SHEEP

Sheep are very easy to keep and work with, as well as their quiet nature which allows for long term studies such as joint and cardiac valve replacements, and the effects of alcohol on fetal growth and retardation. Biomedical research such as fetal development is an important of study as well.

Housing and Animal Management
Sheep should be monitored at least once daily to ensure that they are in good condition and have access to appropriate bedding, water and feed. Wool biting may be a sign of insufficient space allotment, uncomfortable environment or nutrient imbalance. When wool biting is observed, the sheep should be put out on pasture or given increased space.

Sheep in full fleece require more space in confinement than shorn animals. Sheep require a dry comfortable area for lying and space to escape from dominant animals, as sheep will fight less dominant herd mates. Solid partitions can be used to provide areas for escape. Shorn ewes should have access to flooring with low thermal conductivity (straw-bedded or wooden flooring). Continuous housing on concrete floors should be avoided as it leads to joint problems.

The use of slatted floors may increase air ammonia concentrations and lead to increased respiratory problems in sheep. When slatted floors are used, air quality should be continuously monitored.

Adequate ventilation must be provided for housed sheep, as they are susceptible to respiratory infections if air quality is poor. Maintaining full-fleeced sheep in confinement during cold temperatures will result in higher humidity and increased ventilation requirements, compared to sheared animals. Sheep facilities should be checked daily to ensure the ventilation, drinkers and feeders are operating adequately.

Acquisition, Transportation and Quarantine
Sheep should be placed into quarantine after arrival at the research facility, in accord with established flock/herd health SOPs. The animals should be isolated from the population but not from each other. Transportation of sheep should be done in accordance with the Recommended Codes of Practice for the Care and Handling of Farm Animals – Transportation (CARC, 2001; http://www.nfacc.ca/code.aspx). Loading and handling facilities should be designed specifically for sheep, as injuries are likely to occur if facilities designed for cattle are used.

Husbandry
Sheep must not be housed in isolation, sheep should be housed with other members of their species (first choice) or in sight of other sheep (second choice). Isolation leads to extreme stress for sheep. Sheep are by nature social animals, and should be housed in visual, auditory and, preferably, physical contact with compatible conspecifics. Isolation will compound other stressors and may compromise surgical recovery.

If experimental design requires that sheep are to be housed in isolation, an environmental improvement plan should be developed. This could include installation of a mirror, which can be placed outside the pen or crate to protect it from breakage. Animals of varying sizes should not be penned together (other than ewes nursing lambs), as larger animals will get a disproportionate share of the feed. Polled and horned animals should not be penned together.

Housing sheep and goats together is not recommended because of the high probability that the goats may injure the sheep. Intact male sheep and female goats should never be housed together as cross-species fertilization can occur, which will result in abortion at approximately 60 days gestation.
Sheep in full fleece have an excellent tolerance of low temperatures as long as they receive sufficient dietary energy. However, newborns, and shorn animals (<1 cm of wool) can be adversely affected by cold.

**Feed and Water**
Diets or pastures must be sufficient for sheep to meet their physiological requirements. When animals are confined in groups, sufficient bunk space must be provided for all animals to access feed simultaneously. Otherwise, dominant animals may block access to feed.

**Pregnant Ewes**
In the last trimester of pregnancy, rumen capacity may be compromised due to requirements for uterine space, especially in the case of multiple fetuses. At this time, feed must be sufficiently nutrient dense to avoid pregnancy toxaemia (twin lamb disease). Silages and low-quality forages should be avoided.

Injecting ewes with selenium; vitamins A, D and E; and an anti-clostridial booster one month prior to parturition will prevent white muscle disease in neonates and may improve sucking reflex in lambs. It will also provide neo-natal lambs with short-term immunity against clostridial diseases.

Where ultrasound is already being used for pregnancy diagnosis, it may also be used to separate single, twin and triplet-bearing animals, and to better inform feed management.

**Managing Housing for Lambing**
For animals that do not lamb at pasture, a separate lambing area should be provided which includes clean bedding.

Individual pens (1.2 m²) should be available for ewes and lambs after lambing. Residence time in the pen is generally 12-48 hours, but will increase for first-lambing ewes and ewes with multiple births. Pens should be available to group house “orphaned” lambs (un-weaned lambs that are from higher multiple births or where ewes lack sufficient milk or maternal ability). The maximum group size for these animals is 12. The size of the pen should be sufficient to allow each lamb uninhibited access to creep feed and milk, with separate lying areas for all animals; the pen should provide 0.6-0.8 m² of space per lamb.

When lambing in cold weather, newborns should be provided with shelter and bedding, protected from drafts and kept dry. Supplemental heat (heat lamp) may be required if lambing occurs at temperatures less than -10°C, but should only be supplied until the neonates are dry and nursing. If supplemental heat is continually provided, the lambs will tend to pile under the lamp, possibly increasing the risk of pneumonia.

Nursing lambs should be provided with an area that is clean and well-bedded (such as a creep area) and out of all drafts. On pasture, this can be achieved by using straw bales as a wind break.

**Managing Housing for Ewes and Lambs**
In confinement situations, removal of ewes and lambs after lambing to individual pens will prevent mis-mothering. Residence time in the pen is generally 12 to 48 hours, but will increase for first lambing ewes and ewes with multiple births.

In cases of higher multiple births or where ewes lack sufficient milk or maternal ability, un-weaned lambs may be “orphaned” and housed in groups of up to 12 animals. Weaned lambs may be kept in groups. Weaned lambs may be kept in groups, with 0.8-0.9 m² per animal.

Bunk space requirements are 23-30 cm/animal for polled animals, and larger for horned animals. Mature ewes in confinement with lambs require 1.4-2.3 m², depending on the number of lambs raised by the ewe. Bunk space required for mature polled ewes with lambs is 41-51 cm/animal.

Limit-fed sheep should have adequate bunk space for all animals to feed at the same time.
**Orphaned Lambs**
Lambs that are orphaned within 48 hours after birth should receive a minimum of 225 mL/kg live weight of colostrum from a supply of frozen ewe colostrum maintained at the research unit. Nipple buckets or individual bottles may be used for feeding, with all feeding equipment sanitized daily. Frozen cow colostrum may be used in emergency situations.

Milk replacer specifically formulated for sheep should be used subsequently as cow’s milk is not sufficiently nutrient dense.

**Bedding**
Provision of clean bedding is essential to reduce transmission of disease, and must be provided. Long straw, wood chips and wood shavings may be used as bedding. Short, chaffy straw is not recommended as bedding for sheep, as it may become embedded in the fleece and make shearing more difficult. Providing straw bedding after shearing may improve animal welfare as sheep are more susceptible to cold stress for the first week after shearing.

Pens should be cleaned of bedding at least every 3 weeks to prevent excessive ammonia build up in enclosed buildings. Rubber mats are useful in situations where organic bedding is not practical, for example in pens housing sheep post-surgery.

**Environmental Improvement**
Sheep housed in metabolism crates should have direct visual contact with other sheep. Where this is difficult or limited, mirrors should be provided to reduce isolation stress.

Sheep are prone to respiratory diseases when confined indoors. Access to fresh air or outdoor exercise pens will reduce incidences of diseases such as pneumonias.

Sheep should have means of escaping more dominant herd mates, and this can be accomplished through the inclusion of solid partitions in pens.

**Handling**
Personnel that handle sheep should be instructed in low-stress, effective handling methods. Proper facilities for handling, which allow the flow of animals while never removing sheep from the line of sight of other sheep, are an important feature of low-stress handling as separating individual sheep from the flock is stressful.

Sheep should never be held by the wool as excessive bruising will result. Horned sheep should not be held solely by the horns. Raceways of appropriate width (36-38 cm for mature ewes, 25-28 cm for lambs) and height (0.9 m) should be constructed which allow the sheep to follow each other single file to the weigh scale or restraining cradle. Restraining cradles are commonly used for trimming hooves, and should be of appropriate size relative to the sheep, and designed to ensure animal safety. Lighting of raceways is critical, as sheep will balk at entering dark spaces.

A shepherd’s crook should not be used to catch sheep by the legs, especially the front legs. Although it’s use is discussed in the textbook, using a hook is not within the CCAC guidelines.

**Shearing and Crutching**
Sheep (with the exception of hair breeds) should be sheared on an annual basis. For pregnant ewes, shearing is best done 6-8 weeks prior to lambing. When shearing is not possible due to inclement weather or insufficient shelter, pregnant ewes should be crutched (wool removed from vulva and udder areas) to prevent lamb starvation and disease. Neonatal lambs have been observed attempting to suckle on wool tags (balls of fecal material on long fleeces) when the ewe’s udder is obscured.
Shearing of pregnant ewes is preferable as shorn ewes require less space in the lambing barn and are less prone to smothering their neonatal lambs. Shearing also increases feed intake of ewes and improves overall lamb health. Shearing of heavily pregnant ewes (less than 6 weeks prior to lambing) may induce lambing on the shearing floor, and is not recommended.

After shearing, sheep become more susceptible to both cold and heat stress. If shorn in the winter, sheep require protection from the wind and snow, and additional feed energy and/or bedding for at least the first week post-shearing (depending on the severity of cold exposure). If shearing is required during inclement weather and available housing does not offer sufficient protection from the environment, shearing blades that leave 1-2 cm wool cover should be used. If shorn in the summer, sheep may require access to shade to prevent sunburn.

Due to the handling required, shearing is a well-recognized stressor of sheep. However, failure to provide shearing is a welfare concern due to build-up of fecal material and ectoparasites. As well, a heavy fleece may impede animal mobility. Research institutions should have established SOPs for control of sheep parasites, which are suitable for the level of confinement imposed and the physiological state of the animals.

To help prevent transmission of parasites/disease to young animals, young animals should be shorn first and oldest animals last. Shearing equipment should be disinfected regularly. If an animal shows signs of a transmissible disease, such as caseous lymphadenitis, shearing equipment should be thoroughly disinfected prior to use on the next animal.

**Routine Invasive Agricultural Practices**

**Tail docking**

Tail docking should only be performed when absolutely necessary. Circumstances where tail docking is not necessary include:

- sheep that will not be kept on pasture
- ewe lambs that will not be saved as breeding stock
- research projects that either do not have to reflect industry standards or end before fly strike is an issue.
- Hair sheep with short, wool-less tails

Tail docking may be necessary to prevent fly strike for breeds of sheep with long woolly tails. Breeding success will also be reduced in ewes with long woolly tails due to accumulation of tags (lumps of manure).

When tail docking is necessary, it should be performed on animals between 2 and 14 days of age. The tail should be docked distal to the end of the tail fold. In adult ewes, the tail must cover the vulva. Complete removal of the tail (short docking) may lead to rectal prolapse and should not be performed.

For all methods of tail docking, injection of a local anesthetic into the tail can effectively reduce the associated pain. Use of a docking iron is the preferred method for tail docking; rubber rings should not be used unless appropriate analgesia is administered. Injection of local anaesthetics subcutaneously into the tail 1-2 minutes before applying the ring or 5-10 seconds after applying the ring, or administration of an analgesic (e.g., non-steroidal anti-inflammatory drug) 20 minutes prior to application of the ring, have produced low-level cortisol responses equivalent to when a docking iron is used.

**Disbudding**

Many sheep breeds are naturally polled, if required, disbudding should only be attempted on lambs that are healthy and thriving. The use of disbudding irons is preferred as the application of a caustic paste requires removal of the neonate from the dam for an extended period of time to avoid transfer of the paste to the udder.
When using a disbudding iron, there must be sufficient time following use on each animal to ensure maximum heating of the iron. Prior removal of the hair from around the horn bud will improve the effectiveness of the disbudding process. Extreme care must be taken not to apply the iron for too long, as the skull is much thinner than that of a calf, and is more prone to thermal injury. If the iron is hot enough, application for 5-10 seconds may be sufficient. An appropriate local anaesthetic and analgesic must be used.

**Castration**

Castration should not be performed if the research project will end before sexual maturity, unless surplus lambs or kids will be sold through markets where intact males are not acceptable.

Local anesthetic and analgesic must be used for castration. Crushing the spermatic cords by use of rubber rings or burdizzo between 2-4 days after birth has been found to produce less pain and distress than surgical castration. Injection of a local anaesthetic into the neck of the scrotum at the site of the ring will alleviate stress responses associated with castration using rubber rings or burdizzo, although crushing with a burdizzo prior to applying the ring appears to alleviate the stress response to castration.

Use of non-steroidal anti-inflammatory drugs injected intramuscularly 20 minutes prior to application of rings or burdizzo has been shown to reduce cortisol response and abnormal postures in lambs. Local anaesthetics will not mitigate the post-surgical pain responses due to surgical castration. Personnel applying the burdizzo require appropriate training. All castration performed on an animal after 14 days of age should be done in consultation with a veterinarian, and any surgical castration should be performed by a veterinarian.

Castration should not be performed before 2 days of age as the pain caused by the procedure could disrupt maternal bonding and result in the lambs not ingesting adequate amounts of colostrum and becoming predisposed to disease.

**Artificial Insemination**

The complicated structure of the cervix requires use of laparoscopic techniques for successful artificial insemination of sheep. Such surgical techniques, along with appropriate anesthesia, should be performed only under veterinary supervision. Trans cervical techniques have been developed for artificial insemination in sheep, but may lead to tearing of tissues supporting the cervix, and are not recommended.

**Ear Tagging**

When tagging young animals, growth of the ear must be considered, especially when using metal “curl lock” tags for sheep. Tags that are too large will result in torn ears and lost tags.

**Health and Disease Control**

A program of preventative health care should be established in consultation with a veterinarian, and should include quarantine periods for new animals; control of viral diseases such as orf (contagious ecthyma) and maedi visna; and treatment regimens for external and internal parasites. Vaccination protocols for Clostridial diseases (tetanus, pulpy kidney and malignant edema) and strategies for control of diseases such as *Bacteroides nodosus* and *Fusobacterium necrophorum* (contagious ovine footrot) and caseous lymphadenitis also need to be established.

**Body Condition Scoring**

Adequacy of the nutritional regime may be assessed by routine weighing or subjective scoring of body condition. Small ruminants are condition scored by assessing the muscle and fat cover at the first lumbar vertebra, between the spinous and transverse processes of the vertebrate.

A score of 1 would be emaciated, and a score of 5 would be obese. For overall health, small ruminants...
should be maintained at body condition scores between 2 and 4. Body condition scores of sheep are influenced by breed.

Prolific sheep breeds, such as Rideau Arcott, Finn and Romanov, have limited stores of subcutaneous fat, and should have an additional one point added to their condition score when using a five-point scale.

**Hoof Trimming**
Requirements for hoof trimming vary according to breed and whether the animals are intensively housed or pastured. Hooves should be trimmed before over-growth impairs locomotion. “Elf shoe” is the term given to the condition when the hoof wall grows over the sole, creating a pocket that collects feces etc. This condition creates a perfect environment for footrot to set in.

**Contagious Footrot**
Contagious footrot of sheep is a welfare issue if left untreated. Hoof trimming will help to diagnose the foot condition and severity, but trimming is not necessary to treat the disease. Standing animals in a 10% zinc sulphate footbath for a minimum of 20 minutes and repeated soaking within 4 days is generally sufficient to treat contagious ovine footrot. Affected pastures should be kept free of animals for a minimum of 5 days, after which treated animals can be safely returned.

Animals that remain lame after the second treatment should be examined and possibly culled. Further advice should be sought from the flock veterinarian. Appropriate SOPs for control and eradication of footrot will vary slightly by location, and should be developed and implemented under veterinary supervision.

**Copper Toxicity**
Sheep are prone to copper toxicity, and mineral supplements must be properly formulated (no added copper). Diets should not contain more than 15 ppm copper on a dry matter basis, and less than 10 ppm is recommended if using copper-sensitive sheep such as Texel. Grazing pastures fertilized with pig manure may also lead to copper toxicity in sheep.

**Pizzle Rot and Urinary Calculi**
Feeding excess protein to rams or wethers may lead to necrosis of the penis (*pizzle rot*) and should be avoided. Urinary calculi, stones which block the flow of urine, in fed rams or wethers indicate mineral imbalance (generally an imbalance of phosphorus and calcium) and/or inadequate supply or quality of drinking water. Signs of pizzle rot include excessively dirty or stained wool in the sheath area and necrotic regions on the penis, when expressed.

Signs of urinary calculi include straining at urination, dribbling urine and kicking at a distended belly.

**Disposal of Animals**
Non-ambulatory sheep must not be transported, except in certain exceptional circumstances, such as for veterinary treatment. CFIA regulations (June 2005) dictate that non-ambulatory animals cannot be transported except for therapeutic reasons, such as to a veterinary hospital for treatment.

All non-ambulatory(downer) sheep should be euthanized if veterinary examination determines that the prognosis for a speedy recovery is poor.

**Euthanasia**
Euthanasia should be performed by overdose of injectable pharmaceuticals. Captive-bolt/ exsanguination and free-bullet methods are also acceptable if performed competently by trained personnel. Due to the virtual irrelevance of paravertebral arteries in the supply of blood to the brain in sheep, sheep lose brain function and are dead within 15 seconds after the start of exsanguination.
Stunning or use of gunshot may confer no welfare benefits and may be a welfare hazard if not performed effectively.

Due to limited disposal options for sheep mortalities, facilities should be available for incineration or mortality composting.

**Human Safety**
Due to their relatively small size, sheep rarely cause lethal injuries to humans, although rams and bucks may become more aggressive during the breeding season and require monitoring if in close proximity.

Sheep may panic and flee as a group due to a perceived predation threat and large groups of panicked sheep have the potential to cause injury to personnel. When feeding sheep in troughs within a pen, sheep should be gated outside the feeding area while the feed is being delivered.

**Zoonoses**

Q-fever, caused by a rickettsial organism, *Coxiella burnettii*, is extremely contagious in the dried or aerosol state. It may cause abortion in sheep or be asymptomatic but shed in large numbers at kidding/lambing. Sheep may clear the infection but become re-infected if re-exposed. Humans can become infected by assisting dystocias or inhaling contaminated dust. Cats are also carriers, and barn cats may abort and serve as another source of infection.

Generally, Q-fever produces flu-like symptoms in people that can last for a few days with spontaneous recovery or last several weeks and become debilitating. Q-fever has several syndromes including an atypical pneumonia, endocarditis and hepatitis. Very old or otherwise immune-compromised people are more likely to develop severe disease, although healthy people can also become very ill.

Rapid diagnosis of Q-fever and prompt treatment will generally prevent mortality even for high-risk groups. When sheep are used in science, the staff should be aware of the risk of Q-fever, as it may affect themselves, their families and others in the research environment. Research animals should be obtained from flocks and herds that are tested annually for titres to *C. burnetti*. Research facilities should be free of reproductively active cats.

Orf (contagious ecthyma, sore mouth) is a viral skin condition of small ruminants which produces scabs or sores on the mouth, between toes, on the coronary band of the foot, or on the udder/teats of lactating animals. Protective gloves should be worn when handling infected animals. Orf is highly contagious and the virus can survive for decades. Water and disinfectant soap will kill the virus.

*Chlamydophila abortus* infection is a common cause of abortion in small ruminants in some areas of Canada. It is zoonotic and reports exist of pregnant women becoming ill and aborting after contracting the disease while assisting at lambing.

Listeriosis may lead to abortion, fetal death, severe illness or death of the newborn in small ruminants and humans. Infection in sheep and is often linked to consumption of spoiled silage. A key sign in sheep is circling due to encephalitis.
Pregnant research staff should avoid exposure to sheep and their environment if this pathogen is present. Female research staff should be informed of the risk of small ruminant abortion diseases, and should be provided with options for protection from exposure, including work sites away from sheep. Pregnant research staff should avoid lambing ewes or does, aborted fetuses, placentas and birth fluids unless the flock is known to be at low risk for *C. abortus*, *C. burnettii*, and *Campylobacter jejuni* or *C. fetus* infection.

**Particular Considerations in Biomedical Research**

The wooly coat of the sheep which insulates so well when the sheep is living outdoors in -20°C weather is problematic if the sheep is relocated from a farm setting into a vivarium. In such instances, the sheep will require shearing to assist in coping with what may be a 40°C change in temperature.