AFES Circular 134
February 2007

Bison are raised for meat and wool. This herd is at the Alaska Wildlife Conservation Center in Portage, Alaska.
—photo by Mike Miller

Reproductive Management of Alaska Livestock

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Introduction

The most important factor determining the success or failure of any livestock operation is effective management of reproduction. Regardless of how nice those animals look on your farm or ranch, and no matter how good the animals' genetic merits are, if they are not reproducing, they are only worth the current slaughter value or the value of the meat in your freezer. Management of reproduction includes maintaining healthy, adequately nourished animals, planning and controlling animal matings, incorporating the highest quality genetics into the herd or flock, and making timely decisions about when, and which animals, to breed. Ultimately the goal is to produce healthy, vigorous offspring at the optimum time of year. Furthermore, offspring must grow to maturity, providing replacement animals for your herd, to be sold as breeding stock, or to be efficiently grown as meat animals. The effective manager needs to understand that numerous factors including nutrition, health, and environmental conditions such as day length or photoperiod all affect reproduction in both males and females.

This publication is a general guide to farm animal reproduction. Topics to be presented here will help any livestock grower better anticipate what is required to successfully manage reproduction. Additional publications in this series will provide more in-depth information on reproduction in specific livestock species raised under Alaska conditions.

Puberty

Both males and females must go through puberty before they are ready to breed. Puberty is a critical stage of sexual maturation, and the timing of this period varies among species. The most important factors influencing puberty are age and

Table 1. Length of estrous cycle for various livestock species raised in Alaska

			Length of Estrus	
Species	**Cycle Length**	**Range**	**Average**	**Range**
Bison	21 days	unknown	18 hours	12–24 hours
Cattle	21 days	18–24	18 hours	2–30 hours
Elk	21 days	unknown	< 12 hours	unknown
Goat	21 days	unknown	36 hours	1–3 days
Horse	21 days	unknown	5–7 days	4–8 days
Muskox	21 days	unknown	12 hours**	1–25 hours
Reindeer	21 days	18 – 24	< 1 hour**	1–3 hours
Sheep	17 days	unknown	30 hours	24–36 hours
Swine	21 days	unknown	60 hours	2–3 days
Yak	21 days	unknown	24 hours	12–72 hours

**Results of research by the authors at UAF

Bison cow introducing her calf to concentrate feed at Alaska Interior Game Ranch, Inc., near Delta Junction, Alaska. This calf is about four months old.

—photo by Ruby Hollembaek

Table 2. Type of estrous cycle and time of year of the breeding season if the species is seasonal breeder.

Species	Cycle Type	Time of Year
Bison	Polyestrus	
Cattle	Polyestrus	
Elk	Seasonal Polyestrus	Fall
Goat	Seasonal Polyestrus	Fall
Horse	Seasonal Polyestrus	Spring
Musk Ox	Seasonal Polyestrus	Fall
Reindeer	Seasonal Polyestrus	Fall
Sheep	Seasonal Polyestrus	Fall
Swine	Polyestrus	
Yak	Polyestrus (seasonal?)	Summer-Fall

weight. Obviously nutrition plays a large role in the attainment of puberty, but so does the time of birth (early or late in the season) and overall health of the growing animal. Recognizing the changes that accompany sexual maturity and the appropriate time to incorporate first-time breeders into a program is critical to maximize the individual's fertility and subsequent productivity.

Reproduction in the female

Healthy females provided with adequate nutrition will have excellent reproductive performance and can produce offspring on a regular basis. An undernourished female is unlikely to become pregnant when lactating and, if severely undernourished, will not conceive. While poor nutrition alone may not prevent conception, it can result in embryonic loss, stillbirth, or the production of weak offspring. All of these conditions are very costly to a livestock operation.

In the sexually mature female, the ovary produces the egg and is the source of the main sex hormones, progesterone and estrogen. Among livestock, the only time females are receptive to breeding, and the only time they can become pregnant, is during a relatively limited period called estrus, or heat. The hormone estrogen is largely responsible for female behavior patterns that are characteristic signs of estrus. Estrus occurs near the time of ovulation, a term that refers to the release of an egg from the ovary. The time from one estrous period to another estrous period is called an estrous cycle. Once puberty has been achieved, female livestock species all experience repeated estrous cycles during each subsequent breeding season or following each pregnancy. The length of the estrous cycle is similar for many livestock (Table 1).

Some of our Alaska livestock species will breed during the entire year if all other factors are in order, while other species will only breed during specific times of the year (Table 2). Females of species that express repeated estrous cycles during the entire year when not pregnant are referred to as continuously polyestrus. Females of species that express repeated estrous cycles only during a specific time of the year when not pregnant are referred to as

Table 3. Length of gestation for livestock species raised in Alaska

Species	Gestation Length	
Bison	280 days	(~9.5 mos.)
Cattle	280–290 days	(~9.5 mos.)
Elk	260 days	(~8.5 mos.)
Goat	145–160 days	(~5 mos.)
Horse	330 days	(~11 mos.)
Muskox	235 days	(~8 mos.)
Reindeer	198–240 days	(6.5–8 mos.)*
Sheep	145–160 days	(~5 mos.)
Swine	114 days	(3 mos/3 weeks/ 3 days)
Yak	260 days	(~8.5 mos.)

*Current research at UAF being carried out by the authors is seeking to better define the length of gestation in reindeer

seasonally polyestrus. There are some animals (like the roe deer) that have only a single estrous period during a season or year, but those species are not common as livestock in North America.

Following a successful mating, the female becomes pregnant. The length of pregnancy or gestation is dependant on the species (Table 3). Knowing the approximate time of breeding and the length of gestation for a specific species is extremely important for anticipating time of birth. Extra vigilance during the calving period increases the likelihood of the birth and survival of healthy, vigorous offspring.

Reproduction in the male

Healthy males provided adequate nutrition will have excellent reproductive performance and can successfully breed (settle) many females during a relatively short period. Undernourished or stressed males are unlikely to be effective breeders and will leave many females open. Because of the length of time it takes sperm to mature in the male reproductive tract, a stressful insult such as an injury or illness can result in defective sperm as much as four to six weeks later.

In males, physiological puberty (the ability to produce viable sperm) and behavioral puberty (the ability to recognize and breed estrous females) may not happen simultaneously. It is important to recognize the difference and understand that even though a male appears behaviorally immature; given the right circumstances he may be capable of breeding females. Alternatively, a young male may lack the behavioral competence to successfully breed all the females in a harem. It comes back to understanding the characteristics of the particular species being raised.

Before using a male in a breeding program, the manager needs to assess the male's breeding soundness and evaluate the male's fertility and reproductive potential. At a minimum a breeding soundness exam should include visual inspection of the entire animal, including his physical characteristics, evaluation of his general health and condition, confirmation of sound feet and legs, and body condition scoring. Also of utmost importance is palpation of the scrotum and testicles and determination of the size of the testes by measurement of scrotal circumference. Larger scrotal circumference is correlated with increased fertility and increased sperm production in a number of species. Both testes have to be fully descended in order to gain a true measure of scrotal circumference.

Note that seasonality of breeding is not always limited to females. Males of some seasonally breeding species (see Table 2) are themselves seasonal and this is reflected in scrotal circumference and semen quality. Therefore, scrotal circumference in these species must be measured after the male has entered his breeding season, usually a few weeks before the females come into heat.

In some situations, it may be possible to collect a semen sample using electro-ejaculation and an artificial vagina. In this

Muskox calves at the Robert G. White Large Animal Research Station, February 2004. Research by the authors studying synchroniztion of breeding produced these calves over a five-day calving period.
—photo by Sandy Gurbowksi

Muskox calves at the Robert G. White Large Animal Research Station. These calves are the result of reproductive management research on muskoxen carried out by the authors.
—photo by Sandy Gurbowski

Elk on pasture during the breeding season at Kodiak Game Ranch on Kodiak Island near Narrow Cape.
—photo by Bill Burton

Table 4. Time of ovulation and suggested time of mating for several species.

Species	Approximate Time of Ovulation	Suggested Time of Mating
Bison	12-18 hrs. after onset of estrus	12-24 hrs. after onset of estrus
Cattle	12-18 hrs. after onset of estrus	12-24 hrs. after onset of estrus
Elk	unknown	unknown
Goat	9 – 24 hrs. after onset of estrus	24 hrs. after onset of estrus
Horse	24 – 36 hrs. before end of estrus	24 hrs. before end of estrus
Muskox	unknown	unknown
Reindeer	unknown	unknown
Sheep	12–18 hrs. after onset of estrus	12–18 hrs. after onset of estrus
Swine	18–42 hrs. after onset of estrus	24 hrs. after onset of estrus
Yak	Approx. 24 hrs. after onset of estrus	unknown

Elk mother and fawn at the Alaska Wildlife Conservation Center, Portage, Alaska.
—photo by Mike Miller

case microscopic examination of the collected semen will determine percent live sperm, percent motility, and percent abnormal sperm. Again, in seasonal species, this must be collected after the male has entered the breeding season. Obviously, a male with a high percent of abnormal sperm or low percent sperm motility is a poor candidate for a breeding program. Semen collection and evaluation takes more skill than most livestock producers have readily available. Nevertheless, it is not out of the realm of possibility for a group of Alaska livestock producers to work together to acquire this expertise as a part of their annual breeding programs.

Fertile males may still express low levels of breeding behavior, referred to as low libido. Breeding males should be watched closely throughout the breeding period to make sure they are doing their job and are capable of adequate serving capacity. The use of brisket paint or grease, chin ball ink markers, marking harnesses, color change mount detectors, and radiotelemetric mount detectors are all possible methods of monitoring the males' breeding activity and identifying which females are being bred. When using paint, grease, or ink, it is important to change color at intervals that approximate the length of the female estrous cycle and to use light colors early in the season and progressively darker colors as the season progresses. This allows you be aware of repeat breeders, females that did not conceive to an earlier service.

It is also important to consider how many females the male is expected to breed within a short period of time. Male stamina may decrease as the season progresses and in some species, the male may become exhausted and lose critical body mass. A second, "clean up" male frequently replaces the first and breeds those females that failed to conceive to the first mating. A good manager does not neglect the male livestock during the nonbreeding period. Attention to the male's health and nutrition during the nonbreeding season is the best insurance for successful breeding.

Artificial Insemination

Artificial insemination (AI) is a widely used technology in the cattle industry and to an increasing extent among other livestock. This technology is labor intensive and requires the ability to collect and store semen, as well as the ability to synchronize or recognize estrus in the female for appropriately timed insemination. However, it offers many benefits, including the rapid dissemination of desirable genetics within a herd. Semen from prime male can be used long after he is dead, and semen can be shipped with relative ease and at a fraction of the cost of moving live animals, giving the producer access to genetics from all over the world. While AI removes the need to maintain a large pool of breeding males, it also provides the opportunity to market semen from prime males, further expanding the producers' product base.

A successful AI program requires proper selection of males to be used for breeding, careful selection of prime females for insemination, adequate training for the person actually doing the AI, and proper and timely management of the semen tank. A semen tank is a specially designed tank that is filled with liquid

nitrogen. The liquid nitrogen maintains the temperature in the tank at –80°C.

Just as a good manager does not neglect live males during a nonbreeding period, a good manager also does not neglect the semen tank during that time. Lack of attention for nearly a year could result in considerable disappointment if the tank is opened and the manager finds that the liquid nitrogen level has fallen below the safe level, resulting in semen that is either obviously thawed or dead or, perhaps worse, semen that may still be frozen but the status of live sperm is unknown. The viability of stored semen can be ascertained by an experienced individual using microscopy, but it is obviously better not to have that worry in the first place.

The use of AI also requires specific knowledge of female estrous cycles and timing of ovulation in relation to estrus (Table 4), all of which vary between species. In many cases the most effective way to use AI is in combination with estrous synchronization of females. There are several methods of estrous synchronization, the details of which will be presented in another publication.

Record Keeping

Reproductive management doesn't have to involve complex technologies. A tremendous amount can be learned by careful observation and record keeping. The first step in establishing any form of effective reproductive management is setting up and maintaining detailed records for both males and females. This can range from keeping a simple record book to powerful and sophisticated computer programs that help record all aspects of livestock production. With detailed records, timely decisions can be made regarding which individuals to keep for herd replacements, cull, or sell for breeding stock. Establishing when the female was bred (even if it is the time from the beginning to end of breeding group formation) coupled with gestation length provides a time frame of expected calving. The female's relative ease of calving and willingness to mother the offspring are also important considerations for recruitment to a breeding program and should be recorded. Recording offspring sex, birth weight, weaning weight, and average daily gain accumulates performance data on both the males and females and helps streamline decisions on genetic recruitment.

Reindeer cow and calf on the Fairbanks Experiment Farm at the Agricultural and Forestry Experiment Station.
—photo courtesy the Reindeer Research Program.

A beautiful white-faced calf on summer range near Homer, Alaska.
—photo by Mairlis Kilcher

Conclusion

For livestock producers who want to improve their bottom line, our goal with this publication is to get them thinking about the concepts of reproductive management. While successful herd reproduction is paramount to having a successful livestock operation in Alaska, achieving that success requires good management in several areas. Overall animal health and nutrition, facilities maintenance and a clean environment are just some of the key points that need constant attention. A good recordkeeping system enables early detection of problems and facilitates identification and dissemination of desirable genetics.

Last, there are important points to consider when bringing new animals onto the farm or ranch, whether for breeding purposes or for any other reason. Always have the animal undergo a health check by a veterinarian before it arrives at your farm or ranch. Requiring this of the previous owner, as a condition of the purchase, is a good idea. Remember that the health and future of your herd could be compromised if this animal introduces a disease into your herd, especially a sexually transmitted disease. If the animal fails the health check, cancel the purchase deal. Hurt feelings on the part of the current owner are much easier to deal with than trying to eradicate a disease from your herd.

Effective management requires a sound understanding of the principles of reproduction in general and a thorough understanding of the reproductive biology of the species of livestock on your farm or ranch. To find out more about reproduction in a specific species, contact the Extension Livestock Specialist.

Websites:

www.uaf.edu/snras/school/mshipka/mshipka.htm
www.uaf.edu/snras/faculty/shipka.html

Other University of Alaska Agricultural and Forestry Experiment Station and Cooperative Extension Service publications on animal husbandry and reproduction are available. Please contact the station or the extension service (www.uaf.edu/coop-ext/publications/) for more information.

About the Agricultural and Forestry Experiment Station

Cow-calf pairs feeding at the Kilcher ranch near Homer.
—photo by Mairlis Kilcher

The federal Hatch Act of 1887 authorized establishment of agricultural experiment stations in the U.S. and its territories to provide science-based research information to farmers. There are agricultural experiment stations in each of the 50 states, Puerto Rico, and Guam. All but one are part of the land-grant college system. The Morrill Act established the land-grant colleges in 1862. While the experiment stations perform agricultural research, the land-grant colleges provide education in the science and economics of agriculture.

The Alaska Agricultural Experiment Station was not originally part of the Alaska land-grant college system. In 1898, the station was established in Sitka, also the site of Alaska's first experiment farm. Subsequent branches were opened at Kodiak, Kenai, Rampart, Copper Center, Fairbanks, and Matanuska. The latter two remain as the Fairbanks Experiment Farm and the Matanuska Experiment Farm. The USDA established the Fairbanks experiment station in 1906 on a site that in 1915 provided land for a college. The land transfer and money to establish the Alaska Agricultural College and School of Mines was approved by the U.S. Congress in 1915. Two years later the Alaska Territorial Legislature added funding, and in 1922, when the first building was constructed, the college opened its doors to students. The first student graduated in 1923. In 1931, the experiment station was transferred from federal ownership to the college, and in 1935 the college was renamed the University of Alaska. When campuses were opened at other locations, the Fairbanks campus became the University of Alaska Fairbanks.

Early experiment station researchers developed adapted cultivars of grains, grasses, potatoes, and berries, and introduced many vegetable cultivars appropriate to Alaska. Animal and poultry management was also important. This work continues, as does research in soils and revegetation, forest ecology and management, and rural and economic development. As the state faces new challenges in agriculture and resource management, the Agricultural and Forestry Experiment Station continues to bring state-of-the-art research information to the people of Alaska.

Agricultural and Forestry Experiment Station

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