Reproduction and Lambing

Reproduction

A basic understanding of the reproductive biology of ewes and rams will greatly aid in developing and managing an effective breeding schedule. The following chapter provides a brief description of timing of reproductive events in sheep.

Ewes:

Ewes are 'seasonally polyestrous'. This means that they are sexually active only during a particular season and cannot breed during the remainder of the year. During the time that ewes are sexually active, they have regular estrous cycles. A complete estrous cycle includes development of an egg (ovum) on the ovary, readying of the uterus for pregnancy, a period of receptiveness to the ram (the heat or estrus period), and ends with the release of the egg from the ovary (ovulation). Since ewes are polyestrous (poly meaning 'many'), there are multiple opportunities (or estrous cycles) for the ewe to conceive during a single breeding season.

Seasonality

Seasonality of estrous is controlled by the hours of light to which the ewe is exposed. In temperate areas of the world, ewes tend to enter a non-reproductive state during the spring and summer, and start cycling in the fall as the day length decreases. As the gestation length for the ewe is ~5 months long, fall breeding means the lambs are born in the spring. Under natural conditions, the warmer weather and ample feed during spring make it a favourable time of the year for lamb survival and growth. In tropical zones, where day length remains relatively constant, ewes tend to remain sexually active throughout the year. Breeds developed in more tropical areas (e.g. Merino, Rambouillet) or breeds selected for out-of-season breeding (e.g. Rideau Arcott) are less governed by the seasons even when moved to temperate areas. Breeds developed in temperate areas, such as the British breeds, tend to have shorter breeding seasons.

Puberty

Puberty in ewes is marked by the first ovulation. Puberty appears to be dependant on body weight. Most ewe lambs will reach puberty by the time they have developed to 50-70% of their body weight. The onset of puberty is influenced by genetic and environmental factors, including the breed, level of nutrition, and the season of birth.

- Breed: In most breeds puberty occurs between 6 to 9 months of age, although some early maturing breeds such as the Finnsheep will reach puberty at 3-4 months.
- Nutrition: Maturation of the reproductive system will be suppressed if there is a threat to the survival of the animal. If the plane of nutrition is not high enough to provide energy requirements for growth and other body functions, puberty will be delayed. In heifers the proportion of body fat has been implicated as a more exact trigger for puberty than body weight or age alone.
- Season of birth: Ewe lambs born in the spring generally reach puberty by the following fall (~6 months of age). Fall born lambs may not reach puberty until the following fall (12 months of age).

Estrous Cycle

The average estrous cycle (time from one ovulation to the next) is typically 17 days in the ewe. However, there can be considerable variation in this time due to differences among breeds and individual ewes. In other livestock species it has been found that although there may be wide variation among individuals, cycle length for the same animal is relatively constant. Environmental stressors, such as poor nutrition and severe weather (cold or heat), may disrupt cycle regularity. Variation in the length of the cycle may also be due to the stage of the breeding season. Cycles may be abnormally long or short at the

beginning or end of the breeding season. Ewes are less likely to conceive, or maintain the pregnancy if they do conceive, when bred during the extreme boundaries of the breeding season.

Estrus or Heat

This is the phase of the estrous cycle when the ewe will be receptive to the ram. Complete estrus generally lasts for about 24 to 36 hours in the ewe. Estrus has different stages, characterized by the ewe's receptivity to the ram. Standing estrus occurs when the ewe will allow the ram to mount and breed. This stage generally lasts ~10-12 hours.

The length of estrus is influenced by:

- Breed
- Stage of the breeding season (tends to be shorter at the beginning and the end of the season)
- Presence of a ram (may be shorter when a ram is present)
- Age (may be shorter for ewe lambs)

Unlike many other livestock species, ewes tend to show very few behavioural and physical signs of estrus. In some cases, ewes may be more restless than usual, the vulva may appear slightly swollen and there may be mucous discharge from the vagina. However, these signs are not observed for most ewes, and estrus is difficult to detect if the ram is not present.

Ram Effect

Placing a ram with ewes that are just entering the breeding season will cause most ewes to ovulate within a week, and they will begin cycling regularly within the next cycle. This 'ram effect' is thought to be caused by pheromones (scent hormones) released from the ram and detected by the ewe. This effect can be used to help start the breeding season and to synchronize the ewe flock, so they will enter estrus at approximately the same time. This can help concentrate and shorten the lambing season. It has been found that ewes are most fertile during the third or fourth cycle of the breeding season. Using a vasectomized teaser ram will synchronize the flock, but prevents ewes from being bred too early in the season.

Ovulation

Ovulation (the release of the egg(s) from the ovary) generally occurs near the end of the heat period (~24 hours after the onset). The egg(s) will enter the fallopian tubes, and gradually (~72-96 hours after ovulation) will enter the uterus. Standing heat or estrus corresponds with the optimum time for conception, allowing for the transport time of the sperm and the egg to the fallopian tubes. Fertilization of the egg by the sperm (conception) generally takes place while the egg is in the fallopian tubes. Eggs remain viable (capable of being fertilized) for approximately 10 to 25 hours after ovulation.

As sheep often have multiple births, more than one egg may be released during the same estrus period. Although not all ova (eggs) that are release will be fertilized, there is a greater likelihood of multiple pregnancies if the ovulation rate is high. The ovulation rate is dependent on:

- Breed: Most breeds average ~1.5 eggs/estrus. Some very prolific breeds, such as Finnsheep, average 3 eggs/estrus.
- Age: Ovulation rate tends to increase with age, reaching a maximum at 3 to 6 years, and generally declines in older ewes.
- Nutrition: Flushing involves increasing the plane of nutrition before breeding to increase ovulation rate.

Hormonal Control of the Estrous Cycle

Fluctuations in hormone levels control the reproductive system in the ewe. This includes the seasonal cycle as well as the estrous cycle. The hormone melatonin is thought to control the seasonal pattern of the reproductive system. Melatonin production in the brain is controlled by the amount of daylight. Changes in melatonin production through the year act on brain centres controlling the reproductive system to either

trigger or inhibit the production of the reproductive hormones. The light perceived by the ewe doesn't have to be natural light, and controlling light exposure is one method of having ewes cycle out-of-season.

The estrous cycle is controlled through the balance of two hormones produced by the ovary; estrogen and progesterone. The egg develops within a structure called the follicle on the ovary. The cells surrounding the follicle produce estrogen. As the follicle grows and the egg develops, the level of estrogen produced increases. Estrogen is the predominant hormone for approximately 4-5 days in the estrous cycle. When the level of estrogen in the bloodstream reaches a high enough level, it activates an area of the brain that releases a hormone (a gonadotrophin) that causes the egg to ovulate. After ovulation the structure called the corpus luteum (CL) develops in place of the follicle and produces the second ovarian hormone, progesterone. Progesterone is the predominate hormone through most of the estrous cycle. It is also high throughout gestation in the ewe and acts to maintain the pregnancy. The corpus luteum regresses as the next egg develops. The fall in progesterone and the increase in estrogen will induce estrus behaviour in the ewe (i.e. she will be receptive to the ram). Among other factors, a uterine hormone called prostaglandin causes regression of the CL. Administering external hormones is another means of inducing out-of-season breeding and synchronization of estrus in ewes.

Problems with hormone release may result in a disruption of the cycle, which will decrease fertility. For instance, ovulation may not occur, which will cause the level of estrogen to remain high and halt the progress of the cycle. Alternatively, the corpus luteum may not regress which will cause progesterone to remain predominant. Examination of the reproductive system of a ewe that is not cycling properly may reveal what the problem is, and treatment with external source of a hormone may be enough to remedy the problem. The ewe may be prone to similar disruptions in the future and depending on the value of the ewe, culling may be the best solution.

Gestation

After conception, the fertilized egg(s) moves through the fallopian tube to the uterus. The developing embryo will remain in the uterus for the duration of the pregnancy. The uterus in the ewe consists of two coiled tubes (horns) that join at a midline to form the main part (body) of the uterus. The lamb(s) develop in the horns of the uterus. Once established, the fetus will remain in the same horn throughout the pregnancy. The placenta (afterbirth) consists of a series of membrane layers that develop from the embryo. Even with a single lamb the placenta will expand to fill the entire uterus. The surface of the placenta that is closest to the uterine surface will develop attachment structures (cotyledons or buttons). Within these structures the fetal and maternal tissues meet, allowing the transfer of nutrients to and waste from the fetus.

The cervix prevents microrganisms from entering the uterus and harming the embryo. The cervix, located at the juncture of the uterus and the vagina, is a muscular band of tissue that remains tightly closed during pregnancy. A thick mucus block is formed during pregnancy to completely seal the cervix, protecting the fetus and the uterus from infection.

The average gestation length in ewes is 147 days or ~five months. The length can vary by approximately a week, depending on:

- Breed (early maturing, prolific breeds tend to have a shorter gestation)
- Ewe age (gestation length increases with age)
- Gender of the fetus (male lambs tend to be carried longer than female lambs)
- Season (spring lambs are carried longer than fall lambs)

Ewes that are stressed (poor nutrition, subclinical disease etc.) may react by resorbing their fetus(es). This means that the fetal membranes are absorbed back into the ewe's system. Resorption is likely if environmental conditions are perceived by the ewe to be unfavourable for lamb development or if there is a risk to the survival of the ewe. In the case of multiple fetuses, one may be absorbed while the other lamb is retained. Resorption tends to occur early in pregnancy. After a certain stage of pregnancy the fetal material cannot be resorbed by the ewe and problems later on in pregnancy tend to result in abortion (fetal membranes are ejected from the uterus). If lambs die while within the ewe and are not resorbed or aborted, the ewe will quickly become poisoned by the fetus and will die if the lambs are not removed.

Pregnancy checking using ultrasonography will help determine which ewes are bred, and which have multiple pregnancies. This will allow you to cull open ewes early in the season rather than feeding them through the entire gestation period. This also allows you to separate the ewes into groups based on type of pregnancy (single vs multiple) to ensure that ewes under greater nutritional strain are provided with adequate resources to prevent fetal absorption or metabolic problems after lambing.

Parturition (Lambing):

Preparation for lambing and care of newborn lambs are discussed later in this Chapter.

Postpartum

This is the period after the ewe has lambed, including uterine involution (recovery of the uterus from pregnancy) and the resumption of reproductive activity. Uterine involution is generally complete within a month of lambing. The interval to the first postpartum ovulation will vary depending of the timing of lambing (i.e which season). If ewes lamb during the breeding season the first postpartum ovulation can be within 20 days, although this will not generally be a fertile cycle. As well as the season, other factors such as suckling by lambs, breed, nutrition, and environmental temperature may also have an effect.

Ram

Seasonality

Unlike ewes, rams do not generally go through a period when their reproductive system becomes completely inactive. However, changes in day length do affect rams and their sexual activity is highest in the fall, decreasing in late winter, spring, and summer. Testicular size, testosterone levels, sperm production, and libido increase with short days.

Sperm Development and Fertility

The sperm cells that will eventually join with the egg are formed in the testes of the ram. As with other mammalian species, the testes are contained within a muscular pouch called the scrotum, which hangs outside of the body cavity. As sperm cells are sensitive to temperature changes, the scrotum will retract and relax in proximity to the body to help maintain testicular temperature at approximately 4°C below the body temperature. If the sperm cells are exposed to very hot or very cold ambient temperatures, which are beyond the ability of the scrotum to control, Sperm will die and the ram will have decreased fertility.

Sperm development occurs within the testes. Sperm go through several stages, with full maturation and fertility taking approximately 50 days in the ram. Management of the ram during the 50 days before breeding season will have a direct effect the quality of the sperm and therefore the fertility of the ram. During ejaculation, mature sperm are transported from the testes to the internal portion of the reproductive tract through a tube called the vas deferens. In a vasectomized ram, sperm production occurs but the vas deferens is cut to prevent the release of sperm from the testes. The male accessory glands within the internal portion of the tract, contribute ~90% of the semen. This portion of the semen includes various components that help increase the viability of the sperm once it is within the female tract.

Testis size is often used as a judge of fertility and scrotal measurement is used as a basis for choosing breeding rams. Scrotal measurements on the same ram will vary depending on the time of year, with the smallest measurement seen in the spring and the largest in the fall. If scrotal size does not increase significantly (at least ~5cm) between spring and fall, there is a good chance the ram will have fertility problems. Although the change in size is an indication that the reproductive system is functioning, it is not a direct reflection of the quality of the sperm. Short of having his lambs on the ground, measuring the percent motility and the morphology of the sperm is the only way to concretely assess a ram's fertility.

Hormonal Control of Reproduction in the Ram

Although many hormones are at work, testosterone is the predominant hormone produced by the ram. Testosterone is produced by the testes and helps regulates sperm production. As with the ovarian hormones, testosterone production is controlled by a regulatory feedback system to the brain centres. This means that when a certain level of testosterone in the blood system is reached, the brain will send a signal to the testes to decrease production. Therefore, the blood level remains relatively constant.

As with ewes, the hours of daylight affect melatonin production. In turn the level of melatonin produced act on the regulatory centres of the brain, causing the seasonal changes in reproductive activity in the ram.

Libido

Testosterone is, in part, responsible for the mating behaviour or libido in the ram. As the breeding season approaches and testosterone production increases, the ram will generally become more sexually active. As the testosterone level increases, rams that were relatively passive during the off-season may display aggressive behaviour not only towards other rams but also towards handlers.

The testosterone level is not the only influence on libido and various other factors will affect a ram's willingness to breed.

- Ambient temperature: As well as a decrease in fertility, rams often will be much less willing to breed during periods of high temperatures.
- Preferential breeders: Some rams choose to stay with one ewe throughout her estrus period, rather than breeding other ewes that are in heat at the same time. There have been cases of rams showing preferential homosexual behaviour, even when exposed to receptive ewes.
- Injury: Injuries to the reproductive tract or to the feet/legs of the ram may limit breeding.
- Past Experience: Even if the ram is not currently injured, past memories of breeding being painful or causing injury may result in a long-term decrease to the libido.
- Nutritional: Rams should be in good condition but not overly fat as the breeding season approaches. Especially when they are first placed with the ewes, the ram will exert a great deal of energy and will spend a limited amount of time feeding. Poor nutrition leading up to and during breeding will decrease energy reserves and libido in the ram.
- Age: Libido may be lower in rams older than six years of age.

Puberty

Puberty in rams is marked by an increase in blood testosterone, production of sperm, and mating behaviour. An increase in testis size and the beginning of sperm production occurs in ram lambs at around 8 to 10 weeks of age (body weight of 16 to 20kg). Ram lambs produce viable sperm and can successfully breed by ~4 to 6 months of age (40 to 60% body weight). As with ewes, the breed, season of birth, environment, and nutritional status will affect the exact timing of puberty. Do not house young rams with mature rams, as older, more dominant rams may injure the lambs.

The Breeding Season

Length of the Breeding Season

The breeding season should be managed to tailor the length of lambing season to your management system. For example, if you are lambing once per year, you may wish to limit the breeding season (the time the ewes are exposed to the ram(s)) to six or eight weeks. This will allow ewes to have two complete estrous cycles, and therefore two opportunities to conceive. Maintaining a controlled breeding season will help shorten the length of time spent lambing, to decrease the labour involved and will increase to uniformity of the lamb crop for easier management. For large flocks or if you have limited lambing facilities, you may wish to extend or stagger the breeding season. You may also wish to stagger the breeding period to take advantage of various lamb markets. With accelerated lambing systems, ewes are generally exposed to rams for a single estrous cycle. The ewes that have not conceived are put into the next breeding group.

Breeding

As mentioned earlier, ewes will be receptive to the ram for a period of ~10 hours during estrus. In has been found that optimum conception rates occur when the ewe is bred a number of times during this period. If there are a number of ewes in heat at the same time, this will require the ram to be able to breed multiple times within a short period. Rams are capable of legendary feats regarding the number of ewes bred within a short time period (up to 50 matings on the first day with the ewes have been reported). As a result, courtship behaviour, ejaculation, and the refractory period (time between ejaculations) are relatively brief in sheep.

Marking harnesses can be used to help determine if rams are being effective during the breeding season. Rams may be fitted with a special harness, which holds a marking device under the animal's brisket. Alternatively, crayon or paint can be applied directly to the brisket of the ram. The marker should be reapplied often to prevent it from fading. As the ram is mounting the ewe, she will be marked by the crayon or paint. Using different colours for each ram will help determine parentage if you are using more than one ram in a group of ewes. If the breeding season is longer than one estrous cycle, changing the colour of the marker every 17 days will help give an estimate of the number of ewes breed on each cycle. If you use this technique be sure to use a light colour during the first cycle.

Using markers is not a guarantee that the ram is breeding. It is advisable to spend some time watching the flock during breeding season, as the ram may be mounting but not actually breeding. It is especially important to watch young, unproven rams for breeding behaviour and to ensure they are not becoming fatigued. Even with older proven rams, recent injuries or other problems may interfere with breeding. Spending some time during the breeding season to ensure that the rams are working will save disappointment at lambing time.

Ewe: Ram Ratio

The number of ewes that one ram will be able to breed will vary with the production system. For example, if you are synchronizing a large group of ewes, they will be in heat at the same time and more rams will be needed. As fertility and libido are affected by the season, out of season breeding requires a lower ewe: ram ratio. Generally speaking, ram lambs will be able to breed ~25 ewes in their first year and mature rams can typically breed 40-50 ewes within a two month breeding season in autumn.

Gestation Chart: The following chart lists breeding dates and the corresponding expected lambing date based on a 147 day gestation (gestation can range from ~143-153 days). Using this chart you can roughly gauge when ewes should be bred to produce lambs for particular markets. For instance if you wish to market lamb for Christmas at three months of age, they should be born near September 25th. This places the breeding date around the end of April.

Date Bred		Expected Lambing Date		Date Bred		Expected Lambing Date	
January	1	May	29	July	5	November	30
|	6	June	3	|	10	December	5
|	11	|	8	|	15	|	10
|	16	|	13	|	20	|	15
|	21	|	18	|	25	|	20
|	26	|	23	July	30	|	25
January	31	June	28	August	4	December	30
February	5	July	3	|	9	January	4
|	10	|	8	|	14	|	9
|	15	|	13	|	19	|	14
|	20	|	18	|	24	|	19
February	25	|	23	August	29	|	24
March	2	July	28	September	3	January	29
|	7	August	2	|	8	February	3
|	12	|	7	|	13	|	8
|	17	|	12	|	18	|	13
|	22	|	17	|	23	|	18
March	27	|	22	September	28	|	23
April	1	August	27	October	3	February	28
|	6	September	1	|	8	March	5
|	11	|	6	|	13	|	10
|	16	|	11	|	18	|	15
|	21	|	14	|	23	|	20
April	26	|	21	October	28	|	25
May	1	September	26	November	2	March	30
|	6	October	1	|	7	April	4
|	11	|	6	|	12	|	9
|	16	|	11	|	17	|	14
|	21	|	16	|	22	|	19
|	26	|	21	November	27	|	24
May	31	|	26	December	2	April	29
June	5	October	31	|	7	May	4
|	10	November	5	|	12	|	9
|	15	|	10	|	17	|	14
|	20	|	15	|	22	|	19
|	25	|	20	December	27	May	24
June	30	November	25				

Out of Season Breeding Alternatives for Sheep

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Introduction

Out-of-season breeding is becoming more popular as producers move to accelerated lambing programs to supply product to the marketplace on a year round basis.

Controlled reproduction will synchronize the ewe so that lambing occurs in a restricted timeframe. It will also give an out-of-season heat so that ewe can be bred in the spring for accelerated lambing programs and for the production of lamb for the Christmas and winter markets.

Ewes cycle in days of decreasing day length. When in season, sheep cycle approximately every 17 days (range 15-19 days). Some breeds are more seasonal than others. There is a large variation in the onset and duration of the season. Prolific breeds and breeds that originated closer to the equator tend to be less seasonal.

Out-of-Season Breeding

Breed and selection

There is a large variation between breeds in the length of breeding season. The season for each breed tends to vary around the shortest day. Breeds with longer breeding seasons will be more likely to breed out of season. If the season for a breed is about 100 days long the season will tend to start 50 days before the shortest day and end 50 days after the longest day. If the season is 70 days long, it will tend to start 35 days before the shortest day and end 35 days after the shortest day.

Genetic selection is a slow but permanent method of achieving breeding out of season. The trait has a low heritability (10 per cent). This means it is difficult and time consuming to develop a flock of animals with the genetic ability to breed (naturally) year round. In order to create a selection program that works, it is necessary to define what out of season means on your farm.
Some questions to consider:

- Is this a ewe that will breed in April, May, June or July?
- Does the ewe have to lamb out of season every time she is exposed to be considered an out-of-season breeder?
- Is the ewe expected to breed out of season as a ewe lamb?
- How many daughters must a ram produce to be considered proven as an out-of-season breeder?

The other problem that makes selection for this trait very slow is that the trait is not expressed until the selected animal has lambs of its own.

Light Control

Modifying day length can induce sheep to ovulate out of season. The change of day length from long days to short days initiates estrus. As a result, it is necessary to create a situation with light control where long days are followed by short days before the out-of-season breeding starts. This can be done gradually or abruptly.

There are breed differences in response to light control but most breeds will respond to a light control program.

- Expose breeds that have a shorter natural season to extended and decreased light for a longer time period.
- Expose ewes to long days for 8-12 weeks and then to short days for 8-12 weeks before breeding. If the out-of-season breeding period is in June, near the longest days of the year, best results are obtained by using 12 weeks.
- Expose rams, as well as ewes, to the lighting program. Exposing rams to short days increases testicular growth, mating activity and semen quality.

Management factors

There are several management factors to observe in managing the light control system.

- The difference in illumination between short and long days should be six to eight hours. Flashes of light will upset the ewe's perception of the period of darkness.
- A minimum of 100 luxes of light is needed for daylight and less than 10 luxes of light can be present for the period of darkness.
- The time of the start of breeding after the short days begin depends on the breed of ewe and the time of the year. This will usually be a minimum of eight weeks after the short days begin.
- End the short day period as soon as the rams are removed from the ewe.

If all protocols are rigidly observed, conception rates of over 80 per cent can be achieved if there is a minimum of 70 days between lambing and breeding. Ewes under this system will exhibit more than one estrus cycle similar to ewes breeding in season.

If a light control system is undertaken it is important to do everything possible to ensure success because ewes that don't breed out of season (to the light control) will come into estrus the following fall 8-12 weeks later than usual.

To determine the dates when to expose ewes to long days, work backwards from the desired breeding date. The following example helps with the required calculations.
Example:
Desired Date Breeding Begins - May 15
Short Day Period (8 weeks long) Begins - March 15
Long Day Period (12 weeks long) Begins - December 15

Hormone Control

There are two options for hormone control: controlled internal drug release devices (CIDRs) or melengesterol acetate (MGA).

CIDRs

- Insert naturally occurring progesterone impregnated CIDRs into the vagina for 12-14 days.
- Upon removal, treat the ewes with Pregnant Mare Serum Gonadotrophin (PMSG).
- Introduce the ram to the ewes 24 hours after CIDR is removed, when most ewes should be in heat. All ewes should be in heat after 48 hours.
- The fallout rate of the CIDR varies between farms and seasons.
- There is a risk of vaginal infection or injury if the operator is not gentle and proper sanitation of equipment is not observed.
- CIDRs are not recommended for ewe lambs, primarily due to the risk of injury.
- Using CIDRs is the best method of synchronization for artificial insemination (AI) because the time of ovulation can be more accurately predicted than when using MGA.
- CIDRs and PMSG must be obtained from your veterinarian.

The results that producers see with this method can range from 8 per cent to 85 per cent. Typical results are 50 per cent to 60 per cent of the ewes treated having lambs out of season. CIDRs generally produce only one synchronized estrus out of season.

MGA

Melengesterol acetate is a feed additive. It is commonly used in feedlot heifer rations to prevent estrus. It is not licensed for use in sheep and therefore a veterinary prescription is required.

- Feed MGA at a rate of 0.125 mg, twice a day for 12-16 days.
- The MGA can be formulated into a ewe supplement or into a complete ration.
- The two feedings should be as close to 12 hours apart as possible. It is important to keep the hormone levels in the blood consistent.
- Similar to the CIDRs give PMSG as part of the hormone treatment.
- Administer PMSG five to 10 hours after the last feeding of MGA.
- For good results, strictly follow the timing of the MGA feeding and administration of PMSG.
- The ewes will come into heat two to two-and-a-half days after the last feeding of MGA.
- Introduce the ram after 48 hours.

Similar to CIDRs, there is a wide variation in the results of using MGA, with reports of 10 per cent to 85 per cent, with average results of 50 per cent to 60 per cent.

Management Factors Affecting the Success of Out-of-Season Breeding

Treatment of Ewes

The management and care of the ewes has a large impact on the success of out-of-season breeding.

- Ewes must be in good body condition, preferably gaining body weight at the time of mating. Feed the ewes a flushing ration prior to and during breeding.
- The start and duration of flushing depends on the body condition of the ewes. Flush thin ewes starting two weeks prior to the hormone treatment. Flush ewes in good condition starting when the hormone treatment begins. Continue flushing for two to four weeks after mating depending on body condition. Flush ewes until they are body condition score
  3-3.5.
- Minimize, or avoid stress and handling during treatment, mating and for one month after mating.
- If possible, mate ewe lambs separately from mature ewes. The rams will preferentially mate mature ewes and ewe lambs tend to come into estrus later than mature ewes following hormone treatment

Treatment of Rams

It is also important to ensure good care and management of the rams. Poor nutrition can decrease testicular size and sperm reserves at a time when the size and reserves are already smaller.

- Production of spermatozoa takes seven to eight weeks. Begin supplementary feeding eight weeks prior to mating to increase sperm reserves.
- There are seasonal variations for rams in semen production, quality and libido. Elevated body temperatures in rams from hot weather can cause temporary infertility.
- Shear rams two months prior to breeding and ensure that all wool is removed from the scrotum.
- Ensure that adequate ram power is available for out-of-season breeding. Rams are not able to breed as many ewes out of season. It is recommended that a maximum of five ewes to each ram be used out of season, particularly when hormone treatments are used and the ewes are synchronized. Hormone treatments can be staggered to optimize ram power.

Conclusion

Regardless of the out-of-season breeding method used, it is important to ensure that ewes and rams are managed to optimize success. The breed of the flock will affect the animals' natural season and the ability to respond to controlled reproduction methods. Light control, CIDRs and MGA are all successful alternatives to enhance an out-of-season breeding program.

Assisting the Ewe at Lambing

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This Factsheet is one of a set: "Assisting the Ewe at Lambing" and "Care of the Newborn Lamb", concerning lamb survival. They should be read together.

The ewe's gestation period is from 144 to 151 days, with an average of 147 days. The date that the first lambing is to be expected can be calculated from the date of the first exposure of the ewes to a fertile ram. Before lambing starts, a kit of lambing aids should be prepared. The essentials of this kit are:

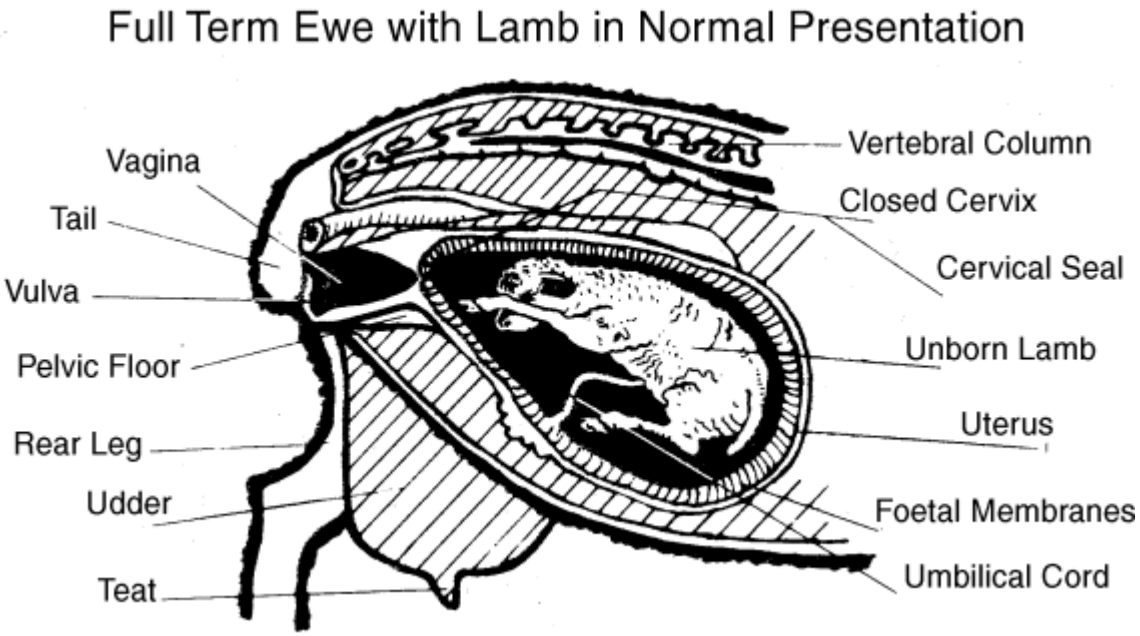
- soap
- disinfectant
- obstetrical lubricant
- sterile syringes - 10 ml and 1 ml
- hypodermic needles of sizes suitable for the ewe and the lamb
- antibiotics and Vitamin E/selenium injections
- lambing cords and lamb snare
- navel disinfectant - iodine based
- intra-uterine oblets
- clean towels or cloths
- clean pail for warm water.

Colostrum and milk replacer should also be available. The colostrum can be from ewe or cow, frozen in 500 ml units. If lambing is to be inside a building, sufficient individual pens are needed to allow each ewe in the group 2 - 3 days individual housing with her lamb(s).

Signs of Impending Lambing

Approximately 10 days before the ewe will lamb, the teats begin to feel firm and full of colostrum. Between then and lambing the lips of the vulva slacken and become slightly swollen. In the last hours before lambing, many ewes will separate from the flock. At this point they should be moved into a lambing pen.
At birth, the normal presentation of a lamb is spine upwards, forefeet with the head between them pointing toward the cervix. The cervix, itself, is still sealed by a mucous plug.
The lamb is surrounded by two fluid-filled sacs, the allantois and the chorion. These first and second waterbags acted as a cushion to prevent injury to the developing foetus. They form part of the placenta. The placenta is attached to the wall of the ewe's uterus by about 80 small buttons, the cotyledons. It is through these and the placenta that the developing lamb has received nutrients from the ewe's blood supply. The placenta with the cotyledons will be expelled as the afterbirth.

Anatomy of the Pregnant Ewe



Physiology of Parturition (Lambing)
The mechanism by which any mammal gives birth is stimulated by changes to the dam's hormone balance and the bulk of the uterine contents (the fetus and the placental fluids). These stimuli cause the uterus to contract, pushing the fetus into the dilating cervix and expel it.

Stages of Lambing

In a normal lambing, there are three distinct stages:

1. Dilation of the cervix
As the uterine contractions start, a thick creamy white mucous, the remains of the cervical seal, is passed from the vulva. This is often missed. Continued contractions of the uterus push the first waterbag into the cervix, stimulating its dilation. Eventually the cervix will be about the same diameter as the neck of the uterus.
At this time the ewe is uneasy, getting up and down, switching her tail and bleating frequently. There may be some straining. This stage can take 3 - 4 hours.

2. Expulsion of the lamb
As the uterine contractions become stronger and more frequent, the lamb and waterbags are pushed into the dilated cervix. The first waterbag bursts, releasing a watery fluid through the vulva. As the ewe continues to strain, the second waterbag is pushed through the vulva and ruptures, to release a thicker fluid.
The rupturing of these bags has established a smooth, well-lubricated passage through the vagina. The hooves and nose of the lamb can often be seen in the second waterbag before it bursts.
The ewe continues to strain, gradually expelling the lamb, forefeet first, followed by the head. There may be considerable effort to pass the head and shoulders of the lamb through her pelvis. Once this happened, final delivery is rapid.
The birth of a single lamb should take an hour or less from the rupture of the first waterbag. A ewe, lambing for the first time, or with a multiple birth could take longer.

3. Expulsion of the afterbirth
The placenta serves no further function once the lamb has been born, and is passed 2 to 3 hours after delivery has finished. Nothing will be passed until after the first lamb has been born. In multiple births, there will be separate afterbirths for each lamb.

Signs of Abnormal Deliveries

Most ewes will lamb unaided and about 95% of lambs are born in the normal presentation, forefeet first. A normal delivery usually takes 5 hours from the start of cervical dilation to the delivery of the lamb, 4 hours for the dilation of the cervix and 1 hour for the actual delivery. The first 4 hours often go unnoticed.
If the ewe:

- continues to strain, but there is no sign of the waterbags, or
- continues to strain an hour after the rupture of the waterbags but there is no sign of a lamb, or
- if the lamb appears to be wedged in the birth canal, or
- if there is an abnormal presentation, a leg back, head back etc.,

Assistance may be needed. Any delay in assistance could mean the difference between a live and dead lamb.

Making the Internal Examination

Cleanliness is important to prevent infection of the uterus. Wash the area round the ewe's vulva with soap and a mild disinfectant to remove any manure and other debris. Scrub hands and arms with soap and a mild disinfectant, and lubricate with soap or an obstetrical cream. The hand is carefully slid into the vagina to feel the lamb and assess the situation. Obviously a person with a small hand is best suited for this task.
In many cases the lamb will be presented normally, you will feel two forelegs with the head between them. In others there will be a malpresentation:

- one or both forelegs back, or
- head back, or
- hindlegs instead of fore legs, or
- one or both hindlegs back, or
- a breach presentation, only the tail and rump felt.

Resolutions

Normal Presentation
Place the noose of a lambing cord over each leg above the fetlock joint and apply a firm steady pull synchronized with the ewe's straining. Lubricate the vagina around the lamb with obstetrical jelly to smooth the passage of the lamb. This is especially important if the waterbags have been ruptured for some time and the vagina has lost this natural lubrication.

Abnormal presentations must be corrected before attempting to pull the lamb. Do not attempt to convert a hind leg presentation to the normal delivery. Pull the lamb out hind legs first, straight back until the lamb's hind legs and pelvis are out of the vulva, then change the pull to downwards towards the ground behind the ewe. Pulling down before the lamb's pelvis is out will wedge the lamb in the pelvic canal of the ewe. Other malpresentations are possible.

Remember that multiple births are common. Two lambs may be presented with legs intertwined. Always ensure that the legs and head are part of the same lamb before attempting to pull it.
Occasionally, deformed lambs will be produced with enlarged heads, stiff joints or skeletal deformities. To successfully lamb, a ewe in these situations may require help from an experienced shepherd or veterinarian. As ewes often have multiple births, the same sequence of the rupture of the waterbag and expulsion of the lamb will be repeated for the delivery of each lamb. After an assisted lambing always check the ewe internally that there is not another lamb to be delivered.

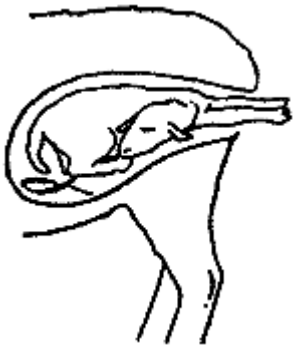
Normal presentation

Breech presentation

One leg back

Hind legs only

Head back

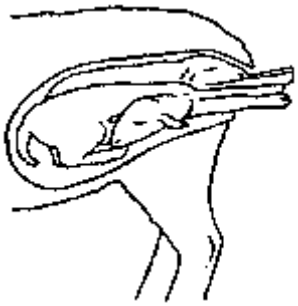


Both forelegs back

Elbow lock

Twins - front and back

Four legs - one head



Aftercare

In all cases, whether the delivery was natural or assisted, check that the lamb is breathing; its nostrils are clear of mucous and are not covered by any uterine membrane. At this time the lamb's navel should be disinfected to prevent infection.
The ewe usually starts to lick the lamb; this is a natural process and should be allowed to continue. Some ewes will eat the afterbirth, but this should be prevented as it can lead to digestive disturbance.
A healthy lamb struggles to its feet soon after birth and starts to nurse its dam. Lambs, weak from a protracted delivery should be helped to nurse, or given up to 250 ml of colostrum by stomach tube. **This first nursing is critical as the colostrum contains antibodies to give the lamb immediate protection against infectious agents common to the flock.** All lambs should nurse or be tube fed colostrum within 6 - 8 hours of birth. In the first 24 hours of life, each lamb should receive about one litre of colostrum. After 36 hours the lamb is unable to absorb any more antibody from the colostrum.
After any assisted delivery the ewe should be given an antibiotic injection and have an antibiotic oblet put into the uterus.

This Factsheet was authored by: Dr. S. John Martin, BVM&S, MRCVS, Veterinary Scientist, Sheep, Goat and Swine

Care of the Newborn Lamb

By: Dr. S. John Martin, BVM&S, MRCVS

This Factsheet is one of a set: "Assisting the Ewe at Lambing" and "Care of the Newborn Lamb", concerning lamb survival. They should be read together.

The profitability of a sheep enterprise depends on the number of lambs sold either for meat or as breeding stock. The number raised to market is a reflection of the complete management of the flock throughout the year. One of the critical points in this management cycle is lambing.

Gestation Care

The ewe is required to deliver strong healthy lambs and to have sufficient milk to raise those lambs. Her ability to do this is a reflection of the gestation management. At breeding, a ewe should have a body condition score of 2.5. Throughout much of the gestation period a diet of good hay should suffice. In the last six weeks, grain can be fed in addition to hay to allow for the growing lambs, the development of the udder, and the fat reserves of the ewe for lactation. The amount of supplementary feed depends on the size and body condition of the ewes and the quality of forage being fed. At lambing the body score should be between 3 and 3.5. Care must be taken not to feed too much grain early in gestation, gradually increasing the amount allows for lamb development. A leveling out or fall in late pregnancy grain intake can result in pregnancy toxaemia and death of the lamb(s) in utero. Conversely, too little grain will give an undersized, weak lamb with a poor chance of survival. Also, the ewe will have insufficient udder development for a good lactation. Not less than four weeks before the due date of the first ewe, all the ewes should receive a booster vaccination against the clostridial group of diseases, (all first lamb ewes should have completed the primary vaccination course before breeding) and an injection of Vitamin E/selenium. If they are not to be sheared, they should at least be crutched to remove excess wool from the udder area.

Lambing Facilities

Each ewe should have a lambing pen in which the bonding between ewe and lamb can be monitored, the lamb is easily caught for any procedures (tail docking etc.), and is seen to be nursing. Depending on the system used, the ewe can be put into this pen when lambing is observed to be imminent, or after the lamb has been dropped. The pen should be about 1.5 m square with a corner divided off to give the lamb a safe area from the ewe. Once the lamb is vigorous and all treatments completed, it and the ewe can be let out into a larger pen with other ewe/lamb sets. After each ewe, the soiled bedding is removed and fresh bedding put down. On average, expect each ewe to spend three days in this pen. Please refer to the Sheep Code of Practice Section 2- Facilities for specific requirements for sheep pens. The Codes can be downloaded at: http://www.nfacc.ca/codes-of-practice/sheep

Lambing Preparations

To be prepared for lambing you will need two kits. One to assist the ewe at lambing (see *Assisting the Ewe at Lambing*, OMAF Factsheet No. 98-091) and the other to process each lamb as it is born.

Lamb Processing Kit

This kit (see Figure 1) should contain:

- suitable syringe and needles
- iodine solution for dipping navels
- Vitamin E/selenium injection
- ear tags and applicators and/or tattooing pliers
- tail docking rings or cutter

Figure 1. Lamb Processing Kit

Lambing

The average gestation period for a ewe is 147 days, but some will always be early. Have the kit of lambing aids ready in advance.
The lamb should start breathing at birth. It may need help; check that there is no placenta covering the nostrils or mouth. A gentle rub over the chest with a towel or straw wisk, tickling the inside of the nostrils with a piece of straw or blowing into the nostrils *(do not allow your lips to come in contact with the wet lamb while doing this)* will often stimulate breathing. There is also a commercial device[1] for this task.

TINT Your Lambs

In the first few days of a lamb's life there are several procedures that should be carried out. Once you are certain that the lamb has had adequate colostrum, TINT them.
T = Tails
I = Inject
N = Navels
T = Testicles

Tails

The tails need to be docked before the lamb is seven days old, and as soon as possible after 24 hours of age (*Code of Practice for Sheep*). The tail can be removed with:

- electric or gas heated docker
- rubber ring
- crush and cut device
- rubber ring plus crushing device.

The docked tail should cover the anus of the ram or the vulva of the ewe. A good guide is to remove it at the joint in the tail bones just beyond the web on the underside of the tail.

Injection

In Ontario, newborn lambs can be born selenium deficient. As a routine, they should be injected with the appropriate dose of a Vitamin E/selenium preparation. Read the label on the bottle for the route of injection, either subcutaneous or intramuscular. Always inject into the neck area, **never** into the muscles of the hind quarters. (Note: If the ewe has been given supplements during pregnancy this may not be necessary)

Navels

The navel of the newborn lamb needs to be disinfected as soon after birth as possible. The untreated navel is an excellent route for infectious agents to enter the lamb causing internal abscessation or joint ill. An iodine solution is the most common disinfectant used. It is either sprayed onto the navel or the navel is dipped in a small container of the solution. If dipping the navels, replace the disinfectant solution in the container after every tenth lamb.

Castration

If the market lambs are to be kept beyond four months of age, castration may be considered.
Again, whether rubber rings, crushing or cut and pull is used, this should be done as soon as possible after 24 hours of age *(Code of Practice for Sheep).*

Identification
Whether tattoos, ear tags, or ear notching is used, the lamb must be identified before it leaves the lambing pen.

Fostering
For any one of a variety of reasons, a lamb may need to be fostered onto another ewe. If possible fostering should be considered as an option before bottle feeding for the orphan.
Fostering should be as soon after birth as possible. If the lamb has not dried off, so much the better. If fostering from a set of triplets, choose the strongest lamb. Keep the ewe and the fostered lamb in a lambing pen until you are certain that the adoption has succeeded.
To persuade the ewe to accept the lamb, one of several techniques can be used. Rub the lamb in the placenta of the ewe's own lamb; if you are replacing a dead lamb, put its skin onto the adoptee; if the ewe still refuses, she can be put into a head gate to prevent her pushing the lamb away when it attempts to suckle. After a few days in the headgate, the ewe will usually accept the lamb.

[1] Constant Delivery Animal Resuscitator, McCulloch Medical.

This Factsheet was authored by: Dr. S. John Martin, BVM&S, MRCVS, Veterinary Scientist, Sheep, Goat and Swine

Hypothermia in Newborn Lambs

Dr. S. John Martin

Introduction

Many newborn lambs die, not from disease, but from hypothermia (chilling). This is especially true in Ontario, where many ewes produce in the coldest months of the year to have lambs ready for the Easter market. Even a newborn lamb at grass in May can be vulnerable (Figure 1). By careful shepherding of the ewe from conception to delivery, and the perinatal care of the new born lamb, many deaths can be avoided.

To maintain its body temperature, the newborn lamb must produce as much heat as it is losing to the environment. If the lamb cannot do this, its body temperature will start to fall, and, if not remedied, lead to death. The rate of heat loss is influenced by several external factors.

Figure 1: Bales used to form a windbreak for lambs

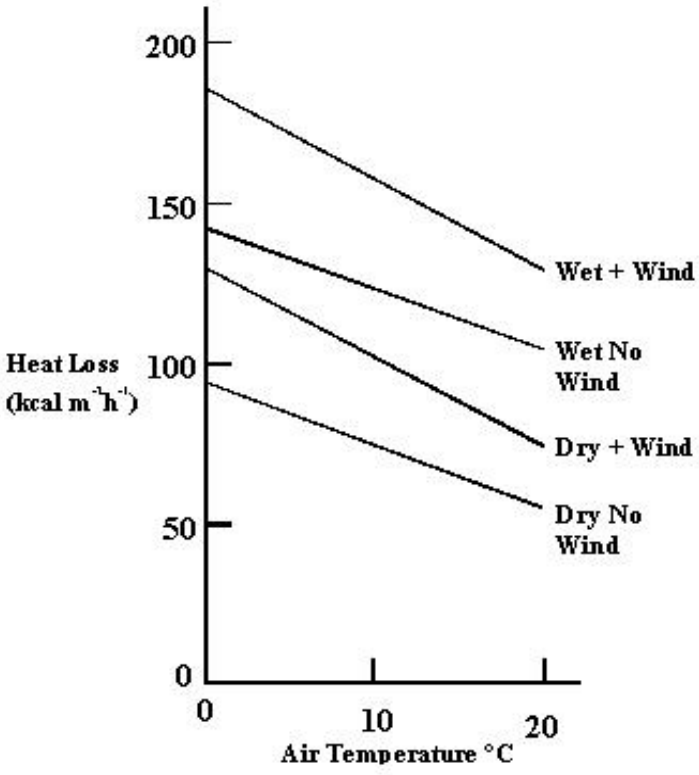


FIGURE 2. The effect of wind, environmental temperature and wetness on heat loss in newborn lambs. [From Alexander, G. (1962), *Australian Journal of Agricultural Research*, 13, 82-99.]

1. Body surface area:body weight ratio. A small lamb has a larger surface area in proportion to its weight (Figure 2). Therefore, it will chill faster than a larger lamb. This risk is greater for lambs born as triplets or quads.

2. Insulation from the coat. Some lambs are born with a thicker coat than others; compare a newborn North Country Cheviot lamb to a Charollais. Once the lamb is dry, the heavier coat will give more insulation, thus the lamb will lose less heat.

3. How quickly after birth the ewe licks the lamb dry. Lambs from maiden ewes, or the later lambs from a multiple birth are the most vulnerable in this regard.

4. Drafts. Lambs born in a drafty pen or outside with no shelter from the wind will have an accelerated heat loss.

5. Environmental temperature. A lamb loses body heat faster, the lower the surrounding temperature.

The heat production mechanism uses the fat reserves, mainly brown fat, laid down during pregnancy and oxygen to produce energy and heat. The starter for these processes is a component of the colostrum. The lamb must nurse the ewe within a few minutes of birth.
The producer can influence many of these factors by:

- selecting a breed or cross which is suited to the operation, e.g., inside lambing against May lambing at grass
- winter lambing in a draft free but well-ventilated building
- being there during lambing to watch the ewes and ensure that all lambs are dried and start to nurse as soon after birth as possible.

This may mean using some form of oestrus synchronization at the breeding season to concentrate lambings into a short time period and to reduce the labour requirements.
Lamb birth weight is influenced by placental size early in pregnancy. By ensuring correct nutrition in the early stages of pregnancy, good placental development can be assured.

Heat Production

To maintain body heat after birth, the lamb must use its own energy reserves to generate heat. This energy reserve is mainly brown fat stores laid down in pregnancy. With oxygen these are converted to energy plus heat. The trigger to start this process is a component of the ewe's colostrum. The fat reserves are limited, and must be complimented by a steady supply of milk from the ewe; the lamb must be suckling regularly in the critical first days after birth to maintain its energy reserves.
Adequate fat reserves at birth for the lamb are derived from the ewe via the placenta during the last half of pregnancy. Ewe nutrition in this period is critical. Not only are the reserves being laid down, but the lamb is rapidly developing. Poor nutrition will result in a small, weak lamb at birth with little internal body fat. This lamb is already at risk, but being weak it will not nurse quickly and may be slow to start breathing. Being oxygen deficient and lacking the "kick start" from colostrum, heat and energy production will be low; the lamb will rapidly become hypothermic. This occurs within the first five hours after birth.
Twelve hours or more into life, a lamb is again vulnerable. Soon after birth the heat mechanism was working but now the energy reserves are used up. The lamb is not able to replace these reserves from the ewe; heat production slows and again the lamb becomes hypothermic. This time the cause is starvation; inadequate milk from a ewe that is feeding another lamb, has chronic mastitis with little milk, or was inadequately fed during late pregnancy.

Recognizing Hypothermia

The only accurate way to recognize hypothermia is by taking the lambs rectal temperature (Table 1). Use a thermometer that measures subnormal body temperatures (many clinical thermometers do not go low enough). Many of the electronic thermometers do and are more robust for the barn than the traditional mercury/glass versions. The lower the rectal temperature, the more severe the hypothermia.
The rectal temperature of a dull weak lamb, that seems unable or unwilling to suckle, should be checked immediately. The sooner remedial action can be taken, the better are the lamb's chances of survival. The normal rectal temperature for a new born lamb is between 39°C and 40°C.

Treatment

The basis of treatment of the hypothermic lamb is to warm it up and provide a source of energy to start heat production again. Treatment varies with the degree of hypothermia as indicated by the rectal temperature (Figure 9).

Mild Hypothermia
The lamb's rectal temperature is between 37°C and 39°C. The lamb is weak but may be able to stand. It should be moved into shelter, dried off if wet, and fed colostrum by stomach tube.

TABLE 1. The appearance and behaviour of hypothermic newborn lambs.
[After F.A. Eales, 1983, "Hypothermia in Newborn Lambs", in *Diseases of Sheep*, edited by W.B. Martin]

Age (hours)	**Cause**	**Appearance and Behaviour**				
		35°C	**30°C**	**25°C**	**20°C**	**<20°C**
0 - 5	Long delivery Immature lamb	Weak but can stand	Recumbent	Coma	Deep coma	Death
12+	Low heat production	Recumbent	Coma and death			

Using a stomach tube is comparatively simple. The operator sits with the lamb restrained on the lap. The tube is passed into the side of the mouth in the space between the front and side teeth (Figure 3). Using gentle pressure, the tube is slid into the oesophagus and down to the stomach (Figure 4). The tube will move easily, any resistance or coughing indicates that the tube has entered the windpipe. It should be removed immediately. The accidental passing of colostrum into the lungs will result in the death of the lamb with an aspiration pneumonia.

FIGURE 3. Using the stomach tube.

FIGURE 4. Lamb with stomach tube into stomach.

FIGURE 5. Stomach tube in place before attaching syringe with colostrum.

Small lambs, under 1.5 kg (3 lbs) at birth, may not have sufficient fat reserves to initiate heat production, even with colostrum. These can be fed an equivalent amount of 20% dextrose solution by stomach tube as an energy source (Figure 5).
The lamb can stay with the ewe provided she is in a sheltered area. The lamb should be watched to ensure that it is suckling. Once the rectal temperature has returned to normal, it and the ewe can be returned to the flock.

How to make up 20% dextrose solution
Calculate total amount needed and multiply this by 0.4 to determine how much 50% solution to use. Example: 5 kg x 10 mL/kg = 50 mL of 20% solution needed. 50 mL x 0.4 = 20 mL of 50% solution. Draw this amount into syringe. Then draw up the difference as boiling water. This solution will be close to body temperature.

Severe Hypothermia
Once the rectal temperature falls below 37°C more radical treatment is required. There are two parts to this treatment:
1. reverse the hypoglycaemia
2. warm the lamb.

The lamb should not be given colostrum until it has been revived; the rectal temperature must be above 37°C.

1. Reversing The Hypoglycaemia
The blood glucose of this lamb will be low. A 20% dextrose solution at a dose rate of 10 mL/kg body weight is injected into the abdominal cavity (intra peritoneally). The site for the injection is about 2 cm (1 in.) below the navel and 2 cm (1 in.) lateral to the midline (Figure 6). Use a large (60 cc) syringe and a 20 or smaller gauge 1 inch needle, inserted at 90° to the body wall. This is the injection site. Ask your veterinarian to show you how to do it. The internal organs will be pushed away by the needle and not damaged. Both the conscious and comatose lamb can be injected in this manner. Only the lamb able to swallow should be fed by stomach tube.

FIGURE 6. The site of intra peritoneal injection of glucose solution as indicated by the syringe

2. Warming

The lamb also needs to be slowly warmed to restore body temperature. The best method is to use a "warming box" where the lamb is placed in a container heated by warm (37°C-40°C) moving air (Figure 7). Always use a warm air heater rather than the more severe heat lamp at this stage. The rectal temperature should be checked every 30 minutes to avoid overheating above the normal rectal temperature (hyperthermia). Once the lamb's rectal temperature has reached 37°C, it should be removed from the warmer, given a feed of colostrum by stomach tube, then returned to the ewe, or, if it is still weak, placed in an "aftercare" unit (Figure 8). Do not return the lamb to the ewe unless it is strong enough to nurse unaided. The aftercare unit has individual compartments for each lamb, with a heat lamp overhead.

Figure 7 – Warming box

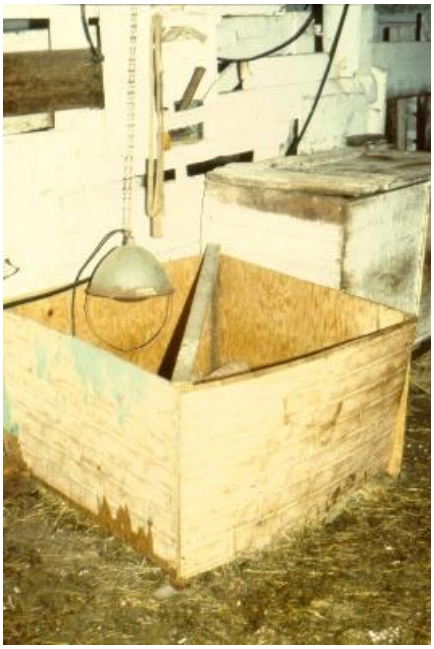


Figure 8 – Aftercare unit

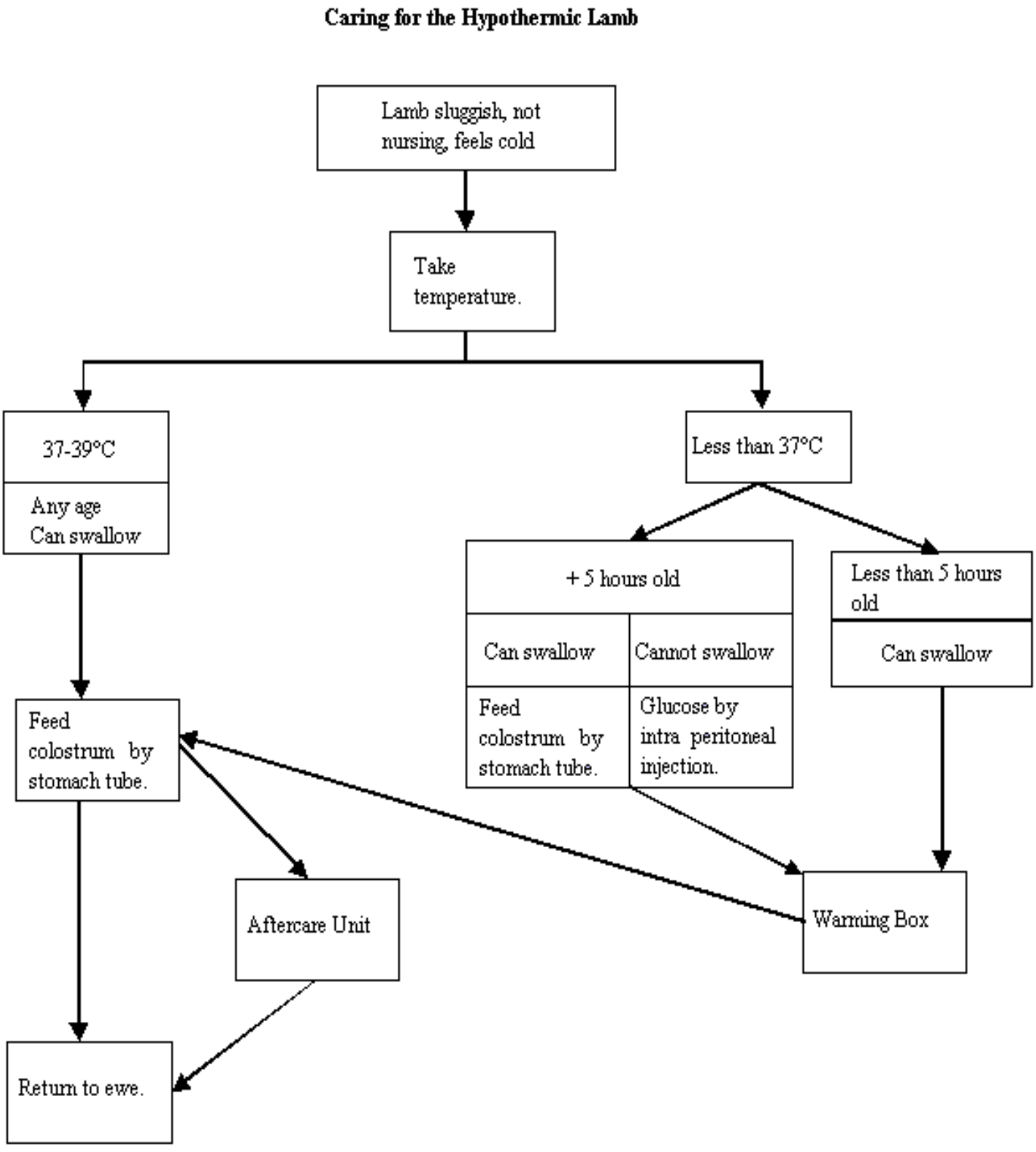
Colostrum

Once the lamb's rectal temperature has reached 37°C, its heat production system should be restarted with colostrum. Give colostrum by stomach tube at 50 mL/kg body weight. Usually there is little problem with the ewe refusing the lamb after treatment.

Ewe's colostrum is obviously the best, but cow colostrum can be used. Collect and freeze the colostrum in 500 mL batches. Thaw it in a water bath at 35°C, never in a microwave as this will denature the complex proteins in the colostrum.

As in all conditions, prevention is the best cure for hypothermia. Good nutrition during gestation, good lambing quarters, observation of the ewe and lamb at lambing and assisting where necessary, will go a long way to preventing lamb losses from hypothermia.

Figure 9:


Caring for the Hypothermic Lamb
Lamb sluggish, not nursing, feels cold
Take temperature.
37-39°C
Any age
Can swallow
Less than 37°C
+ 5 hours old
Can swallow
Cannot swallow
Feed colostrum by stomach tube.
Glucose by intra peritoneal injection.
Less than 5 hours old
Can swallow
Feed colostrum by stomach tube.
Aftercare Unit
Warming Box
Return to ewe.

Castration and Tail Docking of Lambs

Adapted from 'Tail Docking and Castration of Lambs'
By. Manus Graham (Moredun Foundation, Scotland)
(**Also Refer to the Codes of Practice http://www.nfacc.ca/codes-of-practice/sheep**).

Castration

To castrate or not to castrate – that is a question that must be answered by the individual producer. There are many conflicting opinions on this topic. The purpose of this section is to provide producers with all the options. If you do decide that it is necessary to castrate, it is critical that you are certain of your ability to successfully perform this procedure by using proper technique and equipment. Also, anyone performing this technique should take all precautions to avoid unnecessary pain or distress to the animal during the surgery and recovery period. Castration should be done as early as management procedures will allow (after the lamb has received colostrum and before 7 days of age). Castration of rams after the age of 10 weeks must be done by a veterinarian using appropriate analgesics and anesthetics.

Reasons to Castrate

The primary reason to castrate is to prevent indiscriminate breeding and subsequent pregnancies in young sheep. Some producers feel that any attempt to run large numbers of intact males on a property, along with females of the same species is difficult. In the sheep industry, it is quite common to run both females and males together, and therefore, a percentage of the industry feel that it is necessary to castrate. In addition, there is thought to be a higher incidence of male fighting, which can cause injury and loss of productivity. It has also been suggested that if done at a young age, it may enhance pelt removal and meat quality.

Reasons not to Castrate

It is felt by some that castration is unnecessary if lambs are to be marketed for slaughter prior to puberty, which generally occurs between 3 and 5 months of age. Increased male fighting, change in flavour of the meat, and indiscriminate breeding are not seen in animals that are less than 4 months. In addition, studies have shown entire (un-castrated) male lambs show better growth rate, efficiency of feed utilization and carcass yield than castrated lambs. Some markets, particularly ethnic markets, prefer intact ram lambs.

Castration Methods

If the decision is to castrate, there are a number of methods that can be used. The following is a list of methods with their advantages and disadvantages.

1. Rubber Ring - This method is only to be used between 24 hours and 10 days of age. Basically the rubber ring is designed to constrict blood flow to and from the testes and scrotum, thus causing them to slough off after approximately 3 to 6 weeks, leaving a sealed scar behind. It is important to ensure that both testes are present and there is no scrotal hernia (intestines extending into the scrotum due to a hole in the gut wall). The ring should be placed below the rudimentary teats while ensuring that both testes are trapped in the scrotum. Only when everything is correct should the ring be gently released off the elastrator. Avoid placing the ring directly on the teats or the testes as this may increase discomfort. If the ring is placed too high (i.e. between the teats and the body wall, the urethra may become trapped, thus preventing the bladder from emptying. This will not only cause great discomfort but will prevent urine from being passed, which will lead to the death of the lamb.

   Advantages: Inexpensive, quick, no blood loss, effective with care, must be performed by or under direct supervision of competent personnel using proper, clean, sanitized and well-maintained tools, and accepted techniques. Less irritation by flies than with an open wound.

Disadvantages: painful, infection may occur around ring, risk of trapping urethra, in very small lambs the testes are so small that they can actually pass back from the scrotum through the central hole in the ring after the ring has been correctly applied. May be an increased risk of tetanus.

2. Surgical (Open) castration

This is the complete removal of testes via surgery. This procedure requires good hygiene if infection and delayed healing are to be avoided. With this procedure an open wound is left. As assistant is required to catch and restrain the lamb thus leaving the operator's hands free and clean. Only a very sharp knife or scalpel designated for the purpose should be used for castration.

Check to be sure there is no scrotal hernia and that both testes are present. The scrotum should be cleaned and swabbed with dilute Pevidine or Hibitane. The bottom of the scrotum is drawn downwards (leaving the testes behind) and cut off with one smooth stroke of the scalpel. The open scrotum is then pushed up towards the abdomen causing the testes to appear. The testes are grasped one at a time and drawn steadily downwards until the cord breaks. The remaining part of the cord recoils into the inguinal canal and the blood vessels in it contract and thus are much less likely to bleed than were they to be cut. However, some testicular arteries fail to seal despite this traction and severe haemorrhage can result causing a serious setback or death.

By leaving an open wound there is less chance of abscessing to occur because the wound is draining, however there still is a chance of infection. Furthermore, should any loops of bowel travel down either of the inguinal canals there is nothing to prevent them prolapsing and becoming damaged with usually fatal consequences.

Advantages: Can be used in lambs up to 3 months of age; inexpensive; effective; quick; must be performed by or under direct supervision of competent personnel using proper, clean, sanitized and well-maintained tools, and accepted techniques.

Disadvantages: Risk of severe haemorrhage; risk of potentially serious infection; risk of prolapse of intestinal loops; two people required to maintain good surgical asepsis; not suitable during fly season; painful.

3. Bloodless castrators (emasculators or clamps)

The purpose of these instruments is to damage irreversibly the blood vessels to each testis by crushing the spermatic cords without cutting the skin of the scrotum. Thus deprived of their blood supply, the testes shrivel within the scrotum, and the scrotum itself is retained. This is the crux of the method and its main advantage – there is no open wound by which infection could gain access.

It is essential that the scrotum is not crushed across its full width. Were this to happen then it too would be likely to atrophy (due to all the small blood vessels in the skin of the scrotum being crushed) and fall off leaving a gaping wound, which would be unlikely to heal over. Such a wound would cause considerable suffering and could allow infection to gain access into the abdominal cavity via the inguinal canals resulting in peritonitis and death.

For many years the Burdizzo emasculator has been available. It is important to use the small version for lambs as the larger cattle model would crush too much of the scrotum. Lugs or "cordstoppers" on the ends of the lower jaw help prevent failures (see below). It can be difficult to manoeuvre the cord, apply the instrument and restrain the lamb at the same time (often the lamb will struggle vigorously when the crush is applied, if not before) so a handler and an operator are required to do the job safely and effectively. More recently a new lamb emasculator, the Little Nipper, has become available which is designed to be easier to use with one hand. Both of these instruments are precision made and must not be used for other purposes. They should be stored carefully, oiled and with the jaws open.

Each testis gives off a spermatic cord (containing an artery, a vein, a nerve and a *vas deferens* which is the tube that carries sperm from the testis to the penis), which can be felt running in the neck of the scrotum from the top of the testis towards the inguinal canal in the abdominal wall. Doing one side at a time, the spermatic cord is manoeuvred to the outer edge of the neck of the scrotum (in order to minimise the amount of scrotal skin that will be bruised by the jaws of the instrument) before being crushed. It is vital that the skin in the middle of the scrotum is not damaged but essential that the cord is crushed. When the second cord is being crushed the instrument should be applied slightly lower so that the left and right crushes are not directly opposite one another but staggered in order that a greater width of skin in the middle of the scrotum is undamaged. This undamaged area of skin will contain sufficient small blood vessels to keep the scrotum viable (alive).

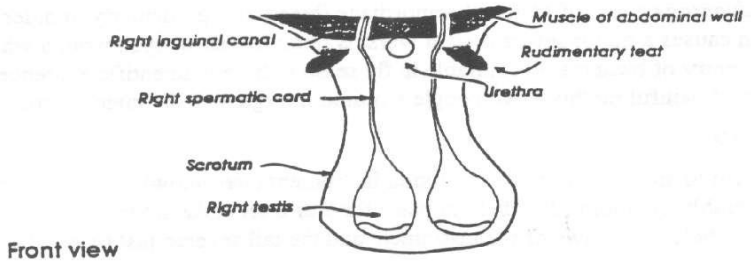
Care must be taken to ensure that the cord does not slip from between the jaws as they are closed. The lugs help to prevent this but were it to happen then the blood supply to that testis would be undamaged and the testis would develop in the normal way. This is arguably the major drawback with this method as such failures will not be apparent for some weeks. Skill and care are therefore required.

Traditionally two crushes are applied to each cord for good measure, the second one below the first as this area should by then be numb. However, a single crush on each cord maintained for 6 to 10 seconds may be as effective with some instruments. The instrument should be applied below the teats (to avoid the urethra as in the rubber ring method) but away from the testis to avoid unnecessary pain. Ensure there is no scrotal hernia present before applying the instrument. Crushing a loop of bowel would usually result in leakage of gut contents and death.

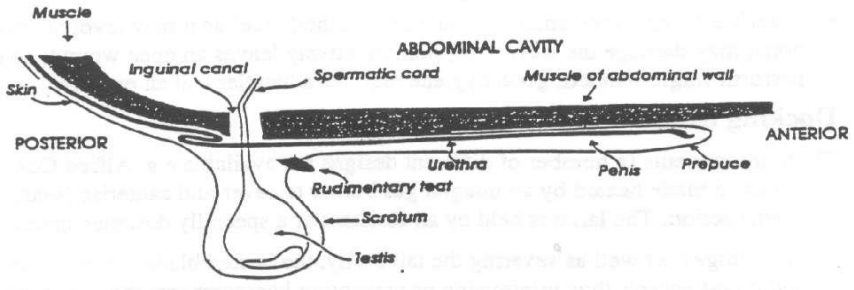
When the cord is crushed, the main nerve to the testis is also destroyed and so the testis quickly becomes insensitive. So although the crush itself is painful there is not the build-up of the type of pain one gets with the rubber ring. However, there is usually some subsequent swelling and stiffness of gait.

Castration of lambs

Diagrammatic representation of the anatomical structures in the region of the scrotum of the lamb



Front view



Side view

The method relies on the instrument being in good working order and the operator being possessed of a considerable level of skill in its use. The high number of failures (i.e. lambs not effectively castrated) sometimes encountered with this method is its main criticism. **Hence, application (missing the cord) and hasty removal (failure to apply the crush for 6 to 10 seconds) are the major contributing factors.** Another factor is the instrument itself. If the hinges or the jaws of the instrument are worn then it may not exert enough pressure to crush the cord effectively. Furthermore, if the jaws of the instrument have become roughened by rust or abuse (being used as a pliers, etc) then they will cut the skin of the scrotum in places and serious infection may follow.

Variability in the pressure exerted by different instruments has been studied and prototypes of powered instruments which always exert the same pressure have been developed.

Advantages: no open wound or focus for infection or flies; no blood loss; can be used on lambs up to 3 months of age; inexpensive once instrument is purchased; scientific evidence suggests it is not as painful as other methods at least in the first few hours after castration.

Disadvantages: Comparatively high level of skill and care required; failure rate can be considerable; failures not easily detected at the time of the procedure; an assistant is required to hold the lamb; risk of damaging urethra; comparatively slow; effectiveness of instruments varies with manufacture; wear and abuse; cost of instrument.

Tail Docking

It is quite common to tail dock lambs with the purpose of reducing future accumulations of faeces around the tail and breech area, which favour the occurrence of Blow Fly Myiasis ("Strike"). The blowfly (*Lucilia sericata)* is attracted to the damp warm conditions of a soiled breech and tail to lay its eggs. The larvae which hatch out burrow into the flesh to feed, leading to tissue damage, distress, loss of condition and even death depending on the severity of the infestation.

Docking tails helps to address food safety concerns, as there is generally a decrease in tag (manure build up) on a docked animal, helping to avoid contact of the meat with bacteria during butchering.

Other reasons given for docking include ease of management at mating and lambing and altering the appearance of certain breeds for traditional reasons. Whereas the former may be the case, the latter is not a sound reason for docking. There is a belief that long tails may reduce breeding efficiency in ewes but the evidence does not support this.

However, available evidence does indicate that docking is beneficial to lambs on farms where blowfly strike is a problem, one study revealing an incidence of strike five times greater in undocked lambs compared with docked lambs. In this regard length of tail remaining after docking is important. Very short tails increase susceptibility to strike whereas long docked tails give the lowest incidence of strike.

The tail affords a degree of protection against the elements to the sensitive anus and vulva and perhaps the udder also. Therefore, it is in each farmer's interest to consider carefully the necessity for docking lambs rather than doing so out of routine. Clearly if scouring is controlled by an adequate pasture management and working program the need to dock should be reduced.
(Note: Some breeds, such as the Icelandic sheep, are naturally tailless.)

Tail Docking Methods

The following is a list of methods available for tail docking.

1. *Rubber Ring*
   This is the most widely used method. Using an elastrator, a constricting latex ring is applied to the tail below the level of the anus in males and the vulva in females. This cuts off the blood supply to the tail beyond the ring resulting in death of those tissues and the sloughing (shedding) of that part of the tail. The actual separation usually occurs at the joint immediately above the ring. This takes about 3 to 4 weeks. Some operators attempt to place the ring on a joint in the belief that this is less painful or more effective. At present, there is no hard evidence to support this although a minority of lambs do seem to react less than others for some reason. Rubber rings must not be applied beyond six weeks of age.

Lamb being tail docked using a rubber ring

   Advantages: effective; inexpensive; quick; can be performed by single operator; relatively unskilled; relatively safe for operator and lamb.

   Disadvantages: infection can occur over the prolonged sloughing period as the ring cuts into the tissues. This can allow bacteria to gain access via the tail resulting in abscesses or, more seriously, Clostridial diseases such as tetanus. Pus formation around the ring is common and may attract flies. Rubber rings may not be used by Law if the lamb is more than 7 days old, timing incompatible with common hill farming practice. Despite its clean appearance, there is a good deal of scientific evidence that this method involves considerable pain in the majority of lambs.

2. *Knife*
   A small majority of farmers use this method. Severing at a joint is easier and therefore swifter. A scalpel or very sharp knife which is not used for any other purpose (other than castration) must be employed. It should be placed in an antiseptic liquid such as povidone-iodine ("Pevidine") or chlorhexidine gluconate ("Hibitane") after use on each lamb. Good hygiene is essential. Soiled tails should be cleaned and swabbed with a dilute Pevidine or Hibitane solution before docking and the operator's hands should be washed and dried frequently. An assistant should catch and restrain the lambs thereby allowing the operator to keep his/her hands free from contaminants. Applying a wound powder or spray (eg. Terramycin aerosol) to the stump may help prevent infection.
   Advantages: effective; inexpensive.
   Disadvantages: risk of serious haemorrhage (bleeding), particularly in older lambs, which causes a major set-back or at worst is fatal; leaves an open wound which can allow entry of bacteria, not suitable in fly season; there is scientific evidence that it is the most painful method; two people required if hygiene to be maintained.

3. *Burdizzo*
   A Burdizzo or similar bloodless castration instrument is used to crush the tail, preferably on a joint. It is held in place for 5 or 6 seconds and then usually a knife is introduced below the jaws of the instrument and the tail severed just below the crush.
   Advantages: Less likely to bleed severely compared with the knife method; can be used in older lambs.
   Disadvantages: slow; some consider this method cruel as it may involve crushing bone; may damage the Burdizzo jaws; effectively leaves an open wound; awkward to perform single-handed; good hygiene requires a handler and an operator.

4. *Docking Iron*
   These instruments (a number of different designs are available e.g. Alfred Cox, Ritchey Tagg) use a blade heated by an integral gas burner to sever and cauterize (sear) the tail in one swift action. The lamb is held by an assistant or a specially designed cradle.
   Advantages: As well as severing the tail easily, the heated blade cauterizes the tissues and blood vessels thus minimising or preventing haemorrhage; the heat sterilises the blade; scientific evidence suggests this is the least painful method, as the nerve endings are destroyed by the intense heat; one design can be operated single-handedly and the flame and blade have a guard over them; can be used in older lambs.
   Disadvantages: some designs involve the use of two operators with a risk of burns being suffered; fire risk; some scientific evidence suggests that cauterized tails take slightly longer to heal; a different method must be used for castration.

Long term side-effects of tail docking

Various studies have been conducted to see if the different methods of tail docking adversely affect subsequent growth and productivity. No such effects were found overall. Nevertheless, individual lambs which suffer severe haemorrhage or infection are detrimentally affected. There is evidence that if tails are docked too short there may be damage to the rectal and/or vaginal nerves, which leads to a higher incidence of rectal and vaginal prolapse.

Summary

- Only castrate or tail dock if necessary rather than as a matter of routine.
- Avoid castrating or docking lambs less than 24 hours old and older than a week of age.
- Only castrate or dock healthy lambs.
- Ensure lambs to be castrated or docked are protected against the Clostridial diseases.
- Avoid castrating or docking in bad weather or in soiled, muddy surroundings or during the fly season.
- Before castrating check that there is no scrotal hernia and that both testes are present in the scrotum.
- Check afterwards, especially last thing at night, for signs of ill effects such as haemorrhage or excessive discomfort.
- Ensure all operators are trained and competent.

Weaning lambs

Properly weaning ewes from their lambs can have a significant impact on current and future lamb crops. In operations where lambs are weaned young and reared on concentrates, weaning usually takes place at six to ten weeks of age. Providing a pelleted creep feed to lambs from early in life may help reduce the stress of the transition and decrease the drop in condition. In a pasture system, lambs are weaned at the end of the summer when the availability of pasture limits the growth of the lambs, and when ewes need to be dried off for rebreeding.

In order to reduce the discomfort thought to be felt by the ewe at weaning, protein and energy levels in lactation diets should be reduced at least seven days before weaning. This also encourages consumption of dry feed by the lamb. Low quality feedstuffs, such as cornstalks and straw, make excellent lactation rations for the week prior to weaning. The change in diet will initiate the drying-up process prior to weaning. Ewes should be maintained on low quality diets for at least 7 days post weaning.

The weaning strategy should be such that it minimizes the stress to both the ewe and the lamb. The ewes should be quietly removed to quarters where they are out of sight and hearing of the lambs. Lambs should be kept in familiar surroundings. The weaning strategy should also minimize the incidence of mastitis infections and ensure adequate milk production for the following lactation (decrease energy in ewe diet one week before and for two weeks after weaning). Ewes that are severely infected with mastitis or have chronic mastitis problems should be culled from the ewe flock.

Once weaning is complete, the lambs should be observed carefully for early signs of illness, and to ensure they are getting enough feed and water. Prior to weaning, the lambs should be consuming sufficient amounts of feed and water to meet their requirements, and should be familiar with feeders and waterers. Early weaned lambs (less than 8 weeks of age) should have access to high quality lamb creep feed.