prostaglandin product (such as Lutalyse or Estrumate) is extremely effective at bringing ewes into heat for either AI (based off heat detection) or natural breeding. To improve synchrony, it is recommended to give two doses, 11 to 12 days apart, and estrus should occur within 1 to 3 days. While this is a cheap and effective means for bringing ewes into estrus, it is worth reiterating that they must be in season. Prostaglandin administration will not bring an anestrous ewe into heat, so other methods must be employed out-of-season. It is also worth mentioning that these drugs should NOT be handled by pregnant women at all.

Synthetic progestins are another very effective product for synchronizing the ewe estrous cycle. While they are more expensive to use than prostaglandins, they can also be quite effective in inducing estrus outside of the natural breeding season. Historically, sponges were commonly applied intravaginally as a means of administration. However, in recent years, the Eazi-Breed CIDR has become commercially available and labeled for use in sheep. This product is also administered vaginally and can be left in for 5 to 14 days, depending on the protocol used. The removal of this product is what will stimulate ewes (either cycling or in anestrus) to come into estrus. When combined with other products, it can be used to help synchronize ewes that are undergoing fixed time AI. As a producer, you might also hear about oral products, such as MGA, Matrix, or Regumate, that are used in other species. These products do not have a label in sheep and should be avoided due to the availability of CIDRs. Additionally, inappropriate use of these products (especially under- or over-feeding) can lead to long-term issues with fertility.

When used within a synchronization protocol containing progestins and/or prostaglandins, ovulation-inducing drugs can be quite useful for controlling the time to AI. GnRH agonists (e.g., Cystorelin or Factrel) are widely available and have been used successfully within synchronization protocols for fixed time AI in small and large ruminants. Another product, called PMSG (pregnant mare serum gonadotropin) has historically been preferred as an ovulation-inducing agent in small ruminant synchronization protocols. This drug acts directly on the ovary and has a moderate super-ovulatory effect, which helps to increasing twinning rates. One product, Folligon, is available in other countries, but has become unavailable in the U.S. in recent years. Another product, PG600, is labeled for use in swine, but has been frequently used extra-label in small ruminants. This product contains a combination of PMSG and another hormone, hCG. In my experience, this product works well in natural breeding systems to promote superovulation, its usefulness in timed AI programs is inferior to that of PMSG alone. Additionally, there is evidence available that ewes can develop a tolerance to it with multiple uses, which decreases its effectiveness over time. It is also worth noting that none of these ovulation-inducing products are currently approved for use in sheep in the U.S.

Of all the methods listed within this section, there are endless combinations that can be used based on an individual producer's goals. It is best to work with your veterinarian to determine what methods will work best for your flock – and sometimes it might require a little trial-and-error. For example, you can combine photoperiod manipulation with hormone treatments to bring anestrous ewes into season for spring breeding/fall lambing. If you wish to start breeding earlier in the season (think July to August), you can utilize the ram and/or dormitory effects and then use prostaglandin administration to short-cycle the ewes for breeding. Combinations of these techniques are also needed to employ fixed time AI, especially if you are paying a professional to perform laparoscopic AI (recommended for frozen semen), which will be discussed elsewhere in these proceedings.

Reproduction within a Natural Breeding System

So now that we have reviewed ways to manipulate reproduction to maximize production within your flock, I would like to touch on factors that play into success with a natural breeding program. Firstly, everything that you do to prepare for breeding should begin with planning when you want lambing to occur. Once you determine the best time for lambing, then you work backwards to determine your ideal timeframe for breeding (and work backwards from there for your synchronization and management protocols). The average gestation length in sheep is 147 days, but can range from 142 to 152 days. You can find many calculators online that can assist you in determining your ideal time for breeding based on when you would like lambing to occur.

One of the most influential decisions on your flock's reproductive success is your ram selection and management. You need to make sure you have enough rams to cover your flock. An adult ram with adequate scrotal circumference size and semen quality can cover up to 40 or 50 ewes within a 27-day breeding period. However, if you are planning to synchronize these ewes as part of your lambing management, this ratio drops to about 1 ram per 15 to 20 ewes. While rams tend to not be as affected by seasonal changes as ewes do, they still experience a decline in fertility outside of the natural breeding season and will likely be unable to cover as many ewes as they would in season. Therefore, rams need to have a breeding soundness exam before any breeding period; especially if it is out-of-season.

A breeding soundness examination of your ram(s) is one of the single most important things you can do to ensure a successful breeding season and is a good way to build a relationship with your veterinarian. This exam should be scheduled with your vet about 1 to 2 months before you intend to breed, so that you have time to find a replacement if needed. However, the exam can also be performed throughout the breeding season as needed, usually if you notice issues, such as the ewes coming back into estrus or low pregnancy rates. Your veterinarian will look at the overall condition of the animal, with a focused exam on eyes, hooves, and external genitalia. Hoof trimming, FAMACHA scoring and deworming, if indicated, should also be performed at this time. As a producer, you should be continuously checking your rams, especially when they are not being used, to ensure they are in good body condition (3 to 3.5 out of 5), have good hoof health, and are not burdened by parasites. Early intervention to any of these underlying issues is key to improving the ram's longevity within the flock. In addition to assessing external genitalia, your veterinarian should measure the circumference of the scrotum. This measurement is very important as the size of the testicles has been linked to sperm output and quality and will determine if the ram can produce enough sperm to service the ewes. This is especially important when breeding out-of-season because scrotal circumference can decrease up to 30% in some rams (and these rams should not be used for out-of-season breeding). If everything externally looks okay, then your vet will collect a semen sample to ensure that the semen is of appropriate quality. Based on the culmination of exam findings, the veterinarian will determine whether the ram is a "satisfactory" or "unsatisfactory" potential breeder. Sometimes, if the results are close to passing, the veterinarian will simply defer and recommend a time in the future (usually 2 to 4 weeks) to re-assess the ram.

Most veterinarians will use an electroejaculator to collect a semen sample. While this is a quick and efficient means of assessing semen, it does not allow for the assessment of libido, or willingness to breed. Therefore, it is important, as a producer, that you are monitoring the ram after turning him out to ensure that he is mounting and breeding ewes. The easiest way to do this is to equip the ram with a marking harness so that you can see chalk marks on the ewes if he has mounted them. If you have concerns about a ram that is not mounting, you can contact your veterinarian to set up a serving capacity test to determine if there is an issue with his libido.

Reproduction with Artificial Insemination

Some producers may elect to not house a ram on their farm. They stink, can be destructive, and you need to rotate or replace them every few years to minimize inbreeding within your flock. By utilizing the management techniques described within these proceedings, you can adequately prepare your flock for breeding with AI. Even if you have a ram on site that you like, you can maximize his longevity within the flock by breeding a group of ewes by AI first to help diversify the genetic pool on your farm. Most commonly, frozen semen is going to be used if you wish to select for good genetics. Laparoscopic AI is recommended when using frozen semen in sheep and needs to be performed by a trained professional (usually a veterinarian; but can vary by state). To accomplish this, you will need to utilize the estrus manipulation techniques described herein to allow for breeding in one visit. More information on AI in sheep will be discussed elsewhere in these proceedings.

Evaluation of Reproductive Performance

After all is said and done, how are you, the producer, going to determine if your reproduction program is successful? The easiest metric to look at is your final pregnancy rates (>95% within season or >70% out of season are ideal) and lambs born per exposure (can vary by flock, but 1.2 to 1.5 is a good starting point, with up to 2.2 in more prolific breeds). You can get more in depth with your evaluation when you want to assess how well you are doing by adding in management strategies. You can look at the cycling rate and/or mating rate by assessing how many ewes were marked in a defined time period. Within the first 14 days of mating you would want ~70% of ewes to have been mated/marked; whereas you want about 95% of ewes to have been bred within your defined breeding period (usually about 27 days). These metrics should coincide with your overall pregnancy rates and your lambing distribution at the end of the season. Maintaining good records of your reproductive performance is the best way to aid in diagnostic testing if there is a low pregnancy rate at the end of the season.

NC STATE UNIVERSITY College of Agriculture and Life Sciences

Using Reproductive Technologies - Synchronization, AI and ET

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NC STATE UNIVERSITY College of Agriculture and Life Sciences

Reproductive Success??

Number of Offspring ranges from 1 to 5

- Yearlings often have a single
- Twins are the most common
- Triplets frequent (less in sheep)
- 4-5 kids is a rare occurrence

Reproductive rate is affected by breed, age, season, and nutrition

Genetics of reproduction

- Number of offspring determined primarily by ewe (number of eggs ovulated sets upper potential)
- Sex of offspring determined primarily by ram

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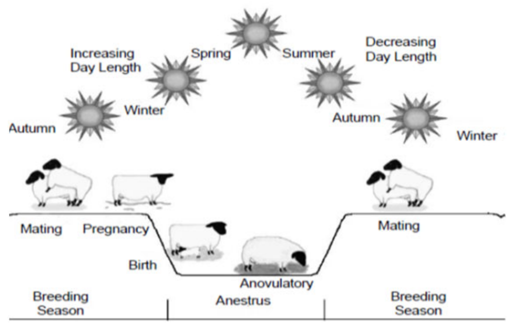
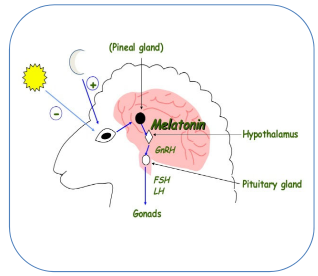
Seasonality

- MOST breeds are naturally "seasonally polyestrous"
- Typically Breed in the Fall
  - 80% of all females will come into heat (estrus) between Sept 1 and Dec 31





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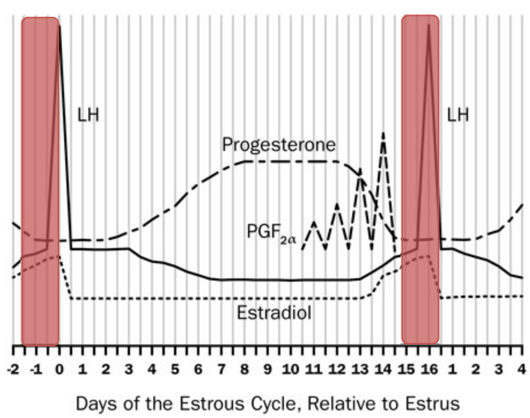
Estrous Cycle Length

- Ewe Cycle
  - Length 16-17 days
  - Estrus 24-36 h typical



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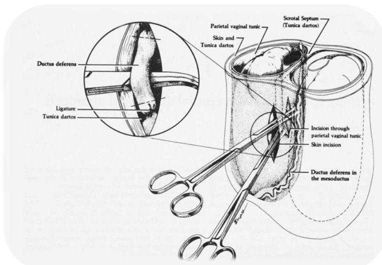
Estrus Detection

- Observe visual cues to know when female is ready to breed
- Improved accuracy requires male
- Use of marking harnesses or paint
- Vasectomized male or male with apron



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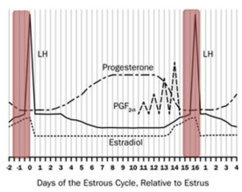
Synchronizing Estrus

- Why??
- Methods
  - Utilizing the Male effect
  - light therapy (Artificial Day Length)
  - Hormone therapy
    - Progesterone treatments (Controlled Intravaginal Drug Release; CIDR)
    - Prostaglandin (Lutalyse ® or Estrumate®) injections



Ram Effect

- Strategic exposure of does to intact males will result in the ewes displaying estrus approximately 7 to 10 days.
- Rams need to be isolated from doe's sight & smell for ~60 days this procedure to be effective
- Effective during short day lengths

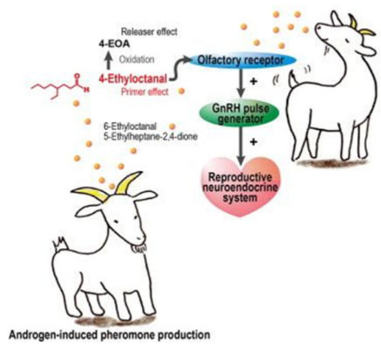


Table 1. Timetable for use of the "ram effect"

Day	
1	Introduce aproned rams
3	Remove aproned rams
14	Introduce fertile rams
18	1st peak in matings
23	2nd peak in matings

Light Therapy
Artificial Day Length

Method of stimulation

1. Suppress Cyclicity
   - Two months of 16-19-20 hour days
   - 1-2 hr. of bright light 16 hours after dawn for 2 months
2. Induce cyclicity
   - return to short day length,
   - does start cycling in about 6 weeks

- Add buck for added male effect
- Consider electricity bill...

NOT VERY COMMON METHOD

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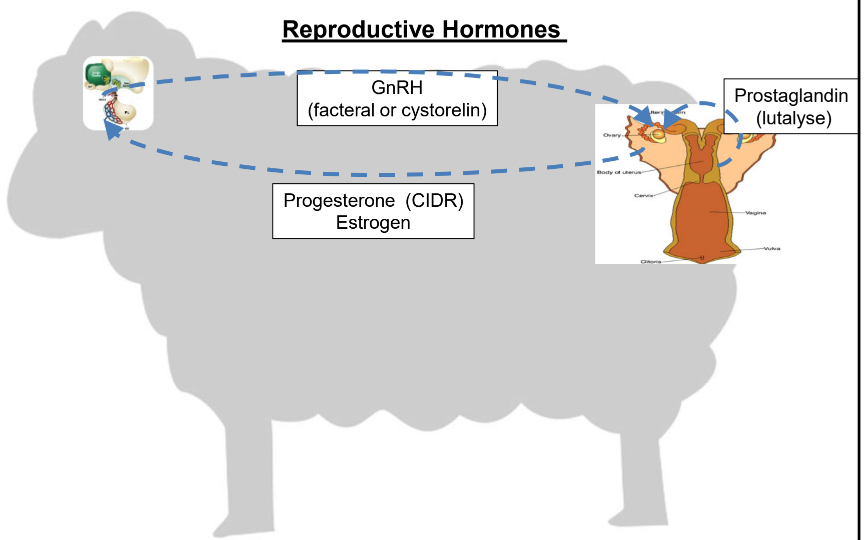
Hormonal Regulation of Reproduction



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Approved Drugs for Sheep

- Very few are approved for small ruminants
  - Extra label drug use
  - Costly
  - Strongly recommend having and valid Veterinary-Client-Patient-Relationship to help with planning and purchase of products

- Disclaimer: Mention or Display of a trademarks, proprietary product or firm in text or figures does not constitute an endorsement by NC State University and does not imply approval to the exclusion of other suitable products or firms.

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Hormonal Manipulation

- Progesterone Treatment
  - Progesterone controls the estrous cycle
    - Megestrol acetate (MGA; Feed Additive)
    - Progesterone implants (CIDRS) are the most commonly used device to block estrus activity

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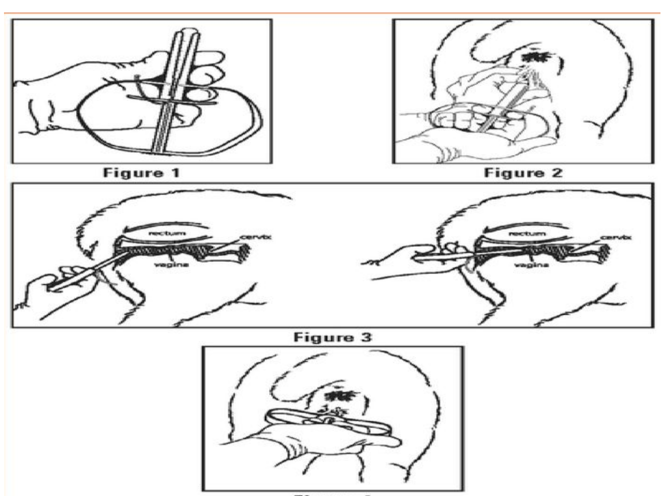
Inserting the CIDR-G is EASY!



Hormonal Manipulation

- Prostaglandin F2a Treatment
  - Prostaglandin F2a controls ovarian function
  - ONLY works in Cyclic ewes
    - LUTALYSE® Injection (15 mg or 3 cc)
    - Estrumate (Cloprostenol Sodium; 150 mg or 0.6 cc)

Hormonal Manipulation

- Chronic Gonadotropin Treatment
  - Chronic Gonadotropin stimulates ovulation
    - PMSG (pregnant mare serum gonadotropin - eCG- 400 IU)
    - PG 600 (400 IU eCG & 200 IU hCG)

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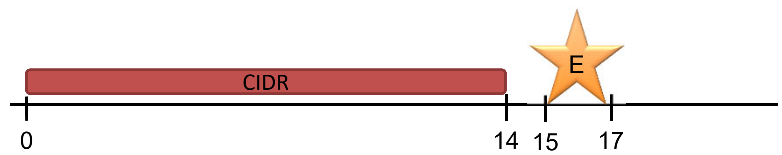
Inducing Estrus in Cyclic Ewes

- Need Progesterone supplementation for 11 to 14 days
  - CIDR – preferred method of progesterone supplementation
    - Can use Prostaglandin F2a (lutalyse) when removing CIDR but not required
    - Do not need extra hormones (eCG or PG600) to stimulate ovulation
  - Note: this method is optimum for getting ewes to cycle together for uniform lamb crop – but for Timed AI
- Ewes will display estrus in 1 to 3 days following CIDR removal



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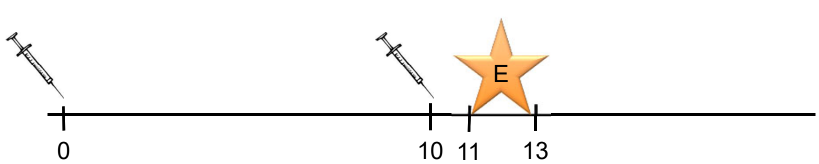
Inducing Estrus in Cyclic Ewes

NO Progesterone supplementation Approach

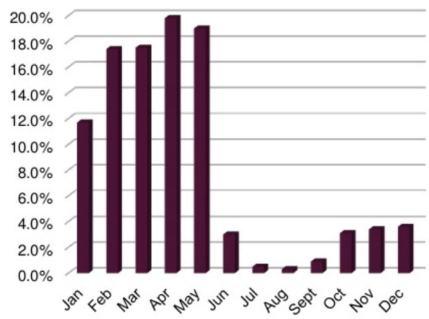
- Make sure ewes are cycling!
  - Give ewes first injection of Prostaglandin F2a (10 to 15 mg) on day 0
    - Wait 7 to 10 days
  - Give ewes second injection of Prostaglandin F2a (10 to 15 mg) on days 7-10
  - Ewes will display estrus in 1 to 3 days following second injection of Prostaglandin F2a
    - Note: Fertility may be lower the progesterone supplemented programs



Out-of-Season Breeding

- Seasonal breeding remains one of the biggest obstacles to growing the sheep/goat industry
  - It is difficult to provide year round supply of lamb to meet the market demand
- Out of season Breeding could increase profits by improving market efficiency

- Percentage of lambs/kids born



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Out-of-Season Breeding
Breed selection

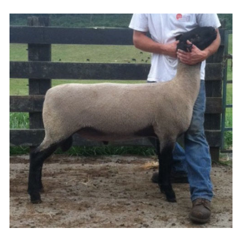
Barbados Blackbelly

Dorset

Rambouillet,
Polypay

Hampshires
Suffolk

YEAR ROUND Breeders → STRICTLY Seasonal



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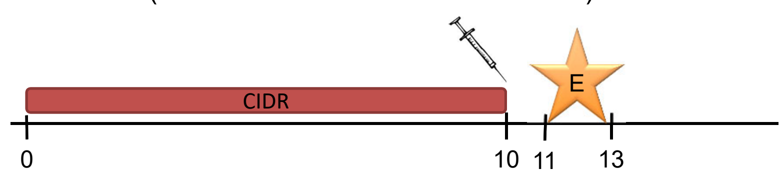
Inducing Estrus in Acyclic (out of season) Ewes

- Need Progesterone supplementation for a minimum on 5 days (typical is 7 or 10 days)
  - CIDR
  - MGA (feed additive)

- When Progesterone is removed need to stimulate ovulation
  - eCG (dose – 400 IU)
  - PG 600 (dose - 400 IU eCG & 200 IU hCG)



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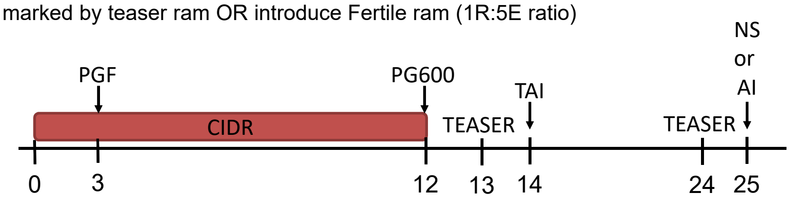
Estrous Synchronization Approach for Timed Artificial Insemination

Day 1: Insert Progesterone Supplementation (CIDR) for 12 days
Day 3: Inject Prostaglandin F2a (Lutalyse 15 mg or 3 ml)

Day 12: Remove CIDR and Inject PG 600 (dose - 400 IU eCG & 200 IU hCG)

Day 13: Estrus Detection (improved with Teaser Ram)
Day 14: Inseminate ewes 51 -55 hours after CIDR removal or 10 -18 hours after ewe is marked by teaser ram

Day 24: Reintroduce Teaser Ram and then inseminate 10 -18 hours after ewe is marked by teaser ram OR introduce Fertile ram (1R:5E ratio)



Questions on Estrous Synchronization?

Breeding Options

- Pasture Breeding
  - Very little labor
  - No Heat checking
  - No control over when ewes are bred
- Hand Mating
  - Ram is kept in a separate pen from the Ewes
  - Observe estrus take ewe to Ram
  - Breeding is observed (precise breeding dates)
  - More time is involved

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Breeding Options: Artificial insemination

- Pros
  - Growing in popularity
  - Can breed to <u>superior sires</u>
  - Introduce new breeds or bloodlines
  - Disease management
  - Maintain fewer males

- Cons
  - Lack of ID of superior sires
  - Lack of semen available to purchase (quality)
  - Smaller size of animal
  - Cost of procedure
  - Cost of semen (vs. natural mating)
  - Difficulty with sheep
    - Complex cervix
    - Fewer signs of estrus
    - Poor fertility with frozen semen

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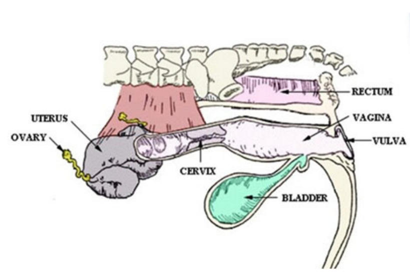
Artificial insemination

- Four Methods
  - Vaginal
    - Semen deposited into the anterior vagina
  - Cervical
    - Semen deposited into cervix
  - Trans-cervical
    - Semen deposited into uterus after cervix is traversed
  - Laparoscopic
    - Semen deposited into uterine horns intrabdominally



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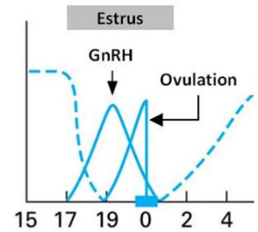
Insemination Procedures

- All about timing
- Observe does in estrus
- Inseminate 12-18 hours after estrus starts



When to breed for best success? 6-28 hours after the onset of heat *												
Heat Period	Before heat	Standing heat **						After standing heat				After heat
Hours after onset of heat		0	3	6	9	12	15	18	21	24	27	
When to breed for best success	Too early to breed			Good time	Excellent Time To Breed					Good time		Too late to breed

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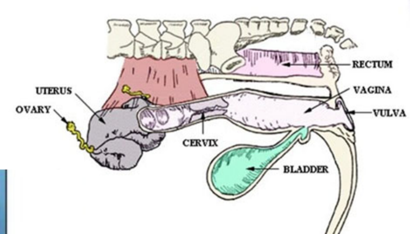
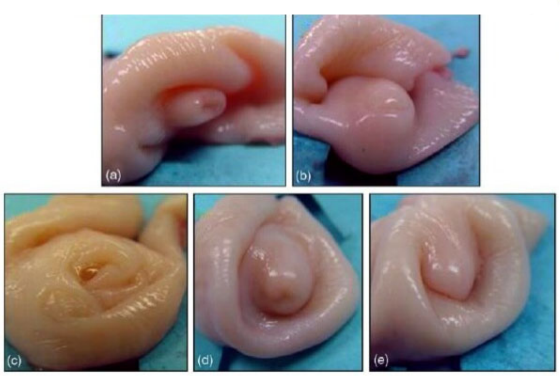
Insemination Procedures

- Cervical Opening
  - Challenging for Vaginal or Cervical insemination





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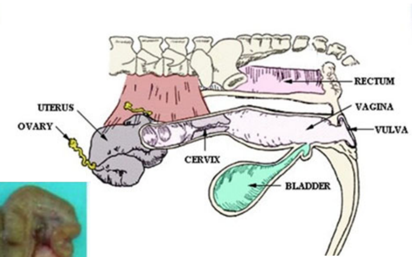
Insemination Procedures

- Cervix
  - Challenging for transcervical insemination



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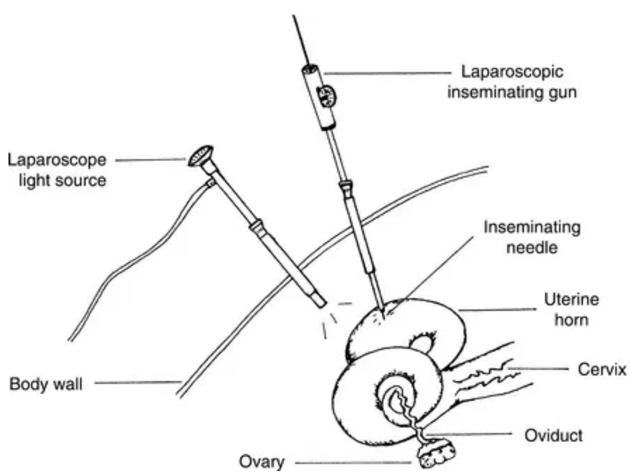
Laparoscopic AI Approach



Laparoscopic AI Approach

Expected Outcomes to AI

ummary of reproductive results obtained using preserved semen with different semen extenders and times of storage in sheep.

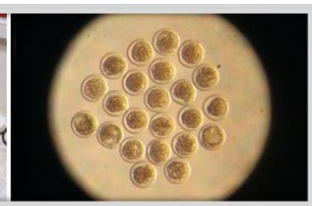
Authors	Storage (°C)	Preservation (h)	Semen Concentration (sperm million/dose)	Semen extenders	AI	Fertility (%)
Naim et al. (2009)	5	12	150-300 x 10^6	OviPro® (Biotay-Minitüb, Germany)	TAI* (54-56 h)	32
		24				11
		12-24	300 x 10^6			29
			150 x 10^6			14
Olivera et al. (2005)	5	24	120 x 10^6	TRIS (TRIS, fructose, citric acid, egg yolk)	AI (natural estrus)	19
		48				22
		24		"Piedra Mora" (UHT skim milk, egg yolk, glycerol)		49
		48				47
Menchaca et al. (2005)	5	12	200 x 10^6	TRIS, glucose, citric acid, egg yolk	AI (natural estrus)	43
		24				35
		Fresh semen				54
Cueto and Gibbons (2010)	5	12	300 x 10^6	skim milk, glucose	TAI* (52-56 h)	40
	15	6-8	150 x 10^6	skim milk		55
Hozbor et al. (2009)	18	8	---	UHT skim milk	TAI	47

AI*: timed artificial insemination in the external uterine orifice; hours (h) after sponge withdrawal;

RIS: hydroxymethyl aminomethane; UHT: ultra high temperature; AI: Artificial insemination. Different letters differ considering P<0.05.

Breeding Options: Embryo Transfer

- Genetic improvement via eggs from superior females
- Not widely used in US sheep industry
  - 1.5% sheep farms
- Primarily used in show flocks/herds
- Provides means to export germplasm
- Requires veterinary expertise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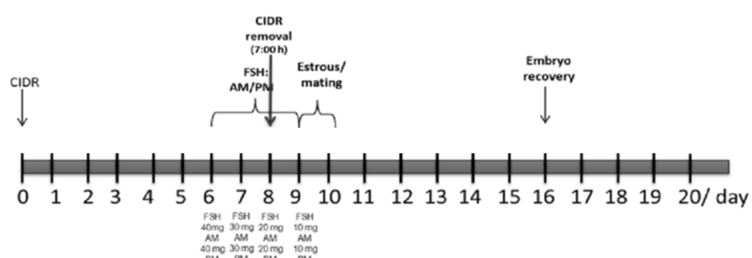
Breeding Options: Embryo Transfer

- General challenges in small ruminants
  - laparoscopic surgery needed for collection and transfer
  - Drugs not approved for use in sheep and goats

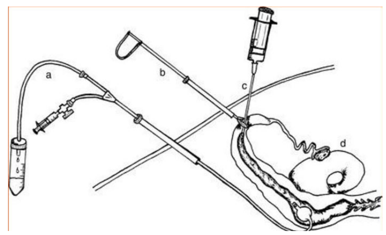
  - Superovulation with FSH or PMSG
  - Insemination



Breeding Options: Embryo Transfer

- Embryo recovery
  - 4-6 days after onset of estrus
  - Fresh transfer or freeze

- Transfer
  - Usually 2 embryos transferred
  - Recipients should have been in estrus on the same day as donor (Use progestogens)
  - 60% survival rates typical (range 40-80%)



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Summary

- Reproductive Technologies such as Estrous Synchronization, Artificial Insemination and Embryo Transfer provides a valuable tool for increasing the impact of outstanding genetics and planning breeding dates to hit desired markets.

- But require increased management, cost, and risk.

- The future holds even more advancements for reproductive technologies in small ruminants!

Using Reproductive Technologies - Synchronization, AI and ET

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Ewe/Doe Obstetrics and Newborn Lamb and Kid Management

Kevin D Pelzer DVM,MPVM
Virginia Maryland College of Veterinary Medicine

It really doesn't matter what you do, ewes/does will decide for themselves when they want to lamb/kid. You can, however, be prepared for lambing/kidding and the potential problems that can occur. The most common physical sign of impending lambing/kidding or parturition in the ewe/doe is the udder begins to fill or bag up. If ewes have a short fleece and in does, one may also observe a softening of the tissues around the dock or tail. The vulva enlarges and a colorless mucous discharge, the cervical mucus plug, may be observed. Even observing these signs in ewes/does only gives one an approximate time of lambing as these observations may be present a week before lambing.

Parturition occurs in three stages. The first stage of parturition lasts from 2 to 12 hours, the time during which the cervix dilates. During this stage, ewes/does will try to isolate themselves. In a crowded barn, this may be in a corner or up against a wall. The ewe/doe acts uncomfortable, getting up and down, lifting her lip, pawing the ground, and frequently urinating. Ewes/does do not "push" at this stage but the uterus is contracting causing dilation of the cervix. Some ewes/does seem to stare off into space and then go back to chewing their cud or eating. Many farmers have said that ewes/does will "go off" feed before lambing/kidding but I have observed ewes actively eating and 45 minutes later deliver a lamb.

The second stage of parturition is expulsion of the lamb/kid. This stage is fairly quick, only lasting 1 to 2 hours. The water bag may be observed followed by the feet and the head. There should be steady progress, meaning more and more of the baby is exposed/pushed out, once the water bag is observed or appearance of the feet. If the ewe/doe strains longer than 45 minutes without producing a lamb/kid, she should be checked for problems. Ewes/does may rest between delivering twins, but twins should be delivered within 45 minutes of the first delivery.

Cleanliness is important when examining a ewe/doe for problems. Contamination of the uterus can lead to serious infection that will negatively impact the health of not only the ewe/doe but also the newborn. Likewise, it protects the shepherd or herdsman as well. The ewe's/doe's vulva should be cleaned with a mild soap and water solution removing all organic debris. The shepherd/herdsman should use an obstetrical sleeve and apply generous amounts of lubrication on the sleeve before entering the vagina.

The most common problem observed in ewes/does with dystocia, difficult birth, is fetal postural abnormalities, body parts are not in the correct position. Normally, the lamb/kid is born with the front legs extended with the head lying on top of the knees. Also the back of the lamb/kid should be against the back of the ewe/kid. In other words, upside down isn't normal and need to be corrected. The head should be 2 to 4 inches from the tip of the toes. If the head is right on top of the toes, the lamb may be "stuck" because the elbows are caught on the brim or edge of the pelvis. Pulling on one leg at a time and fully extending the limb usually resolves this problem. If difficulty occurs in trying to manipulate the fetus, raising the hind quarters of the ewe/doe sometimes allows the uterus to fall forward and reduces the ewe/doe's straining allowing for easier repositioning of the fetal parts.

When a leg is retained or stuck inside the uterus, identify the carpus/knee or the hock and push the carpus or hock to the side while sliding you hand down to the toe and pull the toe to the middle and then backwards (toward you). This will cause the toe to go under the chest and pop out.

A common problem occurs when twins are trying to come out at the same time with each having a leg in the birth canal. One should follow each leg back to the chest to ensure that the legs presented are of the same lamb/kid. If the head and 2 different legs are presented, it is best to gently push the head back in and then replace the leg and retrieve the other matching leg. Be sure to guard the feet as they are sharp and can tear the uterus. In any ewe/doe dystocia, always keep in mind that you may have more than one lamb coming out at the same time.

Sometimes the legs appear but the head is missing. Again check to be sure the legs belong to the same lamb/kid. The head may be turned back to the side or down between the legs. In any case, by gently pushing back on the lamb's brisket/chest, one will usually have enough room to manipulate the head into the proper position. When manipulating the head, push the poll of the head toward the side and pull the nose to the middle. This usually pops the head into position.

Sometimes a ewe/doe may not strain but the membranes are present or the tail is present but no legs. When you examine the ewe/doe, the lamb/kid's butt is pushed up against the pelvis and the legs are extended forward. This is referred to as a true breech. Gently push the butt forward and reach under to grab one of the legs. Place a finger around the hock and gently retract, then reach forward and grab the foot. With the hand around the foot, guarding the toe from penetrating the uterine wall, bring the toe to the middle and push the hock, with your thumb, to the side while lifting the toe into the vagina. Repeat with the other leg. Place the tail between the legs, this reduces the chances of tearing the uterus and remove the lamb/kid.

The third stage of parturition is expulsion of the placenta. The placenta should pass within 8 hours of lambing/kidding. If the placenta retains, the ewe/doe's appetite should be monitored as well as her temperature for a fever (>103.3). If the ewe/doe goes off feed or develops a fever, she should be given penicillin. You need to use more than indicated on the bottle, therefore you need a veterinarian's approval. Most veterinarian's recommend 3 cc of Procaine Penicillin G twice a day in the muscle or under the skin. A dose this high requires that the dam not be slaughtered for 28 days. If milk is being used for human consumption, the milk should be tested for penicillin before being consumed by humans. Mild traction can be applied to the placenta but it should not be torn. If the ewe/doe remains bright, alert, and eating, nothing needs to be done and eventually the placenta will fall out.

Lambs/kids should be born in a dry draft free environment to reduce the risk of hypothermia. Lambs/kids attempt to stand and nurse within 30 minutes of birth. The ewe should have been crutched and clipped around the flank so the lambs have easy access to the teats. If lambs are being crushed, shearing may reduce this problem as ewes can't feel the lambs when overly fleeced. Lambs/kids should nurse within the first 2 hours of birth. Lambs/kids should receive 50ml of colostrum per kg of body weight (3/4 oz/lb) during the first 2 hours and a total of 200 – 250 ml/kg (3.5 oz/lb) during the first 24 hours of life. For example, an 8 lb lamb should receive 6oz in the first 2 hours and 28 oz over the first 24 hours of life.

If a ewe/doe does not have adequate amounts of colostrum, colostrum from another ewe/doe may be used. Note: if your flock is infected with Ovine Progressive Pneumonia or Caprine Arthritis Encephalitis consult your veterinarian as to how to avoid these infections during the newborns early life. If ewe/dam colostrum is not available, goat/ewe or cow colostrum can be used. There is a chance for disease transmission to occur using ewe/goat outside of your farm or cow colostrum, eg. Johnes Disease, so investigation into the health status of the herd is important. Likewise, in rare cases some lambs fed cow colostrum may develop a hemolytic anemia. Commercial colostrum replacements (not supplements) are available and can be used.

Lambs/kids should be placed in a claiming pen or lambing/kidding jug. This allows for proper bonding to occur as well as gives the shepherd/herdsman an opportunity to observe the ewe and lambs for problems. Lambs/kids should remain there a minimum of one day plus a day for every lamb/kid. Ewes/does may ignore weak lambs/kids or lambs/kids born subsequent to the first of a litter, so even though the lambs/kids are with the ewe/doe, one must observe ewe lamb/doe kid interactions.

The lamb/kid's navel/umbilical cord should be dipped in a disinfectant. A 2% iodine, betadine, solution can be used as well as chlorohexidine. Chlorohexidine has been shown to provide some residual bacterial inhibition. Although tincture of iodine is commonly used, it may be too strong as it can cause burning of the tissues.

Lambs/kids may need selenium supplementation if ewes/does are not properly supplemented via mineral salts. Feeding a quality trace mineral salt with the highest allowable selenium should provide the ewe and her lambs adequate selenium. If supplementation is given, lambs/kids should receive 1/3 ml of BoSe.

Heat lamps may provide lambs/kids needed warmth if the lambs/kids are wet or sick. Lamps should be no closer than 4 feet from the ground. Positioning of the lamp is important as a misplaced lamp may set the barn on fire.

Fostering of lambs/kids may be necessary in the case of triplets or inadequate milk production. Match lambs/kids for size, color, and age. The closer to birth fostering occurs, the better the results. Placing fetal fluids on the adopted lamb/kid may help the fostering process.

Colostrum should be hand fed before fostering to insure adequate passive transfer of immunoglobulins. When selecting the lamb/kid to foster, pick the strongest of the lambs/kids. Remove the ewe/doe's lambs/kids and return them after she accepts the new lamb/kid. Do not separate the ewe/doe from her lambs/kids any longer then 2 –3 hours.

Bottle feeding may be necessary if fostering is not an option. Provide the lamb/kid colostrum during the first 24 hours of life. A specific lamb/kid milk replacer should be used based on if you are feeding lambs or kids. Lambs/kids should be fed 4 times a day. The lamb/kid should receive a total of 20% of its body weight a day. For example, a 10 lb lamb would receive 2 lbs of milk (2 pints) a day, 8 oz per feeding. The milk should be fed warm in order to avoid chilling of the lamb during the first week of life. If bloating is a problem, either try feeding cold milk replacer or feed smaller quantities at a time more frequently. The second week of life, lambs/kids can be fed 3 times a day rather than 4. Lambs should be offered creep feed within a week of life and can be weaned when they weigh 20 lbs. More information ia available at http://www.sheepandgoat.com/articles/artificialfeeding.html

Lambing Equipment Box
Bucket
Mild soap, Ivory
Towels
Obstetrical lubrication, KY Jelly, J-Lube
Obstetrical sleeves
Clean baling twine
Antiseptic to dip navels
Hair clips to use on umbilicus in case of hemorrhage.
Bottle nipples
Feeding tube
60 cc syringe to fit feeding tube

Saving Baby Lambs

January 12, 2022

Virtual Shepherd's Symposium

Kevin Pelzer, DVM
Professor, Production Management Medicine
Virginia-Maryland College of Veterinary Medicine

Lambing Kit

- Umbilical supplies
  - hair barrette
  - iodine or novalsan – prevent navel ill
- Needles and syringes
- OB lube and gloves

Lambing Kit

- Umbilical supplies
  - hair barrette
  - iodine or novalsan
- Needles and syringes
- OB lube and gloves
- Soap and towels

Lambing/Kidding Kit

- Umbilical supplies
  - hair barrette
  - iodine or novalsan
- Needles and syringes
- OB lube and gloves
- Soap and towels
- Feeding tube
  - 12 to 16 fr urinary catheter
- Colostrum supplies – **replacement** not supplement
- Nipples
- Thermometer – 101 – 103F

First Stage of Labor

Second Stage

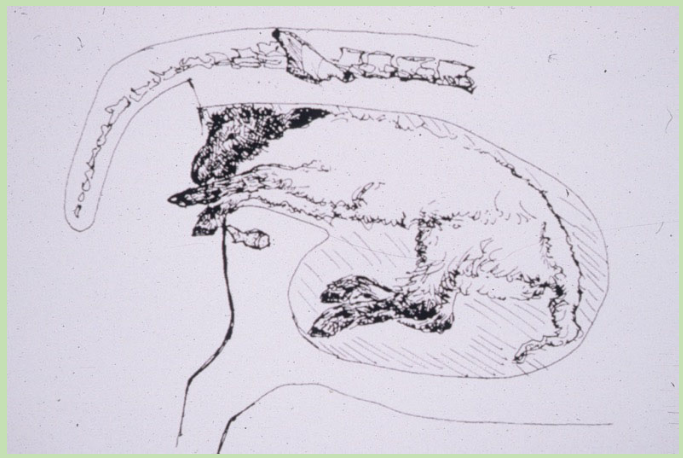
- Expulsion of the fetus
  - may or may not see burst of fluid
  - may or may not see fetal sacks
  - when fetus enters birth canal its oxygen levels decrease causing increased movement
  - 2 hours once ewe starts straining
  - 30 - 45 minutes for twin

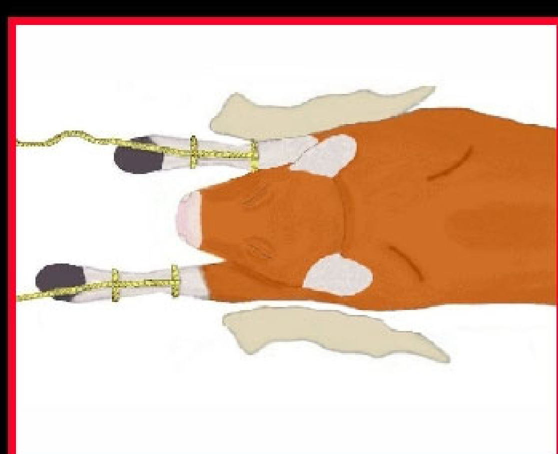
How to get them to breath?

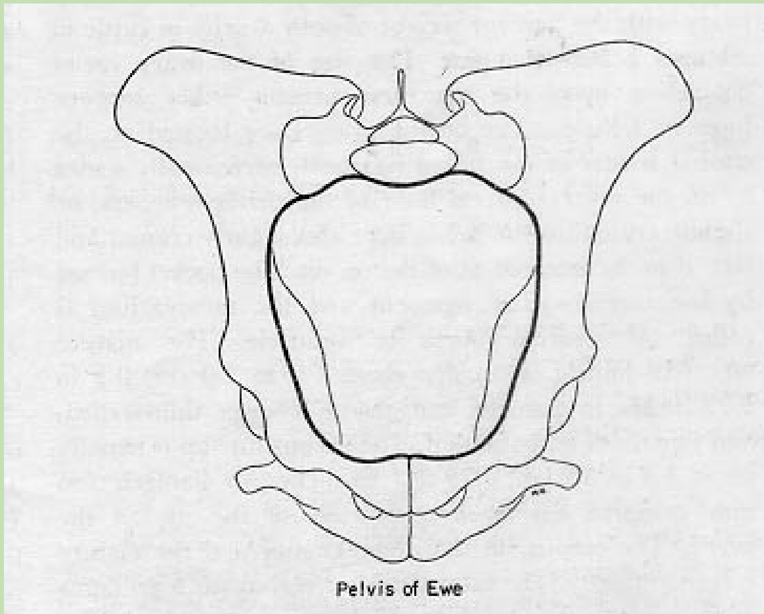
Reasons things get stuck

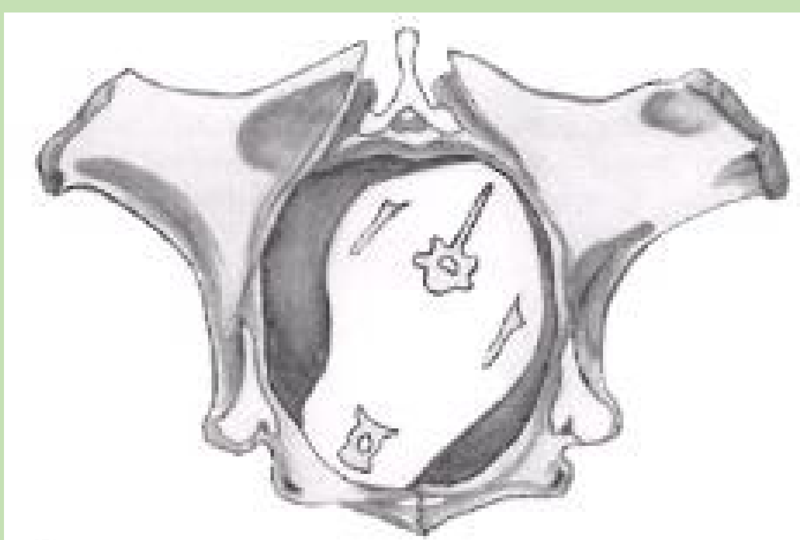
- Fetal malposition – 50%
- Birth Canal Obstruction – 35%
- Maternal fetal mismatch – 5%
- Fetal monsters

- First obstacle is the head
  - turn head slightly sideways
  - lift the lips of the vulva up over the poll of the head
- Head and legs (elbows)
  - pull one leg

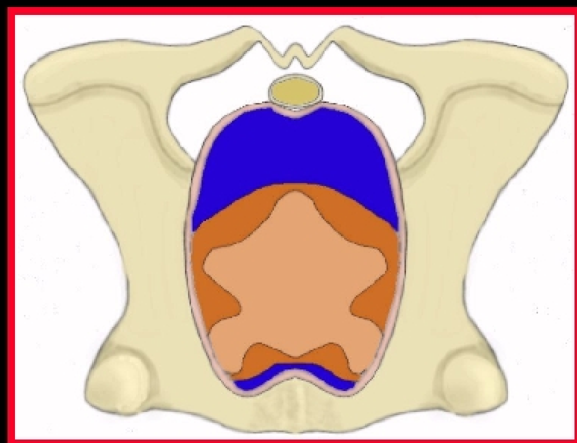


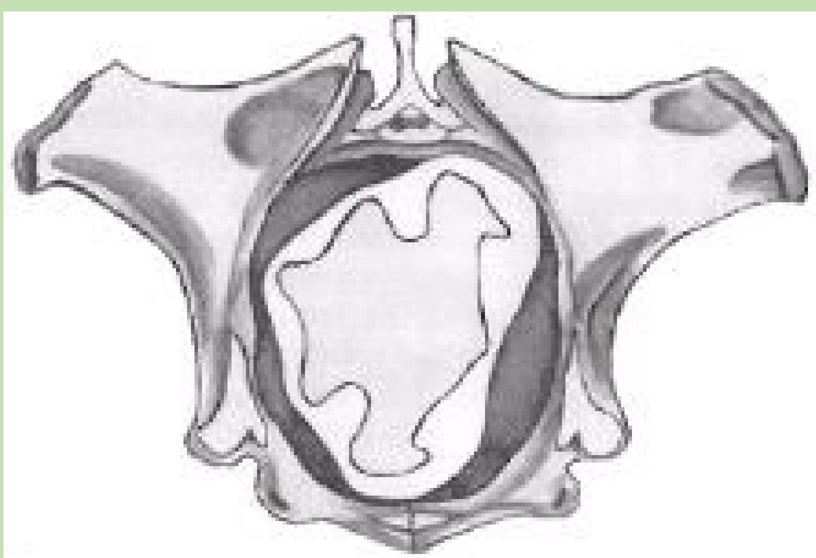


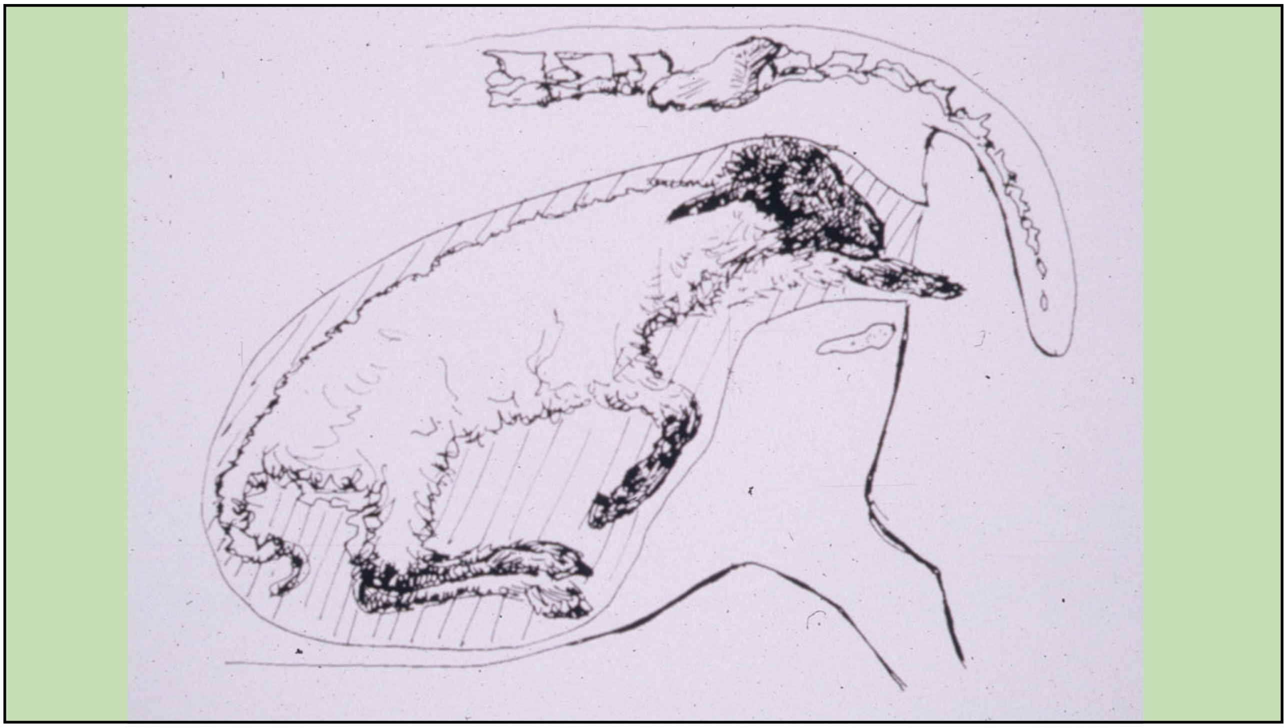

Pelvis of Ewe

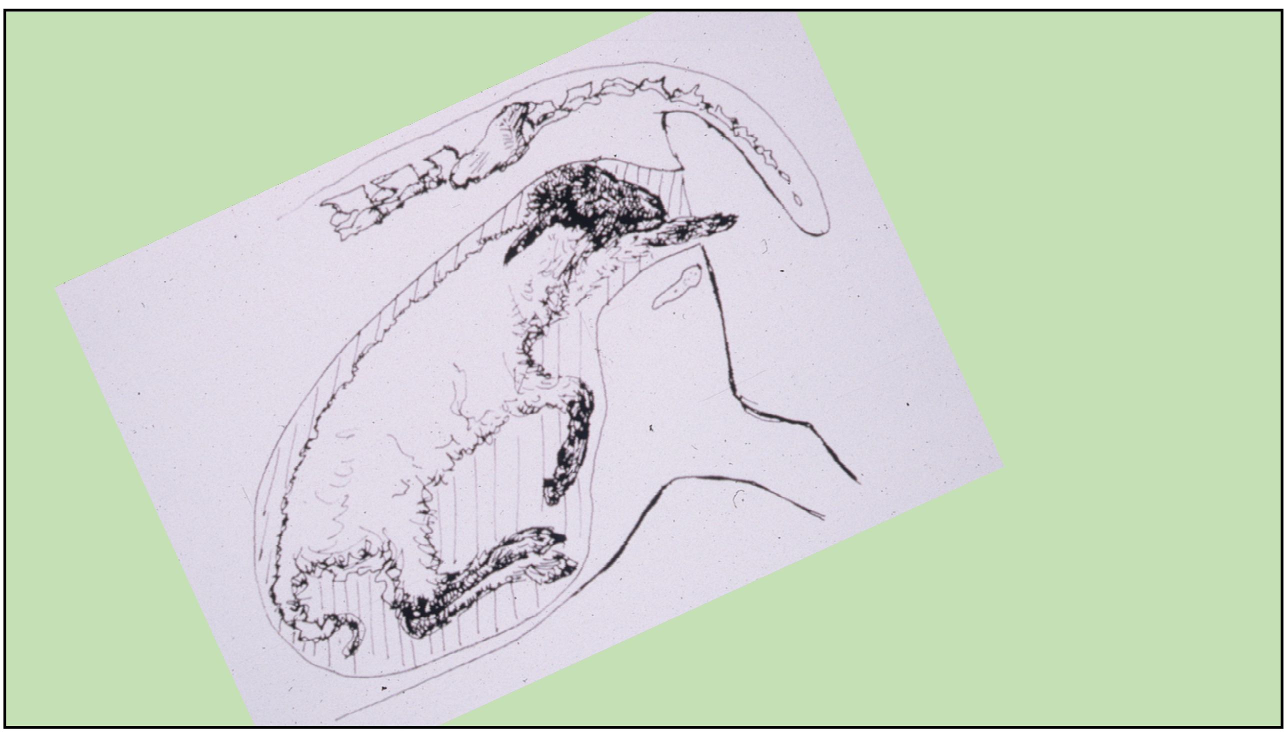


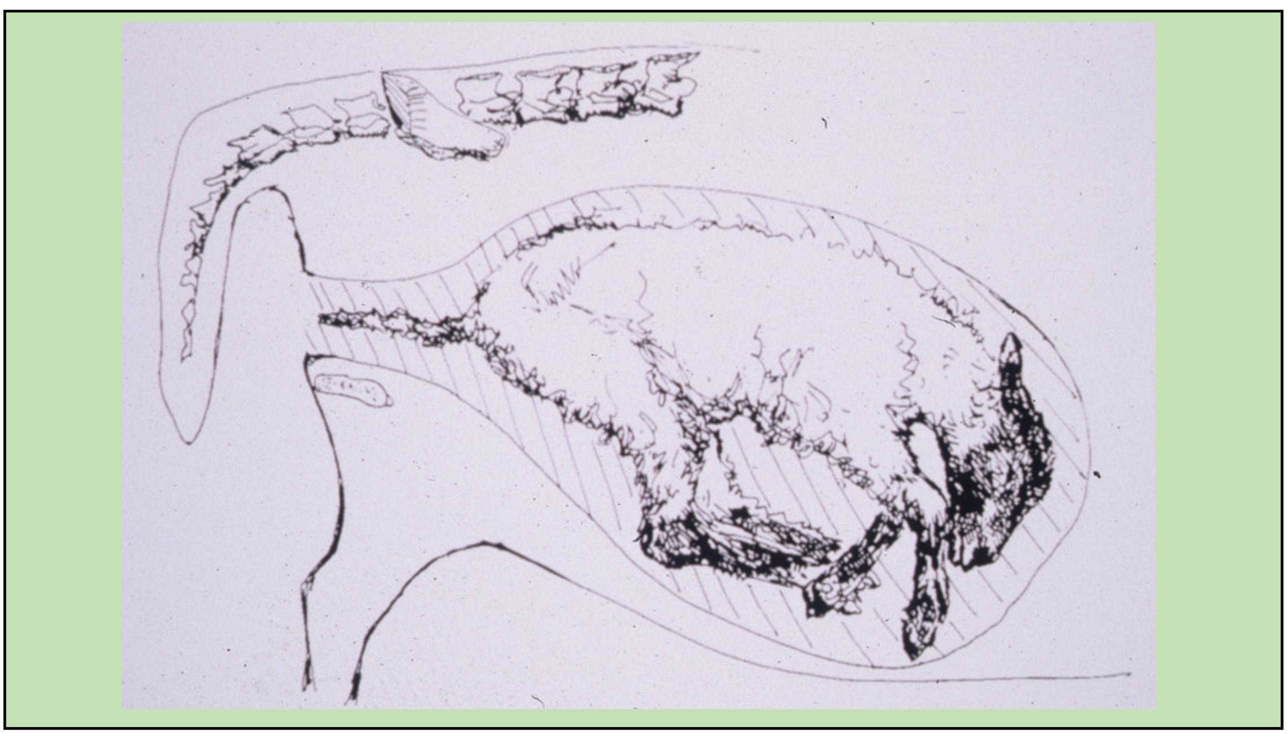
3rd obstacle - Hips

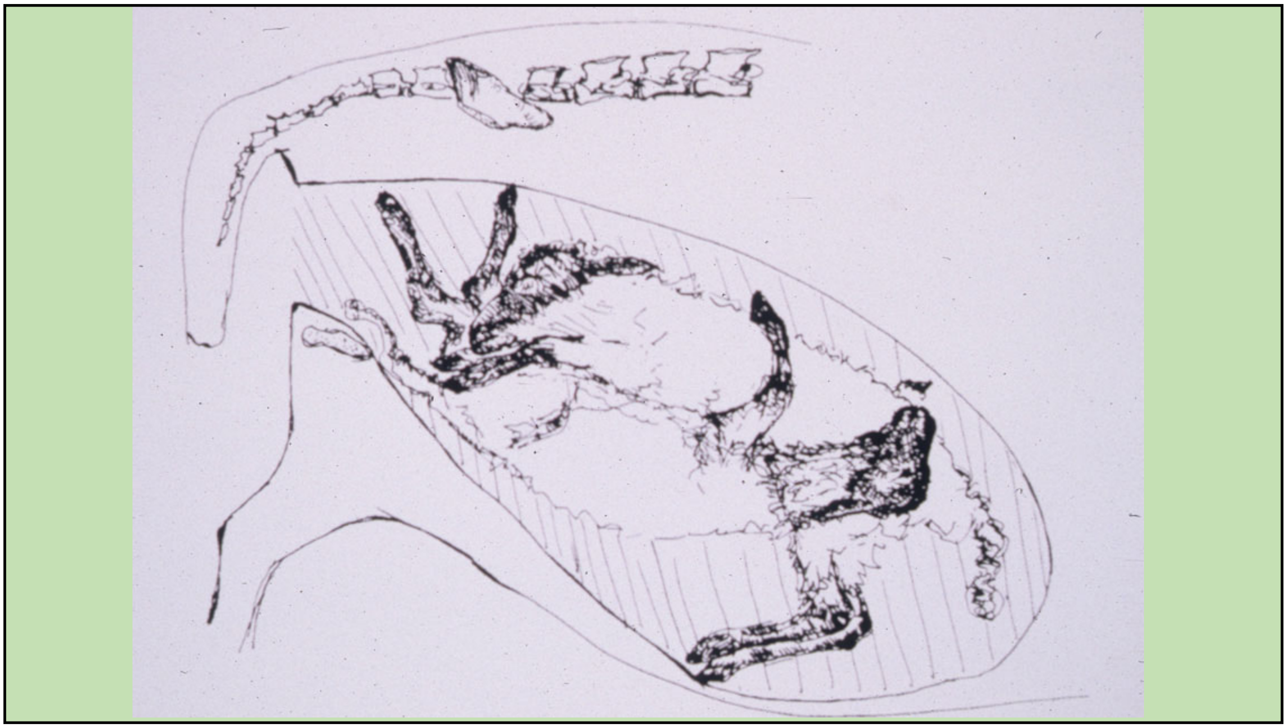












Colostrum Management

- Nurse
  - should nurse within an hour (30 minutes)
  - clean and milk teats to ensure colostrum is present
  - watch to ensure lambs can nurse the teats
- Colostrum
  - 50 ml/kg or 3/4 - 1 oz/lb first 2 hours
  - 200 - 250 ml/kg or 3.5 oz/lb 24 hours

Colostrum Management

- Colostrum banking
  - should be collected from dams within 6 - 12 hours of lambing
  - Specific gravity 1.029 or greater
  - Cool down and freeze
  - Thaw by placing in warm water
- Colostrum alternatives
  - Bovine or goat
  - Colostrum replacement NOT supplement

Making Genetic Progress

First appeared in Eastern Alliance for Production Katahdins Fall 2021 Newsletter

Dr. Andrew Weaver, NCSU Extension Small Ruminant Specialist

$$\Delta G = \frac{Accuracy\ X\ Selection\ Intensity\ X\ Genetic\ Variation}{Generation\ Interval}$$

As breeders of purebred livestock, attention to genetic progress should be at the forefront of our selection programs. The equation above summarizes the components that contribute to genetic progress. ΔG indicates change in genetics (Δ stands for change, G stands for genetics). Genetic progress can be improved by increasing those components in the numerator (Accuracy, Selection Intensity, and Genetic Variation) and decreasing those traits in the denominator (Generation Interval). Each component is described in greater detail below.

Accuracy: Accuracy values represent the relationship between the “estimated” breeding value and “true” breeding value. Increased accuracy results from greater records in the evaluation (individual and progeny records). Accuracy can also be improved through genomic testing. Parentage verification can ensure accurate sire and dam identification. Genomic-enhanced EBVs (GEBVs) provide improvements in trait accuracy as well. Remember, genomic data is only relevant as long as phenotypic records support it. A genomic test does not replace the need for data collection. Additionally, accuracy or genomics alone do not make an individual more genetically superior. They simply allow us to more accurately identify those individuals with superior genetic merit based on EBVs.

Selection Intensity: Selection intensity is reflected in the selection differential. The selection differential is the difference between the selected population for breeding and the average of the population. By selecting individuals further from the average, greater intensity is applied to selection and greater progress can be made. Breed percentile reports can be used to identify superior individuals within the breed for particular traits (Top 5% or 95th percentile for example) that will have a greater selection differential and allow for greater selection intensity.

Genetic Variation: Genetic standard deviation describes the variation in genotypes for a given trait. Traits with more variation give us more opportunity to identify and select superior individuals. However, this component is relatively constant for a population and difficult to change.

Generation Interval: The generation interval is the average age of the parents when the offspring are born. To increase genetic improvement, generation interval needs to be decreased. Therefore, greater utilization of ram lambs and breeding ewe lambs can be very beneficial. Genomics can assist in more accurately identifying those ram lambs to use. Ram lambs and ewe lambs should be managed in a way that improves their early reproductive success.

When making breeding decisions this fall, consider these components in your selection program. Understand tradeoffs may be necessary in some components to improve other components. For example, accuracy may need to be sacrificed in order to improve selection intensity and decrease generation interval. Providing the commercial industry with breeding stock that has superior genetics for economically relevant traits is an important role for purebred breeders and necessary to move the sheep industry forward.

Considerations When Developing a Breeding Plan

First appeared in Katahdin Hairald Fall 2021

Dr. Andrew Weaver, NCSU Extension Small Ruminant Specialist

Establish Your Goals

Establishing goals is the first step to a successful breeding program. Goals allow for the prioritization of important traits and implementation of effective selection practices. These goals should relate to economically relevant traits for a given production system. These traits affect the revenue and expenses of an enterprise. Two questions should be considered when establishing these goals; "What is my market?" and "What is my production system?" Markets may include slaughter lambs or seedstock sales and traits should be prioritized accordingly. Individuals must be able to perform in the production system they are raised in. For seedstock markets, individuals must be able to perform in the production system of their market. Production system needs and market rewards will determine economically relevant traits. Once these traits are determined, they should be prioritized based on current strengths and weakness of a flock.

Utilize Available Selection Tools

Once goals are established, progress must be made in the prioritized traits by effectively using available selection tools. Estimated breeding values (EBVs) are the most powerful tool in our selection toolbox. Estimated breeding values are predictors of genetic merit. These EBVs represent an individual's genotype and allow us to compare relative differences in expected progeny performance within a contemporary group. Expected progeny differences (EPDs) are equal to one-half the EBV (half an individual's genetic merit is passed from parent to offspring).

Estimated breeding values do not indicate a specific level of performance (i.e., number of lambs weaned EBV of +10% ≠ 180% lamb crop in every flock). Two individuals with weaning weight EBVs of +3.0 kg may have weaning weights of 45 lb. in one flock and 55 lb. in another flock. Specific performance for individuals with the same EBVs may vary between farms and within a single farm based on environment. However, relative differences between individuals within a contemporary group should remain similar to that predicted by EBVs.

This is illustrated in Figure 1. Ram A and B have number of lambs weaned (NLW) EBVs of 20% and 10%, respectively. Thus, their daughters would have NLW EBVs (EPDs of Ram A and B), of 10% and 5%, respectively, assuming they are mated to the same group of ewes. These daughters are used in two flocks. The difference in genetic merit for NLW between the daughters is 5%. In flock X, daughters of Ram A wean a total of 31.5 lambs and daughters of Ram B wean 30 lambs. In flock Y, daughters of Ram A wean 37.8 lambs and daughters of Ram B wean 36 lambs. While actual weaning percentage varies between flocks based on environment, the difference in weaning percentage between daughters of these two rams is the same and equal to that predicted by the breeding values. Estimated breeding values should not be used to determine actual performance, but instead used to aid in selection decisions between two or more individuals.

Figure 1. Impact of ram number of lambs weaned (NLW) estimated breeding values (EBV) on daughter weaning litter size in different flocks.

			Lambs weaned by 20 daughters of Rams A or B in two flocks	
	NLW EBV	**NLW EPD**	**Flock X**	**Flock Y**
Ram A	+20%	+10%	31.5 lambs	37.8 lambs
Ram B	+10%	+5%	30 lambs	36 lambs
Difference	10%	5%	5%	5%

Genetic improvement through effective utilization of EBVs should focus on those traits that improve revenue and decrease expenses. Keep in mind, the more traits you select for at one time, the less progress you will make in any single trait. Focus should be placed on a few key traits of importance. Genetic improvement is affected by several factors and described by the key equation. Improvements are made by increasing accuracy of selection, selection intensity, and genetic variation and decreasing generation interval.

$$\Delta Genetics = \frac{Accuracy\ X\ Selection\ Intensity\ X\ Genetic\ Variation}{Generation\ Interval}$$

Reaching Your Goals

Selection intensity is a major factor contributing to genetic improvement. Improvement in selection intensity is illustrated in Figure 2. The majority of individuals within a population are around breed average. Few individuals exist well above or below breed average. By selecting these more extreme individuals for your breeding program, more rapid progress is made in the desired direction. This difference between the selected population and the population average is referred to as the selection differential or genetic reach. The greater the selection differential, the greater the selection intensity, the greater the expected genetic progress.

In a population with an average NLW EBV of 11%, holding all other factors constant, a ram with a NLW EBV of 25% will improve weaning litter size far more rapidly than using a ram with a

NLW EBV of 17%. In a perfect scenario, we'd like to find a ram extreme for all traits ("balanced") to make rapid progress in all desired traits. However, these individuals rarely exist. A ram with all EBVs at breed average (all traits at 50th percentile) may be described as "balanced," but little progress will be made in any trait if this ram is used in a breeding program.

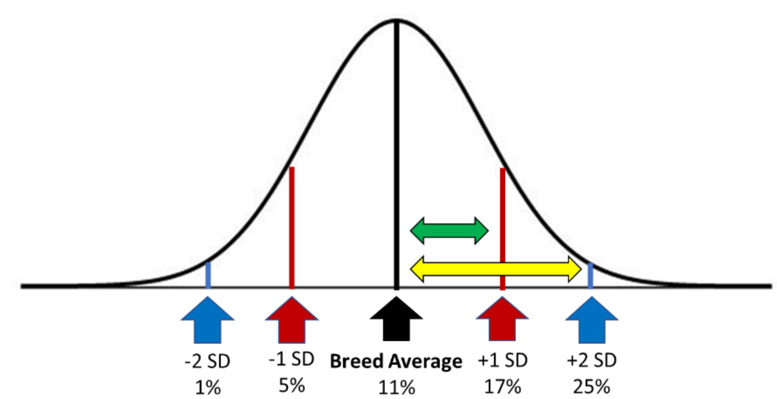


Figure 2. Distribution of NLW EBV for Katahdin sheep from September 2021. Breed average and standard deviations (SD) around the average indicated on normal curve.

Consideration should also be given to other components of the key equation. Accuracy of selection is improved as more data is available to support EBVs. This includes additional progeny records or genomic data. Improved accuracy alone does not make an individual genetically superior. Rather, improved accuracy allows you to identify those individuals that are genetically superior based on EBVs more accurately. Genetic variation for a given trait is relatively constant in a population, and opportunities for improvement are limited for this component. Generation interval should also be considered when evaluating opportunities for genetic improvement. Young genetics are often the best genetics on a farm. Utilization of ram lambs and breeding ewe lambs decreases the generation interval and has potential to improve genetic progress.

While change is inevitable, making progress towards goals has to be intentional. Goals must be established and traits prioritized for improvement to take place. Genetic tools such as EBVs can assist in reaching these goals. Consideration should be given to those components that contribute to genetic progress. Improving selection intensity through effective utilization of EBVs can have significant impacts on the rate of genetic improvement in economically relevant traits. The Katahdin breed has been at the forefront of many genetic technologies in the sheep industry. The breed continues to have the opportunity to put these tools into practice to improve flocks, the breed, and the sheep industry.

Genomic-Enhanced Estimated Breeding Values (GEBV) for the American Sheep Industry

Dr. Andrew Weaver, Lisa Weeks, and Kathy Bielek

Beginning in 2021, the sheep industry will have a new tool in the genetic toolbox that will allow for more accurate selection of breeding stock. This tool is Genomic-enhanced Estimated Breeding Values or GEBVs. Simply put, genomics uses an animal's unique DNA sequence to more accurately predict their true genetic merit. Estimated Breeding Values (EBVs) have been available to sheep producers since the late 1980s. Now, thanks to work by Dr. Joan Burke and Dr. Ron Lewis, GEBVs will be available to U.S. sheep producers. This technology has been widely adopted in the cattle industry with significant improvements to breeding stock selection. Now, genomic technology combined with individual, pedigree, and progeny data will create an even more accurate selection tool for sheep producers.

Genetic traits are often categorized as qualitative or quantitative. Qualitative traits are those controlled by one gene such as Scrapie resistance, Spider Lamb Syndrome or Myostatin. Many of us are familiar with these traits and already use genomics to test for them. For example, testing for Scrapie resistance (Codon 171) returns a genotype of RR, QR, or QQ. These letters denote alleles (differing forms of a gene). This single genotype can determine the phenotypic outcome, that is resistance to Scrapie or susceptibility to Scrapie. Quantitative traits, however, are controlled by many genes! Many of our performance traits, for example weaning weight, number of lambs born or weaned, milk production, and parasite resistance, are considered quantitative traits. So, if many genes control these traits, how do we use genomics to measure them?

Within a DNA sequence, there are "markers" which make that sequence unique for that animal. These markers are called single nucleotide polymorphisms or SNPs for short. A visual representation of these markers is depicted in Figure 1. The quantitative genomic test proposed for our industry examines 50,000 of these markers (SNPs) located across an animal's entire DNA sequence. Patterns among these SNPs in the DNA sequence correlate with individual performance (phenotypic data such as weaning weight, number of lambs born, fecal egg counts, etc.). So, genomic testing, together with pedigree performance information and progeny records, generate a GEBV which more accurately predicts an animal's performance (Figure 2).

The primary benefit of genomic information is the improvement in EBV accuracy. With every EBV, there is an associated accuracy value. This accuracy is reported as a percentage and ranges from 0 to 100%. An accuracy of 0% means we know nothing about that trait and there is no confidence in the value. An accuracy of 100% means that the “estimated” breeding value is the same as the “true” breeding value and can be used with complete confidence. Remember, the breeding values we use are simply **estimates** of an animal’s genetic potential. The accuracy represents how close the estimated breeding value is to the true breeding value for a specific trait. Accuracy depends on the amount of information (i.e., its performance and that of its close relatives) we know about a trait. The more we know about something, the better we can predict it. For example, if we knew every play in a team’s playbook, the status of every player, the weather conditions during the game, and the historical records of the team’s performance, we would be able to predict the outcome of the game more accurately than we would if we were missing any of those components. The more we know about an animal’s performance and genetic makeup, the more accurately we can predict its genetic merit. If you think about EBVs as the seat of a stool, three legs support that EBV: individual performance data, pedigree performance data, and progeny performance data. However, on the GEBV stool, there’s a fourth leg: genomic data. The GEBV has more support. It is more reliable, and therefore, more accurate.

In the past, we achieved improvements in accuracy through a greater number of progeny records in the database. This takes many years of data collection and highly accurate EBVs are typically only available on heavily used rams and older ewes that have been in production for some time. Additionally, achieving accurate estimates for maternal traits on rams requires daughters in production. Genomic data expedites this process. Improvements in accuracy will vary by trait and will be better understood as more genomic data are entered into the database. Current estimates suggest accuracy improvements in the range of 2-24% depending on the trait. This improvement in accuracy is expected to be equivalent to 5-10 progeny in the database.

Genomic data will be most beneficial in selection of young ram lambs and ewes. For example, it could take 5-6 years of production for a ewe to generate 10 progeny. A single genomic test may provide the equivalent accuracy when the ewe lamb is just a few months old. This information allows for selection of ewe lambs more accurately and with greater genetic potential for lifetime productivity. Potential stud ram lambs can be selected at a much younger age and used with more confidence in their first year. Breeders will no longer have to “try out” a young ram on a handful of ewes to confirm his worthiness as a sire. Additionally, genomic testing will boost the accuracy of a ram lamb’s maternal EBVs before his daughters ever enter production.

When used effectively, GEBVs can rapidly improve genetic progress due to the improved accuracy of selection. This technology has the potential to improve U.S. sheep genetics, productivity, and producer revenue. More information on GEBVs can be found on the National Sheep Improvement Program website at http://nsip.org/genomic-enhanced-ebvs/.

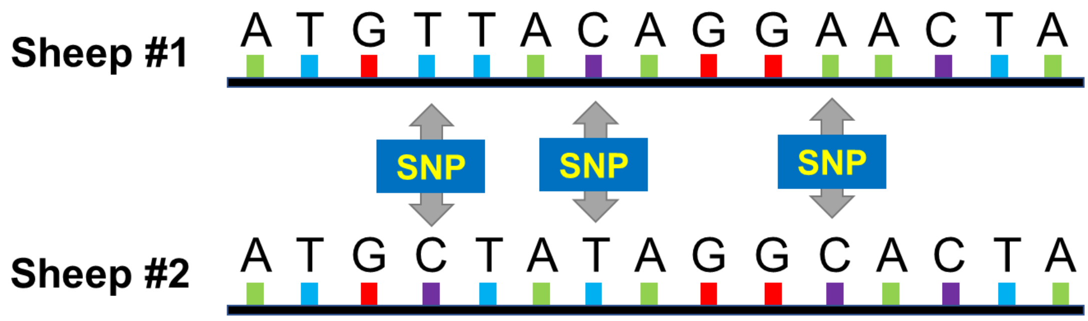


Figure 1. Single nucleotide polymorphisms (SNP) in DNA sequences. In a DNA sequence, the letters A, C, G, and T represent the individual nucleotides. Single nucleotide polymorphisms are single nucleotide (A, C, G, or T) differences between DNA sequences. These SNPs are used as genetic markers in the DNA sequence. Genomic-enhanced estimated breeding values (GEBV) include data from 50,000 SNPs. These SNPs can be used to confirm parentage and improve the accuracy of breeding values.

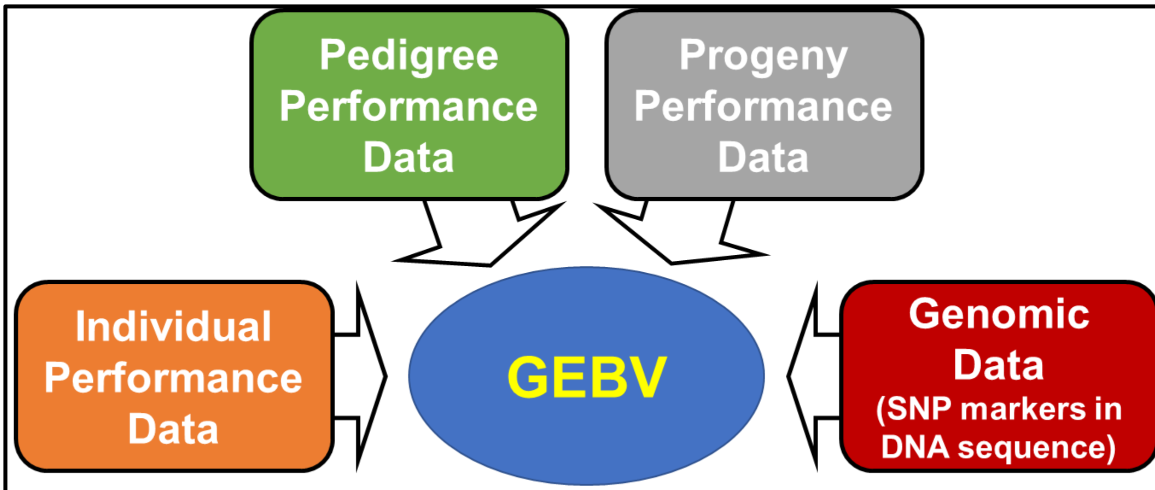


Figure 2. Components of genomic-enhanced estimated breeding values (GEBV). Estimated breeding values are calculated using an individual's performance records, their pedigree performance records, and any progeny performance records. Genomic-enhanced estimated breeding values also include genomic data which consists of genetic markers, single nucleotide polymorphisms (SNP), in the DNA sequence.

Applying Genetics and Genomics to Enhance the Flock

January 13, 2022

Virginia Shepherd's Symposium

Dr. Andrew Weaver

NCSU Sheep Extension Specialist

NC STATE EXTENSION

Identify Goals

Change is inevitable

Progress is optional

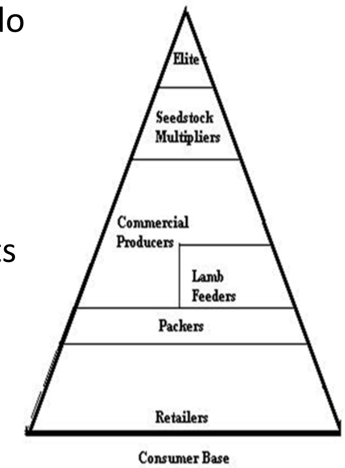
Selection is required for progress

Must have goal to select towards

NC STATE EXTENSION

Identify Goals

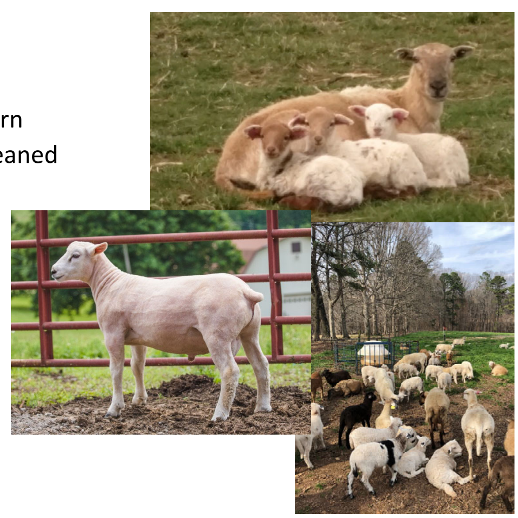
- What kind of producer are you/do you want to be?
- What is your market?
  - What does your market reward?
  - What does your market discount?
- What economically relevant traits apply to your operation?
  - What traits relate to revenue and expenses?



NC STATE EXTENSION

Economically Relevant Traits

- Maternal Traits
  - Prolificacy
    - Number of lambs born
    - Number of lambs weaned
  - Milk
  - Mature Size
  - Fitness
- Terminal Traits
  - Weight
  - Composition



NC STATE EXTENSION

Assess Current Production

- What are your flock's strengths and weaknesses?
  - What does your flock do well?
  - What needs improving?
- Requires observation
- Requires records

"If you don't write it down, it didn't happen."

"If you don't measure it, you can't improve it"

-Peter Drucker

NC STATE EXTENSION

After 4 generations, over 90% of the genetics in a flock are the result of sire decisions.

NC STATE EXTENSION

Key to Genetic Progress

$$\Delta G = \frac{Accuracy\ X\ Selection\ Intensity\ X\ Genetic\ Variation}{Generation\ Interval}$$

- **Accuracy**
  - Correlation between estimated and true breeding values
- **Selection Intensity**
  - Superiority of selected animals compared to flock average (Selection Differential)
- **Genetic Variation**
  - Variation in breeding values within population (hard to change)
- **Generation Interval**
  - Average age of parents when offspring are born

NC STATE EXTENSION

Key to Genetic Progress

$$\Delta G = \frac{Accuracy\ X\ Selection\ Intensity\ X\ Genetic\ Variation}{Generation\ Interval}$$

1. Make the stuff on the top bigger
   - Improved accuracy
   - Greater selection intensity
   - More genetic variation
2. Make the stuff on the bottom smaller
   - Generation Interval

NC STATE EXTENSION

Improving Accuracy

1. Collect more records
   - Collect weaning and post-weaning fecal egg counts
   - Collect weaning and post-weaning weights
2. Use proven genetics
   - Use rams that have already sired offspring
     - Problem: Takes a while to prove a ram and increases generation interval
   - Understand the pedigree

$\Delta G = \frac{Accuracy \times Selection\ Intensity \times Genetic\ Variation}{Generation\ Interval}$

"After this, I want to know the answer to the all-important question, what about her folks? Did she get all of this honestly or is she a freak?”

➢Hank Wiescamp on selecting broodmares

NC STATE EXTENSION

$$\Delta G = \frac{\textit{Accuracy} \; X \; \textit{Selection Intensity} \; X \; \textit{Genetic Variation}}{\textit{Generation Interval}}$$

Improving Accuracy

1. Collect more records
    - Collect weaning and post-weaning fecal egg counts
    - Collect weaning and post-weaning weights
2. Use proven genetics
    - Use rams that have already sired offspring
        - Problem: Takes a while to prove a ram and increases generation interval
    - Understand the pedigree
3. Use appropriate tools
    - Estimated Breeding Values (EBVs) vs. performance data
4. Genomics
    - Validate parentage and generate GEBVs

NC STATE EXTENSION

$$\Delta G = \frac{\textit{Accuracy} \; X \; \textit{Selection Intensity} \; X \; \textit{Genetic Variation}}{\textit{Generation Interval}}$$

What is an Estimated Breeding Value (EBV)?

- Predictor of genetic merit
- Numerical representation of genotype
- More accurate than:
    - Raw performance data
    - Adjusted performance data
    - Ram tests
- Best tool in the toolbox
- “Estimated” not “true” breeding value
    - Associated accuracy value

NC STATE EXTENSION

$$\Delta G = \frac{\textbf{Accuracy} \times \text{Selection Intensity} \times \text{Genetic Variation}}{\text{Generation Interval}}$$

Phenotype vs. Genotype

Phenotype = Genotype + Environment

NC STATE EXTENSION

$$\Delta G = \frac{\textbf{Accuracy} \times \text{Selection Intensity} \times \text{Genetic Variation}}{\text{Generation Interval}}$$

Basis of Genetic Evaluation

Phenotype = Genotype + Environment

We have to control the Environment!

If the environmental influence remains constant, then observed differences in phenotype should be the result of genetic differences.

NC STATE EXTENSION

$$\Delta G = \frac{\textbf{Accuracy} \times \text{Selection Intensity} \times \text{Genetic Variation}}{\text{Generation Interval}}$$

Contemporary Group

- Group of animals that have been given the same **environment** to perform
  - Equal opportunity to express genetic potential
- Same nutritional management
- Same environmental conditions
- Same sex
- Same type of birth
- Same type of rearing
- Same age of dam and lamb

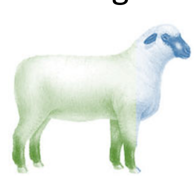
Can adjust for these factors

NC STATE EXTENSION

$$\Delta G = \frac{\textbf{Accuracy} \times \text{Selection Intensity} \times \text{Genetic Variation}}{\text{Generation Interval}}$$

Heritability

- Proportion of what we observe (phenotype) that can be explained by genetics
  - The **<u>genetic component</u>** of a given trait
- Can range from 0 to 1.0 in value
- The higher the value, the greater the heritability, the greater the genetic component



On average, about 20% of what we observe in a trait is controlled by **GENETICS**. The rest is controlled by the animal's **ENVIRONMENT**.

NC STATE EXTENSION

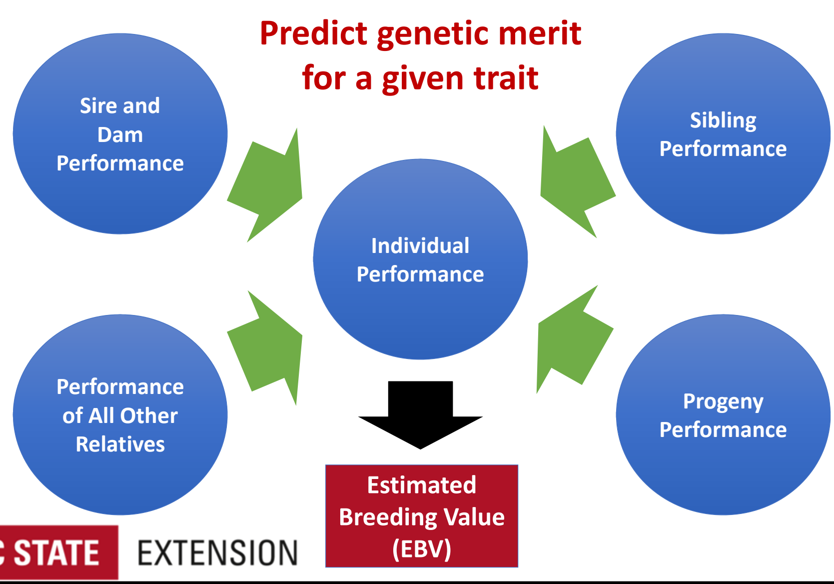
$$\Delta G = \frac{\textit{Accuracy} \times \textit{Selection Intensity} \times \textit{Genetic Variation}}{\textit{Generation Interval}}$$

Heritability of Various Traits

Trait	Heritability
Prolificacy	0.10
Milk Production	0.10
Birth Weight	0.15
Weaning Weight (60 days of age)	0.20
Post-weaning Weight (120 days of age)	0.25
Fecal Egg Count (Parasite Resistance)	0.20
Hair Shedding	0.26
Pounds of lamb weaned/ewe exposed	0.20
Ribeye Area	0.35
Fat Thickness	0.30
Fleece Weight	0.40

NC STATE EXTENSION

Estimated Breeding Values



NC STATE EXTENSION

Phenotype vs. Genotype

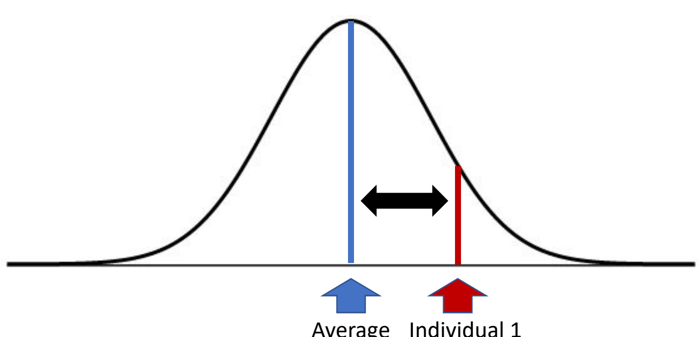
Phenotype = Genotype + Environment

Phenotype = Breeding Value + Environment

NC STATE EXTENSION

Improving Selection Intensity

- Increase the selection differential or genetic reach
  - Increase the difference between the selected individual and the population average



NC STATE EXTENSION

$$\Delta G = \frac{\text{Accuracy X } \textbf{Selection Intensity} \text{ X Genetic Variation}}{\text{Generation Interval}}$$

Improving Selection Intensity

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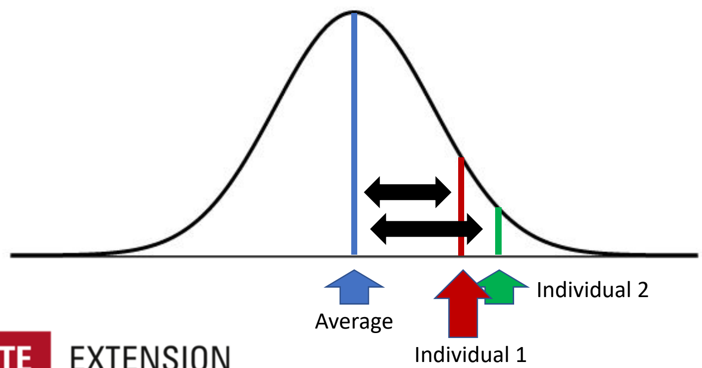


NC STATE EXTENSION

$$\Delta G = \frac{\text{Accuracy X } \textbf{Selection Intensity} \text{ X Genetic Variation}}{\text{Generation Interval}}$$

Improving Selection Intensity

Katahdin Percentile Report

2021

2020-2021 born lambs with genetic linkages

Percentile	BWT	MWWT	WWT	PWWT	PFAT	PEMD	WFEC	PFEC	PSC	NLB	NLW	US Hair Index	YWT	HWT	MBWT	SRC$ Index
100	1.35	2.41	5.50	9.43	-1.78	1.78	-99.99	-100.00	0.00	0.49	0.35	-99.00	9.37	0.00	0.70	138.17
99	0.68	1.67	3.54	6.51	-1.20	1.28	-94.55	-98.05	0.00	0.25	0.22	-99.00	6.25	0.00	0.52	127.07
98	0.61	1.50	3.30	6.00	-1.06	1.14	-91.79	-96.50	0.00	0.22	0.21	-99.00	5.66	0.00	0.46	125.37
97	0.58	1.41	3.17	5.72	-0.94	1.00	-88.42	-94.84	0.00	0.20	0.20	-99.00	5.34	0.00	0.42	124.32
96	0.55	1.33	3.04	5.52	-0.86	0.90	-85.54	-93.07	0.00	0.19	0.19	-99.00	5.10	0.00	0.39	123.36
95	0.53	1.27	2.96	5.32	-0.80	0.85	-82.93	-91.28	0.00	0.19	0.18	-99.00	4.93	0.00	0.37	122.73
90	0.46	1.06	2.66	4.72	-0.59	0.57	-73.71	-83.19	0.00	0.16	0.16	-99.00	4.20	0.00	0.30	120.47
85	0.40	0.94	2.42	4.25	-0.45	0.41	-66.83	-76.39	0.00	0.14	0.15	-99.00	3.74	0.00	0.25	118.91
80	0.37	0.83	2.25	3.93	-0.32	0.29	-59.76	-69.80	0.00	0.13	0.14	-99.00	3.37	0.00	0.21	117.72
75	0.33	0.74	2.11	3.63	-0.23	0.20	-53.24	-63.01	0.00	0.11	0.13	-99.00	3.07	0.00	0.18	116.60
70	0.30	0.65	1.96	3.36	-0.15	0.11	-47.96	-55.94	0.00	0.10	0.12	-99.00	2.80	0.00	0.15	115.60
60	0.26	0.49	1.71	2.90	0.00	0.00	-37.78	-40.09	0.00	0.08	0.11	-99.00	2.26	0.00	0.09	113.92
50	**0.21**	**0.33**	**1.48**	**2.44**	**0.14**	**0.00**	**-27.97**	**-26.56**	**0.00**	**0.07**	**0.09**	**-99.00**	**1.68**	**0.00**	**0.03**	**112.37**
40	0.16	0.17	1.23	1.99	0.29	-0.10	-18.25	-12.49	0.00	0.05	0.08	-99.00	1.06	0.00	0.00	110.72
30	0.11	0.00	0.98	1.52	0.44	-0.25	-6.68	0.00	0.00	0.03	0.07	-99.00	0.16	0.00	-0.04	108.95
20	0.05	0.00	0.69	0.98	0.63	-0.43	1.83	13.60	0.00	0.01	0.05	-99.00	0.00	0.00	-0.10	107.02
10	-0.02	-0.19	0.28	0.18	0.95	-0.69	21.61	41.96	0.00	-0.02	0.03	-99.00	0.00	0.00	-0.20	104.13
0	-0.42	-1.35	-1.77	-4.54	3.46	-2.08	207.04	322.36	0.00	-0.20	-0.11	-99.00	-5.22	0.00	-0.90	90.17

Increasing selection intensity

Breed Average

NC STATE EXTENSION

$$\Delta G = \frac{Accuracy\ X\ Selection\ Intensity\ X\ Genetic\ Variation}{\mathbf{Generation\ Interval}}$$

Decreasing Generation Interval

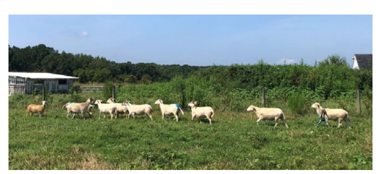
1. Select and utilize younger rams
   - Genomic testing can assist with this and provide valuable accuracy to those decisions
2. Breed ewe lambs
   - Develop ewes accordingly to maximize success at first breeding (7-8 months of age)
   - Use genetic/genomic tools to select young ewes with good expected lifetime production potential

NC STATE EXTENSION

$$\Delta G = \frac{Accuracy\ X\ Selection\ Intensity\ X\ \mathbf{Genetic\ Variation}}{Generation\ Interval}$$

Improving Genetic Variation

- Challenging to address
  - Relatively constant in population
- Utilize outbreeding
  - Unrelated rams and ewes
  - Maintains greatest amount of heterozygosity within purebred breeding system
  - Decrease occurrence of genetic defects
  - Progeny generally less uniform (don't "breed true")
- Minimize inbreeding



NC STATE EXTENSION

Selection Indexes

- The more traits you select for the less progress you will make in any one trait
- However, index is economically weighted to allow for appropriate selection pressure on individual traits within the index
- Available indexes
  - Hair Index – maternal index for Katahdins
  - Maternal Index – maternal index for Polypays
  - Carcass Plus Index – For terminal production

NC STATE EXTENSION

Genomics

- Result from DNA test and evaluation of DNA sequence
- Builds on EBV already established based on parent, individual, and progeny records (if available)
- What does the genomic test and evaluation do for us?
  - Causative genes
  - Parentage verification
  - Genomic-enhanced estimated breeding values (GEBVs)

NC STATE EXTENSION

Genotype and Genetic Markers

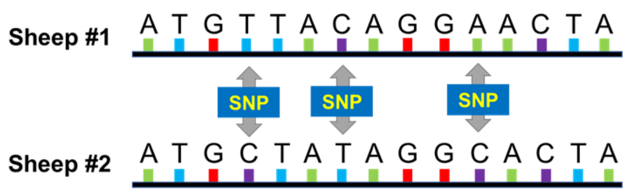


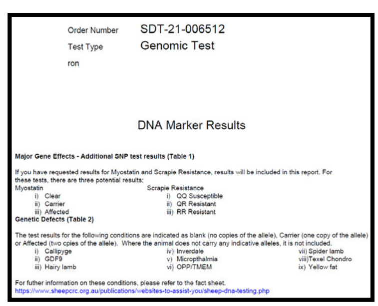
Figure 1. Single nucleotide polymorphisms (SNP) in DNA sequences. In a DNA sequence, the letters A, C, G, and T represent the individual nucleotides. Single nucleotide polymorphisms are single nucleotide (A, C, G, or T) differences between DNA sequences. These SNPs are used as genetic markers in the DNA sequence. Genomic-enhanced estimated breeding values (GEBV) include data from 50,000 SNPs. These SNPs can be used to confirm parentage and improve the accuracy of breeding values.

http://nsip.org/genomic-enhanced-ebvs/

NC STATE EXTENSION

Causative Genes

- Codon 171 (Scrapie Resistance)
  - RR- Resistant
  - QR- Resistant but could pass Q allele to offspring
  - QQ- Susceptible
- OPP Resistance (TMEM 154)
  - Resistant
    - Variants 1, 4, 6, and 10
  - Susceptible
    - Variants 2, 3, and 9
- Myostatin



Order Number SDT-21-006512
Test Type Genomic Test
ron

DNA Marker Results

Major Gene Effects - Additional SNP test results (Table 1)

If you have requested results for Myostatin and Scrapie Resistance, results will be included in this report. For these tests, there are three potential results;

Myostatin
i) Clear
ii) Carrier
iii) Affected

Scrapie Resistance
i) QQ Susceptible
ii) QR Resistant
iii) RR Resistant

Genetic Defects (Table 2)

The test results for the following conditions are indicated as blank (no copies of the allele), Carrier (one copy of the allele) or Affected (two cpies of the allele). Where the animal does not carry any indicative alleles, it is not included.

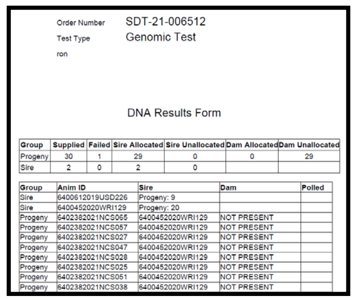
i) Callipyge
ii) GDF9
iii) Hairy lamb
iv) Inverdale
v) Micropthalmia
vi) OPP/TMEM
vii) Spider lamb
viii) Texel Chondro
ix) Yellow fat

For futher information on these conditions, please refer to the fact sheet.
https://www.sheepcrc.org.au/publications/websites-to-assist-you/sheep-dna-testing.php

NC STATE EXTENSION

Parentage Verification

- Pedigree serves as the foundation for EBV calculation
- Accurate identification of sire and dam is critical
- How do parentage errors occur?
  - Ram mis-identification
  - Multi-sire breeding groups
  - Mis-mothering
  - Recording errors



Order Number SDT-21-006512
Test Type Genomic Test
ron

DNA Results Form

Group	Supplied	Failed	Sire Allocated	Sire Unallocated	Dam Allocated	Dam Unallocated
Progeny	30	1	29	0	0	29
Sire	2	0	2	0		

Group	Anim ID	Sire	Dam	Polled
Sire	6400612019USD226	Progeny: 9		
Sire	6400452020WRI129	Progeny: 20		
Progeny	6402382021NCS065	6400452020WRI129	NOT PRESENT	
Progeny	6402382021NCS057	6400452020WRI129	NOT PRESENT	
Progeny	6402382021NCS027	6400452020WRI129	NOT PRESENT	
Progeny	6402382021NCS047	6400452020WRI129	NOT PRESENT	
Progeny	6402382021NCS028	6400452020WRI129	NOT PRESENT	
Progeny	6402382021NCS025	6400452020WRI129	NOT PRESENT	
Progeny	6402382021NCS051	6400452020WRI129	NOT PRESENT	
Progeny	6402382021NCS038	6400452020WRI129	NOT PRESENT	

NC STATE EXTENSION

SW AREC Katahdin Flock

- Total 223 genotyped animals
- 187 animals sire verified (84%)
  - 177 sire confirmed (94.6%)
  - 10 sire discrepancies (5.3%)
- 23 animals dam verified (10%)
  - 20 dams confirmed (87%)
  - 3 dam discrepancies (13%)
- 223 animals gender verified (100%)

NC STATE EXTENSION

Economically Relevant Traits

Genomics can improve accuracy related to:

- Traits expressed in only one sex
  - Prolificacy
  - Fertility
- Traits measured later in life
  - Longevity
- Expensive or difficult to measure traits
  - Feed efficiency
  - End product quality- tenderness, flavor
- Low heritability traits
  - Reproduction
  - Fitness
  - Disease/Health

NC STATE EXTENSION

Practical Applications for Genomics

- Improve accuracy
  - More accurately identify genetically superior individuals
  - Genomic test alone does not make an individual more genetically superior
- Decrease generation interval
  - Identify young rams and ewes to incorporate into breeding programs
  - Use a greater number of ram lambs
  - Improve replacement ewe selection

NC STATE EXTENSION

Summary

Genetic progress can be improved by:

1. Increasing accuracy of selection
   - Collect lots of records, use EBVs, genomics
2. Increasing selection intensity
   - Use more genetically superior rams
3. Decreasing generation interval
   - Breed ram and ewe lambs

NC STATE EXTENSION

"The genes cannot develop the characteristic unless they have the proper environment, and no amount of attention to the environment will cause the characteristic to develop unless the necessary genes are present."

➢Jay Lush, Animal Breeding Plans

NC STATE EXTENSION

Contact Information

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NC STATE EXTENSION

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ASI Report
Lisa Weeks
Region II ASI Director

The American Sheep Industry has been busy navigating through many challenges that resulted from the COVID-19 pandemic that began just before Easter of 2020 yielding a loss of $125 million for lamb producers. Additionally, the industry lost the second-largest lamb processing plant to bankruptcy and the pelt market dropped to a record low. ASI successfully lobbied for the USDA to purchase a total of 279,700 lbs. of lamb shanks in August and September of 2020 in the amount of $2.7 million to American lamb sales. ASI and its state affiliates worked collectively to appeal for support through the USDA's Coronavirus Food Assistance Program. After two rounds of funding, American sheep producers have received more than $156 million to alleviate losses on their flocks, lamb, and wool. Currently the pelt market has bounced back some and lamb prices have risen steadily. Prices reached record highs in some categories in spring/summer 2021.

Potential contagious disease outbreaks like Foot and Mouth Disease (FMD) and how they could impact movement of animals and animal products continue to be a source of concern for the American sheep industry. In order to better prepare before an outbreak, ASI has voluntarily developed the Secure Sheep and Wool Supply Plan (SSWS) for continuity of business. The SSWS Plan better positions sheep operations that have no evidence of FMD infection to move animals and wool to processing or other premises under a movement permit issued by regulatory officials, and maintain business continuity for the sheep and wool industry, including producers, haulers, and packers during an FMD outbreak. Learn more at SecureSheepWool.org.

Legislative issues currently being supported through ASI's lobbying efforts include:

- H-2A labor issues – ASI negotiated to ensure that guest herders were included in immigration language
- Electronic logging – ASI secured needed exemptions to keep sheep moving to their final destination
- Predation – Wildlife Services (WS) plays an important role and ASI fully supports the agency. ASI annually rallies support for WS and has worked to increase funding for cooperator work by the agency
- Trade – ASI opposed increased imports from other lamb producing nations as traditionally 60 percent of all lamb consumed in the US is imported
- Research – In addition to successfully fighting to remove the U.S. Sheep Experiment Station in Dubois, ID from the federal closure list, ASI secured an additional $500,000 in research funding for the station. ASI has also joined the legal fight on a variety of issues ranging from permits for grazing on federal lands to endangered species and more.
- ASI's Guard Dog Fund provides much needed support to producers, state associations and other embroiled in court battles that might prevent producers from performing the work they love while feeding and clothing American consumers.

The demand for American Lamb is at an all-time high. Are we, as producers, gearing up to supply that demand?

ASI Convention: January 19-22, 2022 San Diego, CA – See you there!

American Sheep Industry Association

CORONAVIRUS FOOD ASSISTANCE PROGRAM (CFAP)

- CFAP 1: $69.53 million total to date
  - Wool — $4.27 million
  - Sheep — $15.16 million
  - Lambs — $50.10 million
- CFAP 2 Sheep: $89.83 million total to date
- **CFAP 1 & 2 total to date: $159.36 million to sheep producers and feeders**
- *CFAP figures reported as of November 7, 2021*

USDA WOOL MARKETING LOAN KICKS IN

- Pandemic damage to the wool business on top of the U.S. China Trade war has been severe.
- ASI began working with the wool trade, USDA market reporters, and USDA Farm Services Agency in July 2019 to update the wool marketing loan.
- After much effort, an ungraded wool loan deficiency payment was announced in May 2020. **Currently at 40 cents per lb. greasy** and $2.746 per unshorn pelt.
- ASI continues to work with existing markets and is exploring new markets to move wool with USDA funding.

LRP-LAMB INSURANCE

- LRP-Lamb has not been available for purchase since the pandemic hit and the ensuing MSR bankruptcy.
- Due to the ongoing lack of mandatory price reporting for slaughter lambs, LRP-Lamb product is no longer listed among insurance products on the USDA Risk Management Agency materials.
- The program was the lone risk management tool available to sheep producers.
- ASI's Sheep Venture Company (for-profit subsidiary) that owned LRP-Lamb is encouraging insurance developers to consider building risk management for the lamb industry.

MARKET ACCESS FOR U.S. LAMB

- Japan re-opened to U.S. lamb in July 2018; prior to market closure due to cattle BSE, it was the highest value export market at the time.
- ASI efforts include opening Korea and European Union markets to U.S. lamb.
- Reiterated the cautions of negotiations with the United Kingdom regarding lamb imports to the new Administration. ASI shares trade issues with the US Trade Representative and USDA/OMB regarding the potential rule making on UK lamb and germplasm. ASI led numerous bi-cameral and bi-partisan congressional letters with this position. ASI testified on the issue at the House Committee on Agriculture in October of 2021. Committee members questioned USDA on the issue during the hearing.

PRICE REPORTING TOP PRIORITY FOR ASI

- Mandatory price reporting for livestock legislation renewed for 1 year in September 2020.
- ASI continues to work with the meat industry, stakeholders, and Congress to secure a 5-year renewal and likely a study to determine how confidentiality can be addressed.
- US Congress passed a short-term extension through Dec. 3rd to avoid expiration.
- Cattle oriented federal legislation on cash trade mandate not necessary for the lamb trade.
- ASI testified on Oct. 7 before the House Ag Committee on changes to LMR for lamb.

SECURE SHEEP AND WOOL SUPPLY PLAN

- ASI worked with Iowa State University to develop a business continuity plan to address a catastrophic disease outbreak in the U.S.
- The goal of the SSWS plan is to help producers and allied industries get back to business sooner during a disease outbreak and maintain the supply of meat and wool products to consumers.
- Producer outreach and education materials developed this year with cost-share funding between ASI and USDA.
- Hosting SSWS Plan: Protecting Your Flock Workshops for producers at 2022 ASI Convention.
- Learn more about the SSWS Plan at https://securesheepwool.org/.

CHINA TARIFFS ON RAW WOOL AND SHEEP SKINS

- China announced plans in August 2018 to impose a tariff on grease wool and sheepskins from the U.S. at 25%.
- China is the largest export destination for sheepskins.
- Sheepskins and beef hides/leather demand has **greatly improved** compared to 2020 when much of the world's production was going to landfills or rendered. Prices have rebounded to pre-2019 levels.

IMITATION/FAKE PROTEIN

- ASI adopted policy for regulating lab meat and is actively working with Congress and the Administration to ensure these products are accurately labeled, regulated, and don't disparage genuine American Lamb, beef, or other livestock proteins.

ELECTRONIC LOGGING FOR LIVESTOCK HAULERS

- ASI supported a delay in the enforcement of the Electronic Logging mandate for livestock haulers.
- Working on another delay for the upcoming fiscal year until remaining issues with Hours of Service can be resolved to ensure animal welfare during transit consistent with the Transportation section of the Sheep Care Guide.
- ASI worked to secure the Congressionally mandated front-end 150 air mile radius exemption for livestock haulers including now an additional back-end 150 air mile radius exemption.

OBJECTIVE MEASUREMENT OF AMERICAN WOOL

- ASI and wool industry leaders met in July 2019 on a proposal to expand a wool research laboratory to a commercial facility.
- In January 2020, ASI raised $200,000 from its entities and partners to support a lab with the existing wool research entity at Texas A&M AgriLife in San Angelo, Texas.
- ASI's Sheep Venture Company negotiated a usage agreement for the equipment.
- The university has hired a lab manager and the equipment has been installed. The lab will be ready to test the 2022 wool clip.

AMERICAN WOOL ASSURANCE PROGRAM

- In development by ASI and CSU
- Focus on year-round animal welfare components related to wool sheep production
  - Health
  - Nutrition
  - Stress
  - Handling
  - Facilities
  - Transportation
  - Shearing
- AWA Website will be released May 2021
- Training modules, evaluator training and materials available in 2021

- Level I- Educated
  - Using an online module, producers will learn about good sheep care practices and the AWA program
  - Successful completion earns: a certificate
- Level II- Process Verified
  - Level I required plus records and operating procedures kept and a 2nd party Evaluation.
  - Successful completion earns: a certificate, AWA Process Verified stencil and an electronic certificate
- Level III- Certified
  - Level II certification required plus a 3rd party Audit.
  - Successful completion earns: a certificate, AWA Certified stencil, an electronic certificate, use of the AWA logo, and the ranch's name/logo on the AWA website (optional)

AMERICAN WOOL PROMOTIONAL BOXES

- ASI shipped specially printed boxes featuring American wool socks and promotional items to first-stage processors around the world.
- The promotional boxes were in lieu of a traditional Reverse Trade Mission trip that would traditionally bring first-stage processors to the U.S. for a first-hand look at American wool.
- RTM trips were cancelled in 2020 and 2021 due to pandemic restricted international travel.
- Millions of pounds of American wool have been sold through the RTM program.

AMERICAN WOOL PROMOTIONAL BOXES

- The boxes included a video-capable brochure that provides viewers with the story of American wool without the need for additional playback devices.

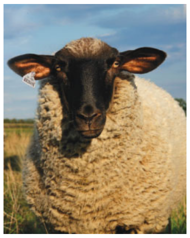
- Videos produced as part of the process will also be used for the purposes of educating those involved in international wool and textile trade, on social media and in future projects.

ASI GUARD DOG FUND

- The ASI Guard Dog fund remained active on top priority issues for the American Sheep Industry
- **Bighorn Sheep** – ASI filed an amicus brief in Washington State where public lands ranchers came under attack with an injunction threatening the turnout of their sheep
  - The injunction was denied, and sheep turned out this spring
- **Gray Wolf** – ASI is working in coalition on several fronts to support the Department of Interior's decision to delist the gray wolf from the Endangered Species Act
- **Sheep Experiment Station** – ASI intervened on behalf of USSES and supported DOJ's efforts
- **Western Resource Legal Center** – ASI has continued to support WRLC's education efforts to train the next generation of resource attorneys at the Lewis and Clark School of Law

ASI CONVENTION – SAN DIEGO, CA

- ASI successfully hosted a virtual convention with over 500 attendees in January in response to the COVID-19 pandemic.
- 2022 — January 19-22 — San Diego, California
- 2023 — January 18-22 — Ft. Worth, Texas
- 2024 — January 8-14 — Denver, Colorado



2022
Shepherd's Symposium

Virginia Department of Agriculture And Consumer Services Update

Dr. Dan Hadacek
Harrisonburg Regional Veterinary Supervisor

National Scrapie Surveillance Update

The National Scrapie Eradication Program continues to document success.

https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/sheep-and-goat-health/national-scrapie-eradication-program

No positive Scrapie animals in 2021.
The last positive case was an Indiana goat in 2019

The USDA has an annual goal of testing 40,000 animals each year.

- A total of 30,121 animals (21,942 sheep and 8,179 goats) were sampled across the US for scrapie testing in FY 2021. (701,245 since 2003)
- Slaughter surveillance accounted for 28,389 samples; 1,732 samples were taken on-farm.

On-Farm Surveillance Testing

The National Scrapie Eradication Program establishes annual sheep sampling minimums for each State, and tracks the States' level of compliance with meeting these minimums. On-Farm Scrapie Surveillance Samples are always needed.

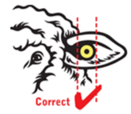
For 2022 Virginia needs to test 196 sheep and 92 goats

Submit whole heads from sheep and goats over 18 months of age that are slaughtered, die or are euthanized on your premises.

Additional information is available on how you or your veterinarian can submit samples or whole heads for scrapie testing. Contact one of the VDACS Veterinarians listed for submission details.

Scrapie Tags

Official ear tags are those approved for use in sheep and goats ***with the US shield printed onto the tag***



Ear tags come in various shapes, sizes, colors and numerical sequences (examples below)

Serial Style Tags

New Participants can contact USDA to receive 100 free plastic tags, while funding is available. There is currently no funding to provide tags for existing participants.

In Virginia,

call **804-343-2569** to enroll in the Scrapie program and receive your free tags

New style (Shearwell) plastic tags from USDA

You need your flock number to reorder tags. You can contact one of the following USDA approved manufacturers to purchase tags.

Allflex USA, Inc.
(plastic tags, RFID tags)
PH: 833-727-2743
Website: www.scrapietags.com

Shearwell Data USA
(plastic tags, RFID tags)
PH: 800-778-6014
Website: www.shearwell.com

Premier 1 Supplies LLC
(plastic tags only)
PH: 800-282-6631
Webpage: www.premier1supplies.com/c/ear-tags-and-tattoo-supplies/ear-tags-for-usda-scrapie-eradication-program

National Band & Tag Company
(metal tags only)
PH:859-261-2035
Website: www.nationalband.com

Alliance ID, USA
(microchips only)
PH: 800-434-2843
Website: www.microchipidsystems.com

EZid, LLC
(microchips, RFID tags)
PH: 877-330-3943
Website: www.EZidAvid.com

Who Needs Tags?!?!

Culled Sheep
Culled ewes or rams must be officially identified/ear tagged either before leaving the farm or at an approved livestock market. Cull sheep are defined as greater than 18 months of age.

Lambs
Ewe lambs under 18 months of age need to be officially identified/ear tagged before leaving the farm or at an approved livestock market.

Lambs under 18 months of age going **directly to a slaughter plant** *do not need official identification*.

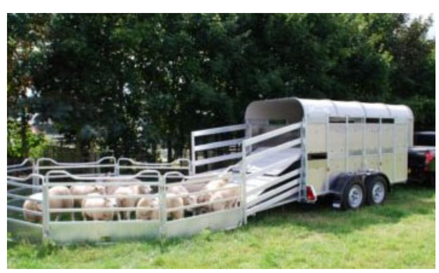
Breeding Ewe or Ram
If going to **show**: Official I.D. required.
If going to **sale**: Official I.D. required.
If staying at **home**: No official I.D. required.
Any show/exhibition is considered interstate movement if out of state animals attend.

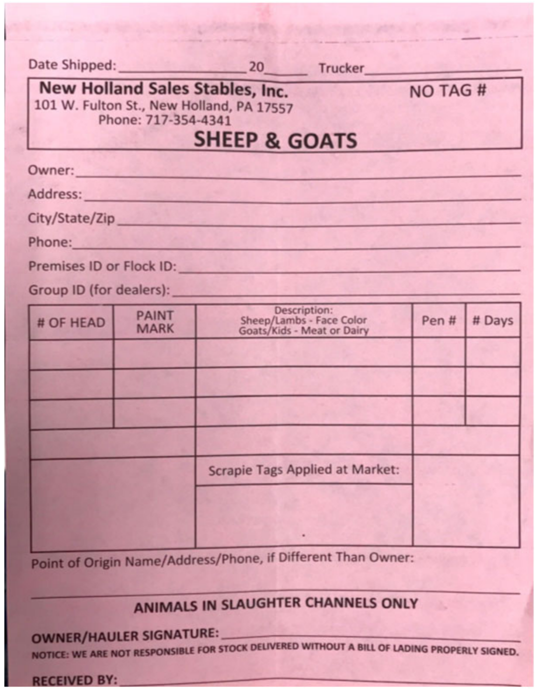
Just Remember: When Sheep leave the farm, They need a Scrapie Tag.

Marketing Update

Many Virginia sheep are sold at New Holland Sales in PA. In 2021, they began utilizing the USDA approved owner/shipper form below.

In addition to all sheep being scrapie tagged, you will need to provide:
- -Flock # or Premises ID
- -description of shipment
- - complete contact information





Date Shipped: ______________ 20____ Trucker______________

New Holland Sales Stables, Inc.
101 W. Fulton St., New Holland, PA 17557
Phone: 717-354-4341

NO TAG #

SHEEP & GOATS

Owner: ______________
Address: ______________
City/State/Zip ______________
Phone: ______________
Premises ID or Flock ID: ______________
Group ID (for dealers): ______________

# OF HEAD	PAINT MARK	Description: Sheep/Lambs - Face Color Goats/Kids - Meat or Dairy	Pen #	# Days
		Scrapie Tags Applied at Market:		

Point of Origin Name/Address/Phone, if Different Than Owner:

ANIMALS IN SLAUGHTER CHANNELS ONLY

OWNER/HAULER SIGNATURE: ______________

NOTICE: WE ARE NOT RESPONSIBLE FOR STOCK DELIVERED WITHOUT A BILL OF LADING PROPERLY SIGNED.

RECEIVED BY: ______________

Scrapie Eradication is important!

-Scrapie is a prion disease like CWD (Chronic Wasting Disease), BSE (Mad Cow disease)

-Eradication will open up profitable domestic and foreign marketing opportunities.

-Scrapie tags are not going away. Sheep producers lead the way in animal identification as a species.

Questions?!?!

Contact:

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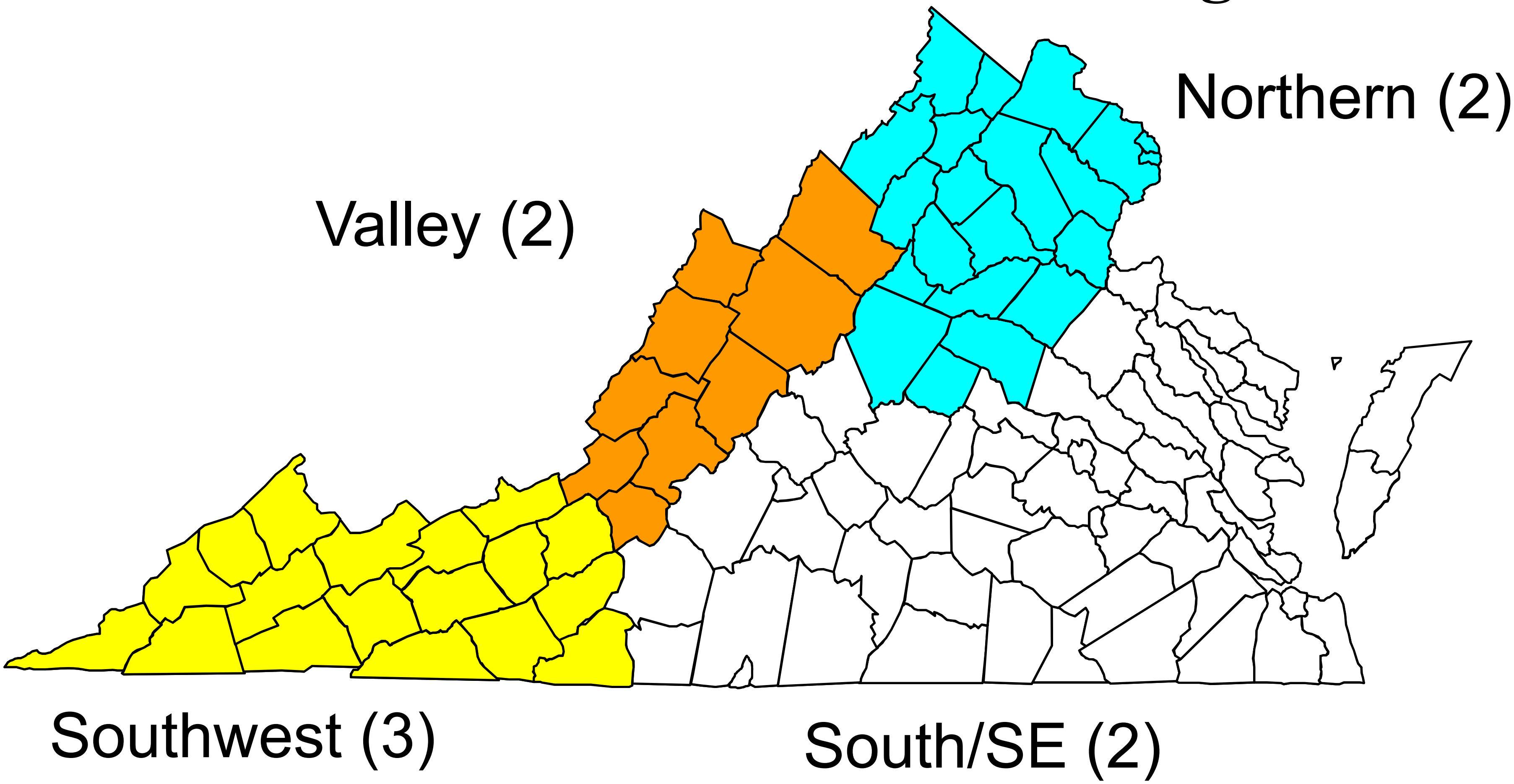
Both plastic and metal tags are acceptable identification.

Orange tags are available from NB&T. White tags are still acceptable. Blue tags are “slaughter only” or “meat” tags and are available from USDA .

2021 Virginia Sheep Producers Association
Board of Directors

Name	Position (term)	City, State	Phone	E-mail
Mandy Fletcher	President; Southwest Region- 2021 (2)	Abingdon, VA	276-759-4718	beyondblessedfarm@gmail.com
Corey Childs	VP Seedstock; Seedstock Council- 2022 (2)	Berryville, VA	540-955-4663	cchilds@vt.edu
Frank Patterson	VP Commercial; At Large, Elected- 2022 (2)	Raphine, VA	540-348-4124	shepherdshaven47@gmail.com
Martha Polkey	VP Wool; Wool Council- 2022 (1)	Leesburg, VA	703-727-5604	mp@budiansky.com
Gary Hornbaker	Northern Region- 2021 (1)	Berryville, VA	703-431-2314	garyhornbaker321@gmail.com
Daniel May	Seedstock Council- 2021 (1)	Grottoes, VA	724-880-5679	mayvalleyfarm@yahoo.com
Dan Woodworth	Valley Region- 2021 (1)	Waynesboro, VA	540-649-0053	sesmeoaks@gmail.com
Robin Freeman	South/SE Region- 2022 (1)	Chesapeake, VA	757-681-4819	gumtreefarm@cox.net
Jim Hilleary	Northern Region- 2022 (1)	Marshall, VA	703-777-0373	jim.hilleary@vt.edu
Lisa Lewis	Southwest Region- 2022 (1)	Glade Spring, VA	276-780-3101	cedarspringfarmsllc@gmail.com
Sarah Mackay-Smith	At Large, Elected- 2022 (2)	White Post, VA	540-837-2529	pastured@cullenstone.com
Patti Price	Wool Council- 2022 (1)	Luray, VA	540-244-7545	
Laura Begoon	Seedstock Council- 2023 (1)	Grottoes, VA	540-421-3469	lbsponaugle@gmail.com
Kate Mahanes	Valley Region- 2023 (2)	Staunton, VA	434-760-1515	katemahanes@hotmail.com
Jennifer McClellan	Southwest Region- 2023 (2)	Riner, VA	540-392-6067	nolleywoodfarm@gmail.com
Tom Stanley	At Large, Elected- 2023 (2)	Lexington, VA	540-588-0241	milkbarnmeadow@gmail.com
Larry Weeks	At Large, Board Appointed- 2023 (1)	Waynesboro, VA	540-943-2346	lweeks@lumos.net
vacant	South/SE Region- 2023 (1)			
Scott Greiner	Educational Advisor	Blacksburg, VA	540-231-9159	sgreiner@vt.edu
Matthew Sponaugle	Technical Advisor	Harrisonburg, VA	540-383-7983	matthew.sponaugle@vdacs.virginia.gov
Kevin Pelzer	Technical Advisor	Blacksburg, VA	540-231-4618	kpelzer@vt.edu

VSPA Commercial Council Director Regions



Roy Meek Outstanding Sheep Producer Award Recipients

2020 – Lee Wright, Washington County
2019 – Jason & Kerri Shiflett, Augusta County
2018 – David Fiske, Augusta County
2017 – Burke Simmons, Augusta County
2016 – Cecil King, Pulaski County
2015 – Larry & Lisa Weeks, Augusta County
2014 – Jeff Lawson, Augusta County
2013 – Laura Begoon, Rockingham County
2012 – Sonny and Ashley Balsley, Augusta County
2011 – Leo Tammi, Augusta County
2010 – Bobbi Hefner, Highland County
2009 – Mac Swortzel, Augusta County
2008 – David Shiflett, Augusta County
2007 – Doug Riley, Augusta County
2006 – Mike Carpenter, VDACS
2005 – Jim Wolford, Wythe County
2004 – Martha Mewbourne, Scott County
2004 – David Redwine, Scott County
2003 – Martha Polkey, Loudoun County
2002 – Carlton Truxell, Augusta County
2001 – Corey Childs, Clarke County
2000 – John Sponaugle, Rockingham County
1999 – Bill Stephenson, Page County
1998 – Gary Hornbaker, Clarke County
1997 – Bruce Shiley, Clarke County
1996 - Weldon Dean, Rockingham County
1995 - Bill Wade, Augusta County
1994 - John Henry Smith, Russell County
1993 - Robin Freeman, Chesapeake
1992 - Courtland Spotts, Pulaski County
1991 - Ted Bennett, Halifax County
1990 - Clinton Bell, Tazewell County
1989 - Rex Wightman, Shenandoah County
1988 - Tim Sutphin, Pulaski County
1987 - Zan Stuart, Russell County
1986 - J. W. Riley, Augusta County
1985 - John Bauserman, Fauquier County
1984 - Roy Meek, Pulaski County
1983 - Jonathan May, Rockingham County