

Production Guide



DOMESTIC GAME FARM ANIMALS

Red Deer



CRAAQ
CULTIVER L'EXPERTISE
DIFFUSER LE SAVOIR

Red Deer

Notice

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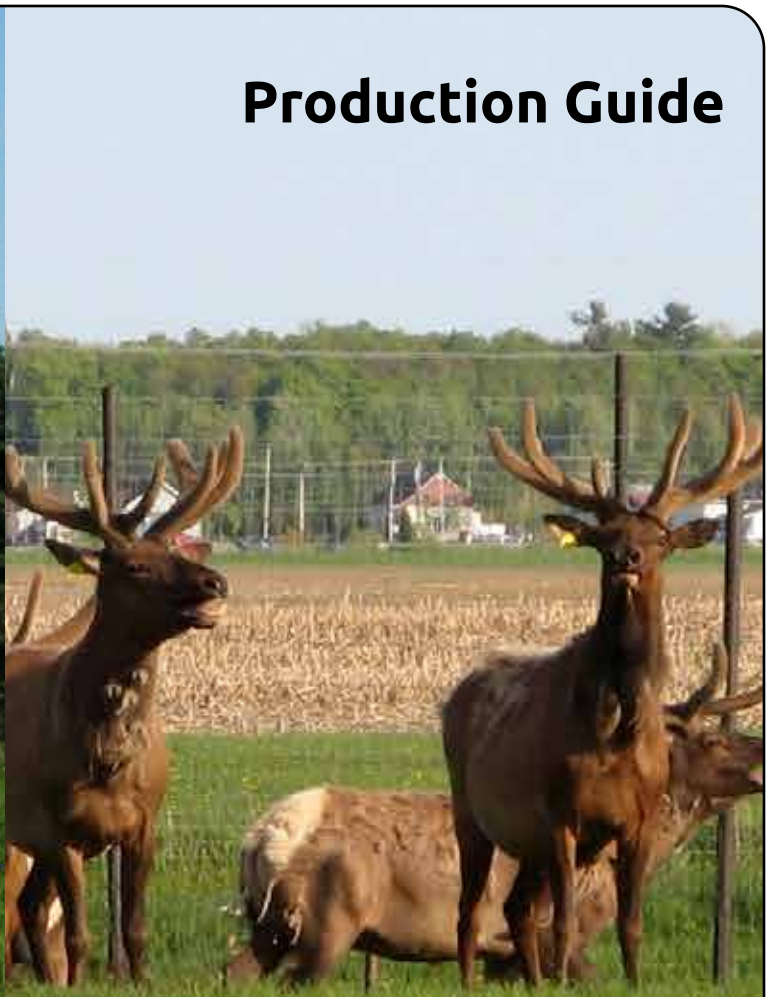
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Production Guide



DOMESTIC GAME FARM ANIMALS

Introduction to Game Farming



CULTIVER L'EXPERTISE
DIFFUSER LE SAVOIR

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© **Etienne Boucher**, MAPAQ (bison)

© **Michel Langlois**, MAPAQ (wild boar)

INTRODUCTION

Large game animals have been raised in Quebec since the 1980s. By 2011 there were over 208 owners of large game animals in the province (Table 1), of whom 140 had more than 10 females.

Table 1. Number of big-game owners¹ by species

	Bison	Red deer	Wapiti ²	Wild Boar
Number of owners	50	73	45	40

1. An owner is a person who has declared at least one female of a large game species, regardless of whether other species are also present. Source: *Fichier d'enregistrement des exploitations agricoles*, MAPAQ, 2011.

2. Outside of Québec, wapiti are usually called "elk".

As in other farm sectors, the start-up process for a bison, red deer, wapiti or wild boar farm should be systematic and well structured. At several points one can either carry on or decide to stop with no harm done. One can choose between purchasing a few animals for **hobby farming** or working to develop a **commercial operation**. Commercial undertakings in particular demand thorough preparation, including a business plan, technical and economic planning, learning about animal husbandry, nutrition, genetics and reproduction, and groundwork on marketing—especially since the bills will have to be paid from business earnings.

The main generators of income are:

- sale of venison products;
- agri-tourism (farm visits, etc.);
- sale of breeding stock;
- sale of velvet antlers (deer);
- hunting (game ranches).

NINE STEPS TO SETTING UP A GAME FARM

Step 1. Self-assessment: Do you have the skills to succeed as a producer in this industry?

Game farming doesn't just mean looking after a herd. There are many other skills to develop and hone – a game farmer wears many hats!

Producer¹

Raising livestock requires solid production knowledge, a certain know-how, and a willingness to work whenever needed. Game farmers must understand their animals' behaviour, paying attention to their needs to get the best performance possible.

Entrepreneur

An entrepreneur is well organized and resourceful, has good planning skills and is able to react quickly to the unexpected. Every farm has ups and downs, and producers must be able to deal with them. Price drops, low production volumes, problems with disease... To succeed, preparation is essential, as is the ability to adapt to new challenges – and especially, never give up.

Manager

Keeping costs in check, regularly assessing productivity, culling unproductive animals... Good management skills are essential, for without them operations will be inefficient. Every activity (purchase of inputs, product sales, etc.) must be planned, and every decision will have a direct impact on the success of the business.

Businessperson

To satisfy the target clientele, producers need to be well organized, must know how to negotiate, be able to adapt, and ensure the best service they can. A farm's success is directly tied to its earnings. **Marketing must be a top priority whenever decisions are being made.**

1. Before plunging into intensive livestock production, it's best to gain experience by starting out with a small herd. This gives the producer a chance to test his or her interest, while developing a better grasp of the synergy between processes: production, slaughter, processing and distribution.

Step 2. Exchanges and networking with other industry stakeholders

It goes without saying that big game production today requires management skills in nutrition, genetics, reproduction and marketing. This diverse expertise, acquired over many years, is intrinsically linked to a producer's professional network. To start off on the right foot:

- visit existing farms, not only to see herds, but also to take note of different types of facilities. Chat with producers who are already in business, perhaps glean advice on purchasing animals, to avoid possible missteps;
- present the project to family and friends and to future potential meat buyers;
- meet with local butchers, grocers, restaurant owners and consumers to better understand their needs and the different markets for specialty game meat;
- meet with a business start-up advisor at the nearest *Centre local de développement* (CLD), plus an agronomist with a production-management background, to lay the groundwork for the future business;
- meet with the livestock advisor of the nearest MAPAQ (*ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec*) office to obtain information on financial assistance programs, among other things;
- find out about local veterinary services with experience in the species you want to raise.

Step 3. Be informed: Regulations, standards and obligations affecting livestock operations

There are certain legal and administrative regulations that every producer must know and respect, including the following.

Regulation respecting animals in captivity

This Regulation falls under the *Act respecting the conservation and development of wildlife*. Red deer, wapiti, bison and wild boar may be kept in captivity without a permit, under certain conditions. If however they are kept for hunting purposes, producers must apply to the MAPAQ for a game ranch permit. Conditions and obligations related to the permit are described in Division IX of the Regulation, which can be found at: <http://www.canlii.org/en/qc/laws/regu/rrq-c-c-61.1-r-5/latest/rrq-c-c-61.1-r-5.html>.

Sections 3 and 4 of the Regulation outline the general obligations of any person who keeps an animal in captivity (shelter, water, food) as well as those on humane slaughter. Sections 8 to 12 set out responsibilities related to pens and perimeter fencing, with the obligation to promptly notify a wildlife protection officer on discovering that an animal has escaped.

Regulation respecting the identification and traceability of certain animals (Animal Health Protection Act)

The permanent identification of cervids with a chip tag and bar code tag, with a few exceptions specified in the Regulation (<http://www.canlii.org/en/qc/laws/regu/rrq-c-p-42-r-7/latest/rrq-c-p-42-r-7.html>), is

mandatory in any herd with 6 or more cervids. Set up to enable swift action in the event of a food safety or animal health problem, the traceability system is managed, in Québec, by *Agri-Traçabilité Québec*. For more information, see: <http://www.atq.qc.ca>.

Agricultural Operations Regulation

Falling under the *Environment Quality Act*, the *Agricultural Operations Regulation* is aimed at protecting the environment, particularly water and soil, against pollution caused by certain agricultural activities. It sets out general obligations regarding livestock waste; describes design standards for raising and storage facilities; and lists situations in which an authorization certificate must be requested from, or project notice given to, the *ministère du Développement durable, de l'Environnement, de la Faune et des Parcs* (MDDEFP). To consult the Regulation, see <http://www.canlii.org/en/qc/laws/regu/rrq-c-q-2-r-26/latest/rrq-c-q-2-r-26.html>.

Would-be livestock producers must also submit a project notice to municipal authorities to obtain the necessary authorizations, notably in regard to distances from wells and neighbours.

Registration of agricultural operations with the MAPAQ

Qualifying as a producer with the MAPAQ has several advantages, including access to government support programs. To qualify, an operation must generate (or be expected to generate) farm revenues of at least \$5,000. For more information (in French only), see <http://www.mapaq.gouv.qc.ca/fr/Productions/enregistrement/Pages/enregistrement.aspx>. The regulation requiring registration may be consulted at <http://www.canlii.org/en/qc/laws/regu/rrq-c-m-14-r-1/latest/rrq-c-m-14-r-1.html>. First-time applicants should contact their regional service centre (see <http://www.mapaq.gouv.qc.ca/fr/Regions/Pages/Carte.aspx>).

Standards and obligations regarding cutting, processing and sale of food products

In Québec, the slaughter, cutting, processing and sale of food products must be carried out in compliance with strict standards, and require permits. For more information (in French): www.mapaq.gouv.qc.ca/fr/md/Permis/Pages/Permis.aspx.

Step 4. Marketing: The number one priority

Before making a single purchase, nailing a single board or buying the first piece of equipment, it is imperative that you:

- determine the primary goal or outcome of the agri-business (hobby farm, commercial production, off-farm sales), taking into account whether it will be a part-time or full-time undertaking;
- if the goal is off-farm sales, ensure there is a slaughterhouse, processing plant or butcher, either locally or in the region, as well as points of sale (grocers and restaurants);
- define the final product (carcass, cuts, processed products) and decide what operations if any will be performed on-site (cutting and/or processing);
- obtain information on the regulations governing slaughter, cutting, processing and sales (both on and off the farm).

Without good market planning, earnings will be meagre or slow to develop.

Step 5. Development and creation of a business plan

A business plan is the paper version of all the dreaming, planning and decisions surrounding a particular project. The business plan outlines the business as the producer sees it, identifying its orientation, defining a start-up strategy, and setting goals. The business plan is a crucial requirement in any application for financial assistance.

It is recommended that the business plan be drawn up with the assistance of a private consultant, regional economic development agency or government bureau.

Step 6. Find the necessary capital

As part of the business plan, the producer will develop an investment calendar. Whether growth is projected over the short or long term, it can take a while for earnings to compensate expenses (stock purchases, maintenance), and the business may at first seem unprofitable. However, quickly making some initial sales can bring in much-needed income, despite the low production volumes at start-up, since production will grow as sales gradually increase.

Step 7. Implementation

- Build fences to make yards and pens, and construct a sorting centre with a squeeze and loading chute, so the animals can be handled safely.
- Purchase animals (this is one of the biggest expenses). Buying quality stock (in terms of both genetics and performance) will make every aspect of the operation easier.
- Set up purchase agreements with potential meat buyers (butchers, restaurants, etc.).

Step 8. Monitoring herd performance

- Maintain detailed stock records (age, weight curve from birth to slaughter, number of births, mating, etc.) to track both individual and herd performance. This information will help in selecting the best breeding stock.

Step 9. Specialization

Strongly recommended:

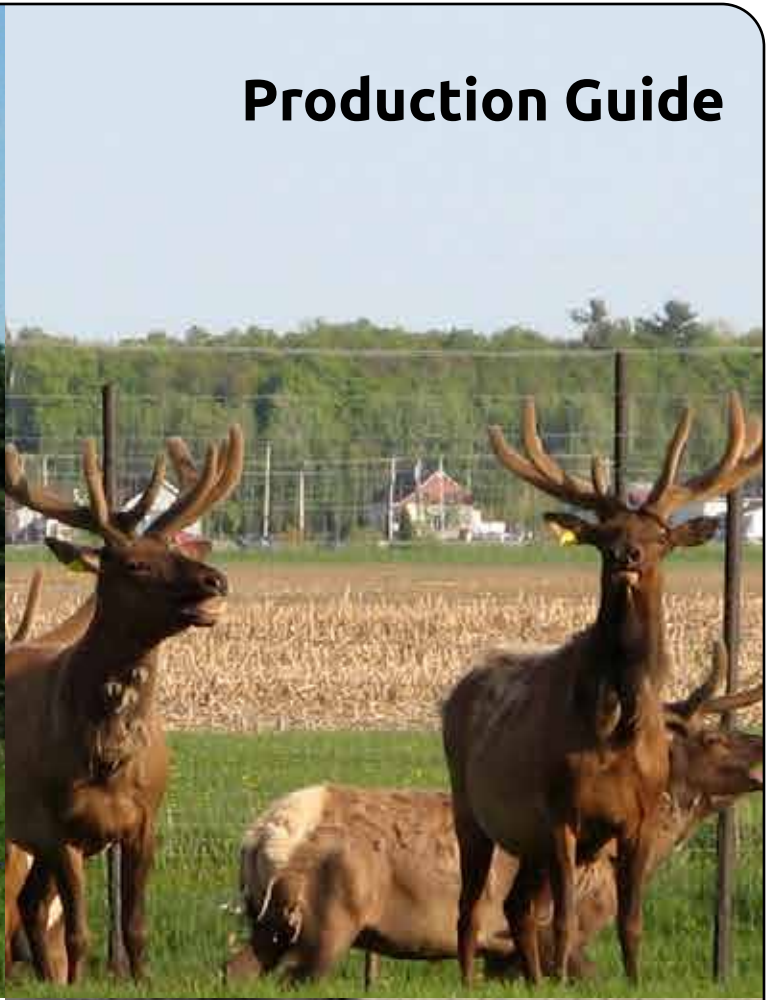
- for the first few years, take courses in production and animal husbandry, marketing, agri-tourism and so on, to expand your knowledge about aspects related to the objectives in your business plan;
- seek input from specialists in animal production, marketing and processing on any questions or challenges you encounter;
- continue learning and extending your knowledge as the business grows.

FOR MORE INFORMATION

Besides the websites mentioned above, here are some suggestions for where to obtain more information:

- the *Centre de référence en agriculture et agroalimentaire du Québec* (CRAAQ) distributes DVDs produced by the *Fédération des éleveurs de grands gibiers du Québec* on the breeding and handling of wild boar, bison, wapiti and red deer, as well as on marketing and cuts of meat. See: <http://www.craaq.qc.ca/Publications-du-CRAAQ>;
- the CRAAQ's "Références économiques" collection includes sample budgets for bison, red deer, wapiti and wild boar production. See: <http://www.craaq.qc.ca/ReferencesEconomiques>;
- other CRAAQ resources (financial assistance for young farmers, consulting services, resources for young farmers) can identify financial assistance programs, find advisors and provide certain other services. See: <http://www.repertoiresducraaq.ca>;
- regional agricultural training networks (*Collectifs régionaux en formation agricole*) are listed at <http://www.formationagricole.com>;
- the Ontario Ministry of Agriculture, Food and Rural Affairs provides good information about non-traditional livestock: <http://www.omafr.gov.on.ca/english/livestock/index.html>;
- the MAPAQ site offers a start-up kit for new producers on restaurant and retail sales (in French): <http://www.mapaq.gouv.qc.ca/fr/restauration/nouveauxexploitants/pages/trousse.aspx>

Production Guide



DOMESTIC GAME FARM ANIMALS

Basic Principles of Genetics



CULTIVER L'EXPERTISE
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INTRODUCTION

Red deer, wapiti (elk), bison and wild boar farmers need to understand the basic principles of genetic selection, so they will be able to raise, breed and market animals with the right characteristics for particular markets (meat, hunting, velvet antler, etc.). Regardless of the type of livestock, every farmer will need, at one time or another, to purchase breeding stock, choose semen for artificial insemination (red deer, wapiti, bison), or select breeding stock from within their own herd.

Understanding and using the basic principles of genetics is part of the constant evolution and improvement of livestock (conformation, productivity, growth, etc.). Quality breeding stock and optimum production conditions are key to ensuring profitability.

GENETICS AND ENVIRONMENTAL FACTORS

An animal's performance (phenotype) is linked as much to its genetic makeup (genotype) as to its environment (Figure 1): the best breeding stock in the world would never reach its full potential in a subpar environment.

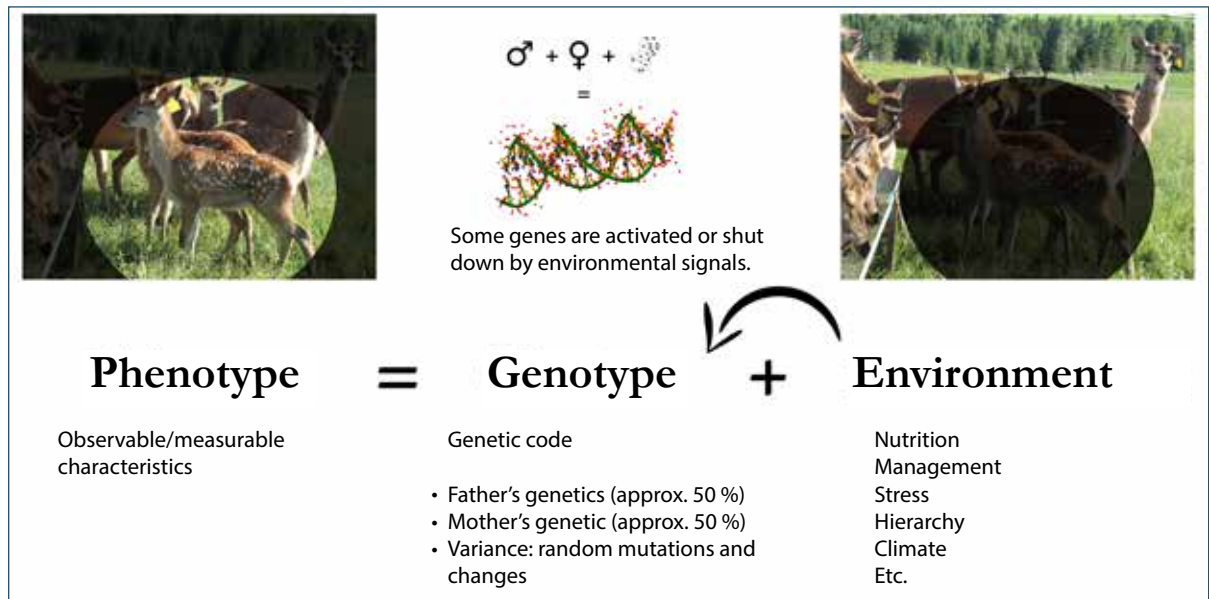


Figure 1. Factors affecting animal performance

Source: Juan Pablo Soucy

In animal production, the weakest link in the production chain determines performance. The classic illustration of this concept is a barrel in which each plank corresponds to some aspect of performance: inevitably, the shortest plank determines the maximum water level (Figure 2).

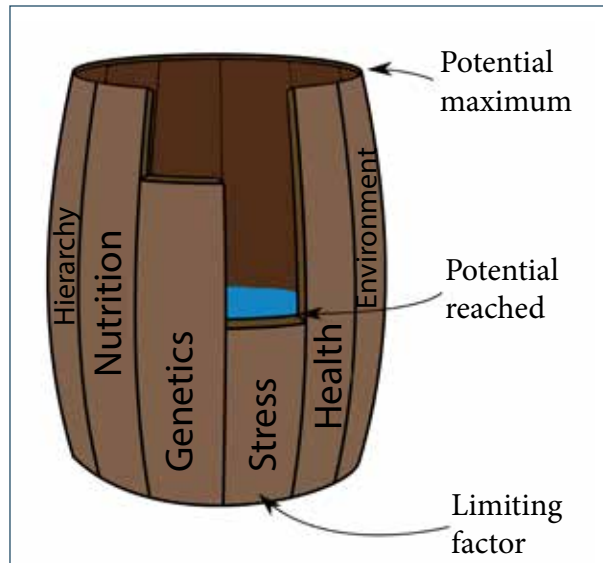


Figure 2. The weakest link in any production system limits potential animal performance

Source: Juan Pablo Soucy

DEFINITIONS

Genes and genetic makeup

A gene is a sequence in a unit of DNA that occupies a specific position on a chromosome and carries genetic information transferred from parents to offspring. With ~50% of its genes from its father, and ~50% from its mother, each individual carries a unique combination of genes (genetic makeup) that makes it different from other individuals.

Qualitative traits

Environmental conditions have little or no effect on qualitative traits, which are easily observable (e.g. eye colour, conformation, cervid antlers, hardiness, vigour, wild boars' flight instinct, etc.).

Producer organizations are working to develop conformation¹ tables for these alternative livestock, similar to those used for conventional livestock.

Quantitative traits

Quantitative traits are measurable characteristics that can be altered to a greater or lesser extent by environmental conditions (nutrition, housing, etc.). The genes involved in quantitative traits interact with environmental factors, and an animal's genetic potential may be undermined by inadequate production practices.

Most economically significant characteristics (growth rate, milk production, etc.) are quantitative traits.

1. For more information on red deer conformation see the following factsheet: *Evaluating Red Deer for Breeding*.

Heritability of qualitative traits

Heritability is a value between 0 and 100% (sometimes expressed as a decimal or fraction between 0 and 1) that indicates the importance of heredity in the expression of a particular characteristic and its transmission from parents to offspring. Environment is the other factor. Knowing the heritability of a trait facilitates the selection of breeding stock.

A desirable trait with high heritability will depend largely on heredity and should be included among selection criteria. The expression of a less heritable trait is influenced more by environmental factors than by heredity, but this does not preclude it from being a selection criterion; it simply means that genetic improvement for that trait will be slower.

Inbreeding

Inbreeding is a reproductive technique that consists of mating closely related individuals. Inbreeding was often used in the past to develop herds. It is no longer recommended because it increases the risk of accumulating unfavourable genes, reducing zootechnical performance, and creating hereditary anomalies.

If the same male is used over several years and bred with its own daughters, granddaughters, etc., inbreeding results, increasing the degree of consanguinity within the herd. Parentage should therefore be considered in planning reproductive groupings and purchasing breeding stock. Generally, the herd should be managed to ensure a maximum coefficient of consanguinity of no more than 6.26% to 10% (the equivalent of first cousins).

STEP-BY-STEP SELECTION PROCESS

The purpose of selecting breeding stock is to improve the herd by only mating animals that perform best in one or more ways. Selecting the best breeding stock ensures that their genes are transmitted and multiplied. The selection process must therefore start with clearly defining the type of animal desired to meet the target market, followed by considering which selection criteria can lead towards that animal.

Attempting to select for multiple traits at once will only slow the process of improvement. It is important to assess and account for the impact of selection on other aspects of production. For instance, selecting for higher weights at one year of age could also lead to higher birth weights, increased birthing difficulties, higher nutritional requirements, etc.

The first step is to exclude animals that do not fit the desired profile, then to select for one or two criteria at a time until a satisfactory level is achieved.

Bison

Only healthy, vigorous, productive animals with good conformation and a good temperament should be selected for breeding stock. Currently, most producers keep the majority of their females if they are good breeders. The selection of breeding bulls is more important, hinging on one or two characteristics with high heritability (carcass, growth, weight, reproductive efficiency) (Table 1). A producer who is raising bison for meat will want to develop animals with the highest feed efficiency possible. Breeding-stock operations will want to develop fertile animals that calve easily and produce offspring with good growth and conformation.

Table 1. Comparative heritability estimates for various characteristics in beef cattle¹

Characteristics	Heritability (%)	Characteristics	Heritability (%)
<i>Adapted from Alberta Agriculture, 1988; Hamilton and Wilton, 1987</i>		<i>Adapted from Utrera and Van Vleck, 2004; Cammack and coll., 2009</i>	
Reproduction		Carcass mass	35 – 42%
Age at puberty (females)	20 – 40%	Area of rib-eye muscle	28 – 36%
Scrotal circumference	20 – 50%	Carcass yield	37 – 41%
Milk production	25%	Calving date	10 – 49%
Weight performance			
Birth weight	25 – 40%		
Weaning weight	25 – 30%		
Weight at 1 year	50 – 60%		
Weight at maturity	50 – 80%		
Growth			
Daily gain: birth to weaning	25 – 30%		
Daily gain: post-weaning to market weight	45 – 50%		
Carcass characteristics			
Carcass classification	35 – 45%		
Backfat thickness	25 – 40%		
Area of rib-eye muscle	25 – 40%		

1. Because bison are of the same family as cattle, similar characteristics may be assumed between the two species.

Wapiti and red deer

Females that have had repeated problems with calving in previous seasons, and males with lower reproductive performance (number of offspring, distribution of births) should not be selected as breeding stock. Breeding bulls can be selected to meet the target market (breeding stock, velvet, venison) based on weight and velvet yield (Table 2). Cows can be selected based on the birth weight of their offspring, tendency to conceive in the early autumn, temperament, growth curve, etc.

Table 2. Comparative heritability estimates for various characteristics in red deer and wapiti

Red deer and wapiti		Red deer	
Characteristics	Heritability (%)	Characteristics	Heritability (%)
<i>Adapted from Jordan and coll., 1994; Friedel, 1994</i>		<i>Adapted from McManus and Hamilton, 1991; van den Berg and Garrick, 1997; Kruuk and coll., 2002; Delgadillo Calvillo and coll., 2008; Quinn-Walsh and coll., 2010; Ramírez Valverde and coll., 2011</i>	
Weaning weight	25%	Velvet antler mass	26 – 36%
Weight: 1 year	35 – 40%	Body mass at maturity	54 – 62%
Weight: 3 years	40%	Body mass at birth	15 – 27%
Milk production	20 – 30%	Body mass at weaning	14 – 21%
Type	35 – 40%	Body mass at 1 year	16 – 34%
Fat accumulation	35%	Gain post-weaning	10 – 14%
Antler weight	20 – 25%		
Velvet antler growth	35%		
Behaviour	20 – 30%		

Wild boar

Male breeding stock should be selected for good conformation and solid legs. The parents' behaviour and social hierarchy are also important selection criteria.

For the hunting market (game ranches), hardy individuals with good flight instincts should be selected. Producers raising their own stock will probably have to compromise between sow selection and hunting stock. As for meat producers, they require prolific sows with good mothering abilities, high rates of offspring survival, good growth rates, good carcass yield, good muscling, etc. Sows must have enough nipples to feed 6 to 8 piglets. If data are available, producers should use male and female breeding stock from uniform litters, which will help guarantee a good lineage.

Table 3 outlines the heritability of major characteristics in domestic hogs.

Table 3. Heritability estimates of major characteristics in swine¹

Characteristics	Heritability (%)
Reproduction	
Age at first estrus	30%
Number of nipples	30%
Gestation period	40%
Growth	
Average daily growth	30%
Appetite	35%
Leg quality	35%
Carcass	
Carcass yield	35%
Backfat thickness	45%
Area of rib-eye muscle	45%
Percentage muscle	50%
Carcass length	60%

1. Because hogs are of the same family (*Suidae*) and close cousins of wild boar, similar characteristics may be assumed between the two species.

Adapted from CPAQ, 1995

SPEED OF GENETIC IMPROVEMENTS

The speed at which selection advances genetic improvement (and thus, herd performance) depends on four main factors:

- selection differential: the difference (with regard to one or more traits) between the parents selected to produce the next generation and the average for that species. The greater this difference, the stronger the effects of selection will be;
- heritability: the more a given trait is heritable, the more precisely breeding stock can be selected for it;
- selection intensity: the degree of superiority of animals selected for breeding, compared to the average;
- generation interval: the average age of parents at the birth of their first offspring. The shorter this interval, the more swiftly genetic improvement can progress.

Example

A wapiti producer sets a selection differential of 3.2 kg for velvet antler production by 2 year bulls. By mating bulls that will be 3 years old at their offspring's birth with cows that will then be 7 years old, the producer can expect the calves to produce 0.22 kg/year more velvet than the previous generation, based on the following calculation:

$$\text{Genetic progress} = 0.35 \text{ (heritability)} \times 3.2 \text{ kg} = 0.22 \text{ kg/yr}$$

5 yrs (average age of parents)

ARTIFICIAL INSEMINATION

In red deer, wapiti, bison and wild boar, artificial insemination is primarily used for genetic improvement:

- to tap into the genetic makeup of semen from high-quality male breeding stock without having to invest in the purchase of elite animals;
- to improve herd quality faster than with natural mating;
- to allow the extensive use of male breeding stock with desirable genetic characteristics, by:
 - fertilizing a greater number of females;
 - using the same semen over a long period through freezing;
- to mitigate the risks of diseases transmitted through natural mating.

Despite these advantages, artificial insemination can be challenging, and is not for everyone. For most producers, natural mating with the best male breeding stock in the herd will be a better option.

Artificial insemination is more commonly used for red deer than for wapiti or bison. Some producers use artificial insemination for several years to improve herd genetics, then go back to natural mating with the resulting stock. Even if artificial insemination is used, the use of a back-up male is recommended in the cycle following insemination².

The success rate of artificial insemination varies depending on several factors. Artificial insemination requires considerable handling of the animals, including the administration of hormones to stimulate and synchronize estrus and ovulation, and the insemination process itself. These procedures require good anatomical and physiological knowledge, and must be performed with precision. Many producers start by using the services of an experienced professional (e.g. a veterinarian), but eventually learn the technique themselves. Note that it is essential to have the proper equipment (a squeeze) for immobilizing the females during handling.

2. For more information (particularly on insemination), see the following factsheets: *Reproductive Management of Red Deer* and *Reproductive Management of Wapiti*.

Production objectives should first be identified (herd improvement, velvet production, trophy animals, etc.) in order to select the most appropriate semen to achieve those objectives. Basic selection criteria should be applied in choosing females for artificial insemination: quality animals, previous births, calm and accustomed to handling, good body condition, etc.

CROSS BREEDING

Cross breeding refers to reproduction between unrelated strains of the same species (such as red deer and wapiti) to rapidly improve specific characteristics. Cross breeding is common in New Zealand, where red deer cows are bred (either naturally or artificially) with elk: the hybrid calf (which is then called “wapiti” in that country) is bigger than red deer calves, and the hybrid animals have better growth rates. Depending on its origin, a herd of deer may include both purebred and hybrid animals. For the purebred red deer industry, such hybridization is problematic, since crosses between hybrids or with purebred animals result in the herd having persistent hybrid genes, and thus to the gradual erosion of genetic purity.

Blood tests to identify variants of hemoglobin, a blood protein, can be used to verify the status of herd members or animals being considered for purchase. Such tests exploit the fact that the hemoglobin of a purebred is different from that of a hybrid. There is also a registration system for producers of purebred red deer.

Bison

Bison/cattle crosses are possible, but not recommended. The two types of meat are distinct in terms of taste, composition (protein) and cost. Bison meat has advantages that would be undermined by interbreeding.

Cross breeding between plains bison and wood bison does seem beneficial, and producers have noted that the hybrid offspring have higher, wider and deeper haunches, and higher carcass weights, attractive features for meat producers. The animals do not appear to have greater bone mass, but do seem to have smaller heads. However, such hybrid bison cannot be registered, exported, or entered in competitions.

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Production Guide



DOMESTIC GAME FARM ANIMALS

Evaluating Red Deer for Breeding



CRAAQ
CULTIVER L'EXPERTISE
DIFFUSER LE SAVOIR

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INTRODUCTION

Red deer farming was for many years oriented toward spectacular hunting trophies, with meat as a by-product. Today the situation in Québec has reversed, and the strongest market is clearly for venison. While there is still a hunting market it is relatively small, and to make it profitable considerable effort and financial investments must be devoted to genetic improvement. Producing a quality deer for hunting takes 4 to 8 years, while a deer can be ready for the meat market in 5 to 19 months.

While cattle are categorized as either dairy or beef, a herd of red deer can be developed to produce either hunting trophies or carcasses of high quality meat, though rarely both at once. This leaflet outlines the evaluation criteria (performance, temperament, body condition and conformation) that pertain to breeding for the purpose of meat production. Whether purchasing new breeding stock or selecting from within the herd, the breeder must attempt to choose stags and hinds that will improve the herd's genetics and contribute to the production of better feeder animals. The goal of this document is to guide that process.

SPECIES DEFINITION AND OTHER CONSIDERATIONS

In mammals, the cervid family (*Cervidae*) is divided into two sub-families: the *Cervinae* (Eurasian and African deer) and the *Capreolinae* (New World deer). The sub-family *Cervinae* comprises 4 genera, including the genus *Cervus* which in turn consists of 10 to 12 species depending on the method of classification. The number of species varies with the reference source, since taxonomy has evolved considerably since the advent of genomic analysis. Thus, it is now possible to distinguish more precisely whether two groups of animals belong to the same species.

The European red deer or elaphe deer, from the Latin name *Cervus elaphus*, is not immune to this ambiguity. For a long time it was classified in the same species as wapiti (often called elk outside of Québec). Wapiti are more commonly identified today as *Cervus canadensis*, though it would be more appropriate to consider the red deer and wapiti as two sub-species. The genus *Cervus* has great potential for hybridization. This complicates the task of classification, since genetically the red deer is almost as close to the sika deer (*Cervus nippon*) as to wapiti. All of them can in fact be crossbred. Recent studies combine these animals into a single species divided into 23 sub-species (Geist, 1998; Kuwayama and Ozawa, 2000; Polziehn and Strobeck, 2002; Ludt and coll., 2004).

In the context of deer farming the situation is somewhat clearer. Worldwide, most farms work with a single group of cervids, though many breeders take advantage of the species' hybridization potential, primarily by using male elk in herds of red deer. Nearly half the animals produced in New Zealand have elk genes (Nicol and coll., 2003). At marketing time, the correct term must be applied if hybrids are used (e.g. "deer meat" as a generic).

In Québec, red deer farming is for the most part separate from wapiti farming. Producers, particularly those who produce breeding stock for sale, use different bloodlines within a breed to bring their herd toward their objectives. (A bloodline, or breed line, is all the members of a family group over generations,

as confirmed by pedigree records and as observed through inherited traits.) Distinct geographic territories have given rise to great variation in conformation among groups of European red deer. Thus the English, Yugoslavian, Hungarian, Scandinavian and Spanish breed lines, like the Asian breed lines, all have very different characteristics. However, assembling different genes from among all the genes available to obtain animals of superb quality requires many years of judicious selection. To perform such selection, a clear understanding is needed of the breeder's objectives as compared to the herd's current performance. Accurate evaluation of each animal in the herd is essential for the optimal use of genetics.

PURCHASING ANIMALS

Certain precautions should be taken when preparing to purchase breeding stock. This means:

- asking the seller for complete documentation for each animal (documents from Agri-Traçabilité Québec (ATQ), genetic purity test, weight data, etc.);
- asking for pedigrees (documents certifying the genealogy of purebred animals); they are very useful when available (Figure 1);
- observing the herd of origin; consistent quality is a sign of constant effort for improvement, whereas an animal that is the only standout in a mediocre herd, unless purchased from a different herd, would be of questionable genetic potential;

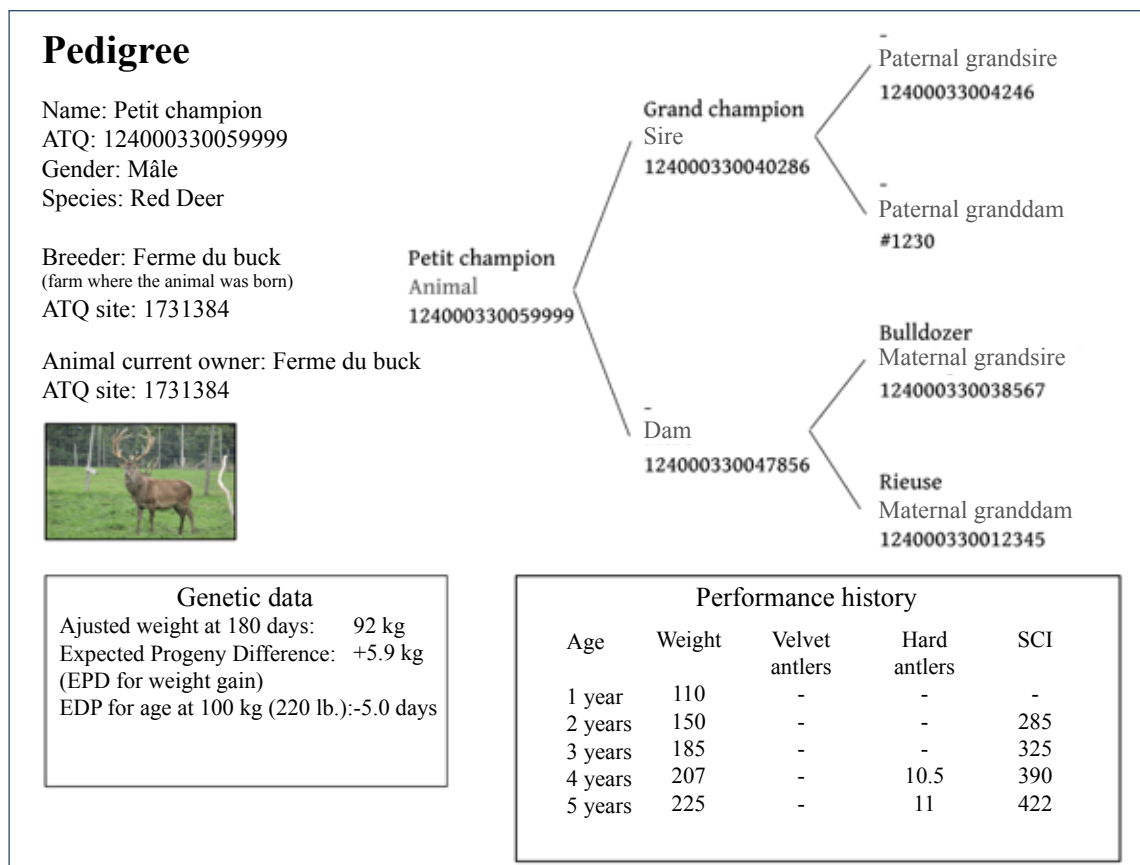


Figure 1. Example of a pedigree

- evaluating each animal's conformation and body condition, as discussed in detail below;
- ideally, for stags, knowing the results of fertility tests to be sure their semen is viable (this information is not always available);
- asking about the breeder's management practices, including feeding; an animal that does well in a herd where only forages are provided could perform differently when forages are supplemented with concentrates (and vice-versa).

GENETIC PERFORMANCE

Keeping records

It is impossible to achieve genetic improvement without having a clear starting point. Keeping good records is therefore essential, whether on computer or on paper (very practical when working with animals, if data is entered promptly). All relevant data about the animals must be recorded and saved.

Important information to record:

- identification of the stag used in each group of hinds;
- dates when the stag was introduced and removed;
- weight at specific ages (all animals);
- slaughter data (offspring);
- feed used;
- reasons for culling or mortality;
- conformation scores and other notes;
- data on the thickness of back fat and muscle (ultrasound) (Figure 2).



Figure 2. Use of an ultrasound device to measure back fat and muscle thickness

Photo: Juan Pablo Soucy

Data interpretation and other selection tools

Keeping records is great, but using them is what really pays off. The data collected can be used to produce an in-depth portrait of the herd. With a simple spreadsheet, calculations and analyses can reveal average weaning weights, heaviest animals at slaughter, growth curves, etc. Sophisticated statistical analyses can be done with other software, as well as long-term monitoring to identify hinds that year after year produce the heaviest calves; stags that consistently sire the best calves; carcass yields per breed line; detailed pedigrees, etc.

Regardless of how extensively the data is analyzed, breeders should take every opportunity to compare their herd's performance with that of other farms. No matter how certain you are that you're on the right track, finding out where you stand relative to other operations is always worthwhile. Whether with a professional or other breeders, there are several ways of measuring the performance of your herd. For example, model growth curves can be used as a basis for comparison with respect to weight gain (Figure 3). Such growth curves do not include animals in the upper or lower 5%.

Over the next few years, genetic selection tools will become available that can analyze multiple herds. This will allow a breeder to obtain information on the animals' real potential, as can already be done in more traditional livestock productions (beef, pork). The point is that an animal with exceptional characteristics (phenotype) will not always be able to transmit those characteristics to its offspring. Calculating the genetic potential index (GPI) or expected progeny difference (EPD) in descendants provides a more precise evaluation of the animals' real genetic value. For several years now a genetic selection program using just such tools has been in place for red deer in New Zealand.

Genomic selection tools called SNP chips (for single nucleotide polymorphism) are already in use for cattle, and are starting to appear in the cervid industry. A single chip (detector) can identify thousands of genes in a single animal, giving a precise portrait of its genetic traits and therefore its potential. This can be done as soon as an animal is born. The tests currently available for cattle evaluate over 800,000 different variations in a single analysis.

On the other hand, it must be remembered that poor performance can be due not only to genetics, but also feed, stress, parasites, disease and climate. In addition, if hinds that are performing poorly are not systematically culled, their productivity will decline dramatically from about 9 years on (Hill and coll., 2003; Vásquez and coll., 2003; Nussey and coll., 2006).

TEMPERAMENT

Temperament is an important but often neglected aspect when choosing animals for reproductive purposes. This applies to both stags and hinds. Since temperament is moderately heritable, it has an influence on both the herd's productivity and its overall health (Boivin and coll., 2010; Hoppe and coll., 2010; Schutz and Pajor, 2010). Choosing calm animals increases the probability of obtaining higher productivity, better quality meat and good general health. In addition, calm animals are easier to handle and to transport, reducing the risk of accident.

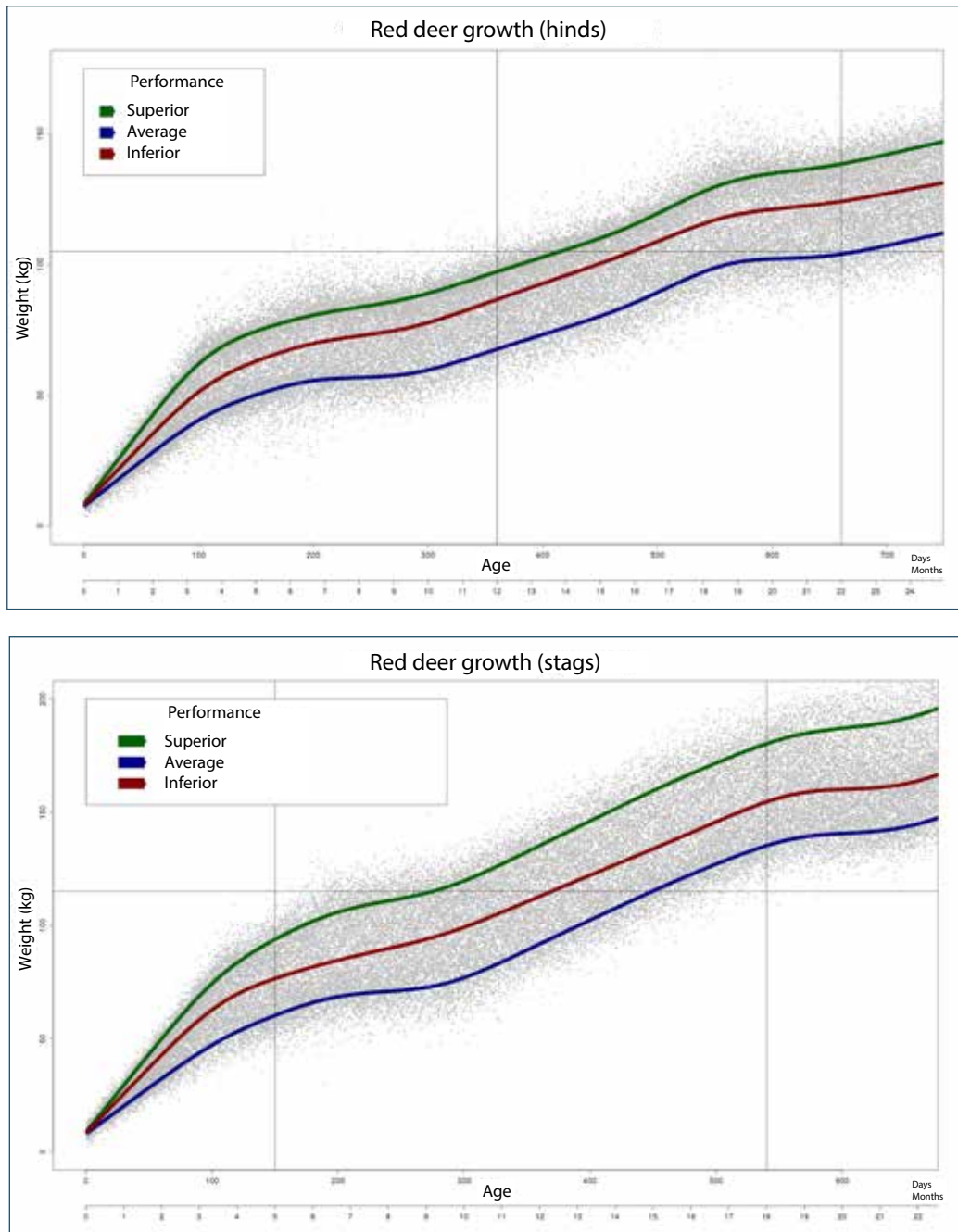


Figure 3. Model growth curves for red deer raised in Québec

In the hinds, behaviour related to calving and calves should be observed closely. Maternal traits play an important role in the calf's growth and survival. Hinds that allow other calves to nurse are preferable, since they contribute to uniform weight gain throughout the herd. Staying away from the rest of the herd a

few days before calving is also a sign of good maternal instinct. Hinds that are too nervous in the presence of humans should be culled quickly, since they will tend to stress the rest of the herd (Hill and coll., 2003; Pollard, 2003; Vásquez and coll., 2003; Delgadillo-Calvillo, 2008).

In stags, when not in rutting season a mild temperament is desirable; but not too mild, since a stag should not be constantly dominated by other stags or the hinds. Good libido and good reproductive performance are also signs of quality stags for breeding.

BODY CONDITION

Body condition corresponds to the animal's degree of fat cover; it is an important parameter. An animal that is excessively fat has a body condition score (BCS) of 5 (on a scale of 1 to 5), while an animal that is extremely thin has a score of 1 (Figure 4). Too low a BCS can be a forewarning of poorer reproductive capacity. Too high a BCS on the other hand, in hinds, can lead to difficulty in calving.

The best parts of the body for measuring body condition correspond to the principal sites of fat deposits: the sides, back and rump. Body condition is independent of conformation, but the two are sometimes confused because they influence each other.

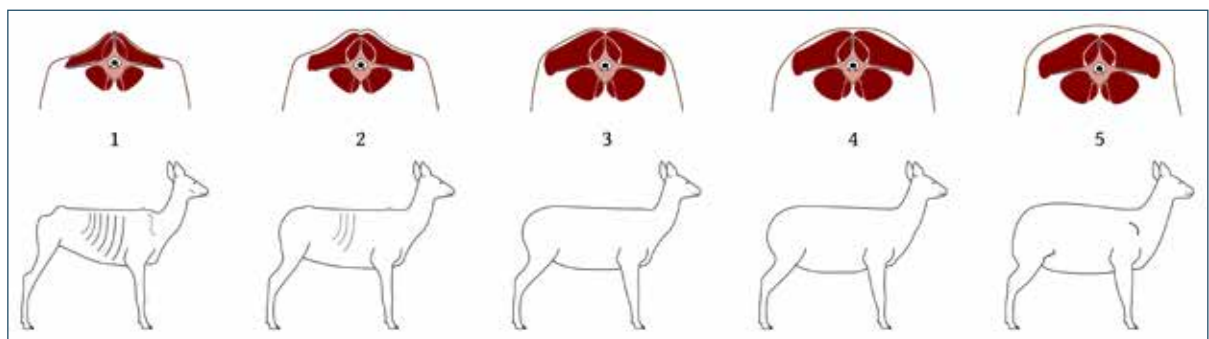


Figure 4. Illustration of body condition scores in red deer

In the red deer, body condition varies naturally with the time of year and the animals' activities in the different seasons (Figure 5).

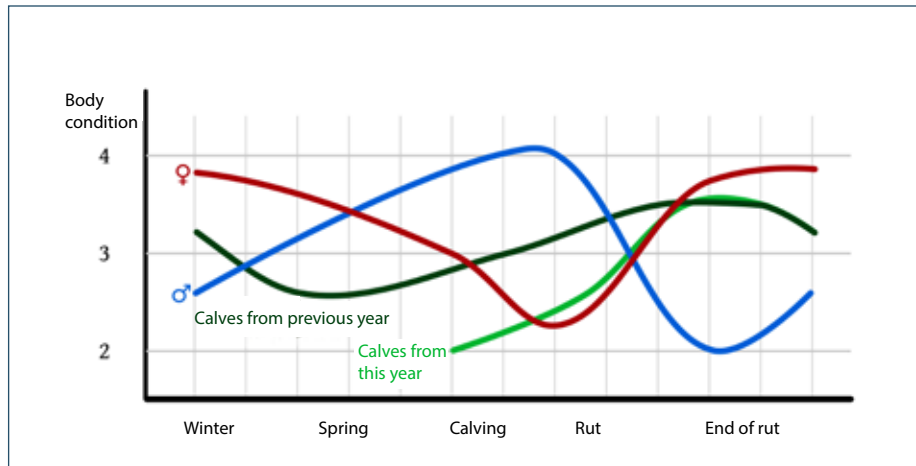


Figure 5. Variation of body condition in the red deer

CONFORMATION

While it is normal for body condition to vary throughout the life of the animal, conformation will never improve if it is not satisfactory from the beginning. It is therefore crucial to select breeding stock with good conformation. In Québec, red deer tend to be evaluated with a “hunter’s eye”. This section considers them in a different manner, as animals intended for meat production.

Musculature

Meat corresponds to the muscle in a living animal. Muscular animals should therefore be selected, particularly in the case of males. Broad, deep rump muscles are preferable (Figures 6, 7 and 11), as is a broad, well-muscled back. These are the most profitable parts of animals that will be processed for meat. Good musculature is equally important for reproductive hinds, but to avoid calving problems it should not be excessive. Musculature is scored on a scale of 1 to 3: 1 (excellent), 2 (normal) and 3 (poor).

Capacity

Capacity corresponds to the volume of the animal’s rib cage (Figures 7 and 11) and is also scored on a scale of 1 to 3: 1 (excellent), 2 (normal) and 3 (poor). Large volume in front means more space for the rumen and lungs, improving the animal’s digestive and respiratory potential. To the rear, good volume and wide hips provide a large attachment surface for muscles and a wider passage for calving in the females. Animals with a broad, deep trunk are therefore preferable.



Figure 6. Rump musculature (left to right: poor, normal, excellent)
Photo: Juan Pablo Soucy

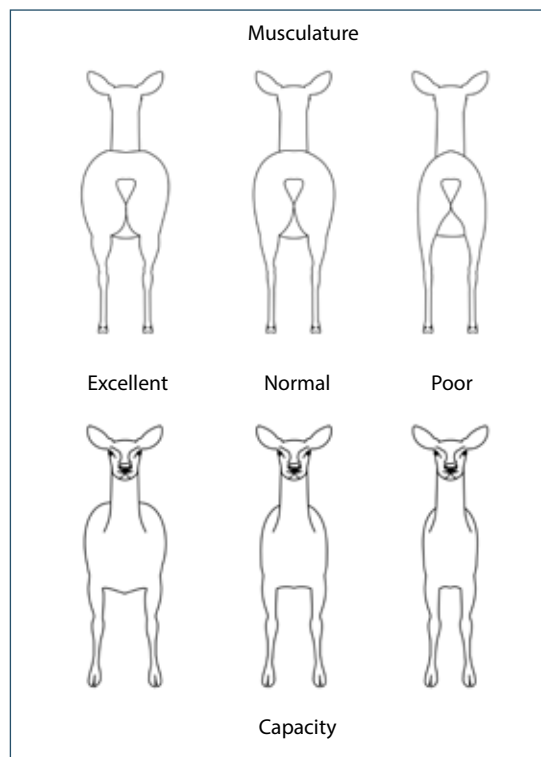


Figure 7. Musculature and capacity
Photo: Juan Pablo Soucy

Back length

Related to capacity, back length (Figures 8 and 11) is another important parameter because it determines the length of the tenderloin and strip loin, two of the most profitable meat cuts in a red deer. Back length is scored on a scale of 1 to 3: 1 (short back), 2 (normal back) and 3 (long back). Back length is easiest to evaluate by observing the proportion between the animal's back length and that of its legs. The back should also provide the animal with solid support, a trait referred to as back structure.



**Figure 8. Back length in three animals of similar size
(left to right: short back, normal back, long back)**

Photo: Juan Pablo Soucy

Back structure

The animal's back is the central beam for every limb of the body. It should therefore be as broad and straight as possible, in part to allow a good deposit of muscle. A slight hump at the shoulders is normal, but there should be no break behind them. A hollow at the hips or the middle of the back (Figures 9 and 11) must be avoided, since it weakens the animal's support and increases the risk of injury. The score for back structure is either 1 (poor) or 2 (good).

Legs and hooves

To support the animal's weight, it is crucial that its limbs be straight and solid (Figures 10 and 11). The hooves should be equal and not overly long, a defect often combined with weak musculature that in hinds is an impediment to mating. Both front and back legs should be straight and as parallel as possible.

Close-set legs are often the main defect in this part of the body, frequently related to the animal having poor capacity. Legs that angle beneath the animal, instead of being at right angles to the trunk, are another common problem in cervids (Figure 11).



Figure 9. Left: straight back, as desired. Right: hollow back, a structural defect
Photo: Juan Pablo Soucy

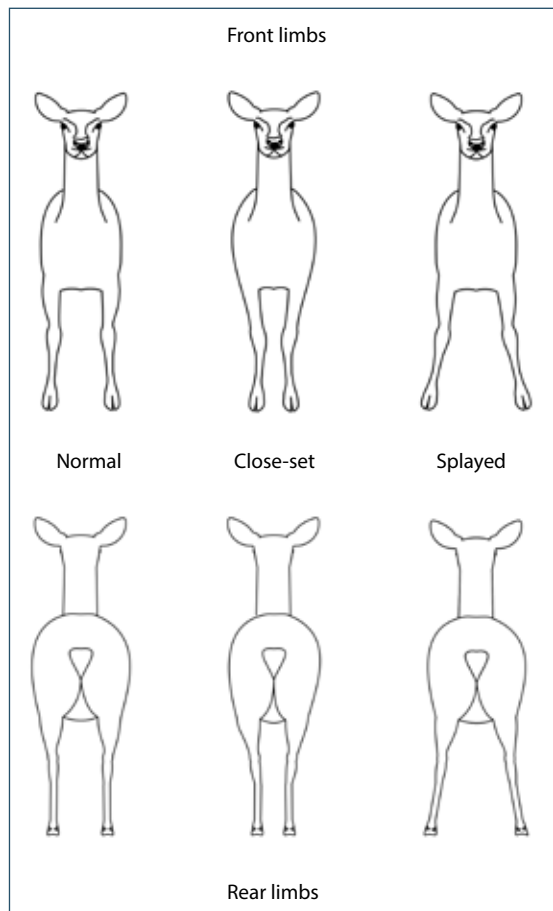


Figure 10. Legs and feet

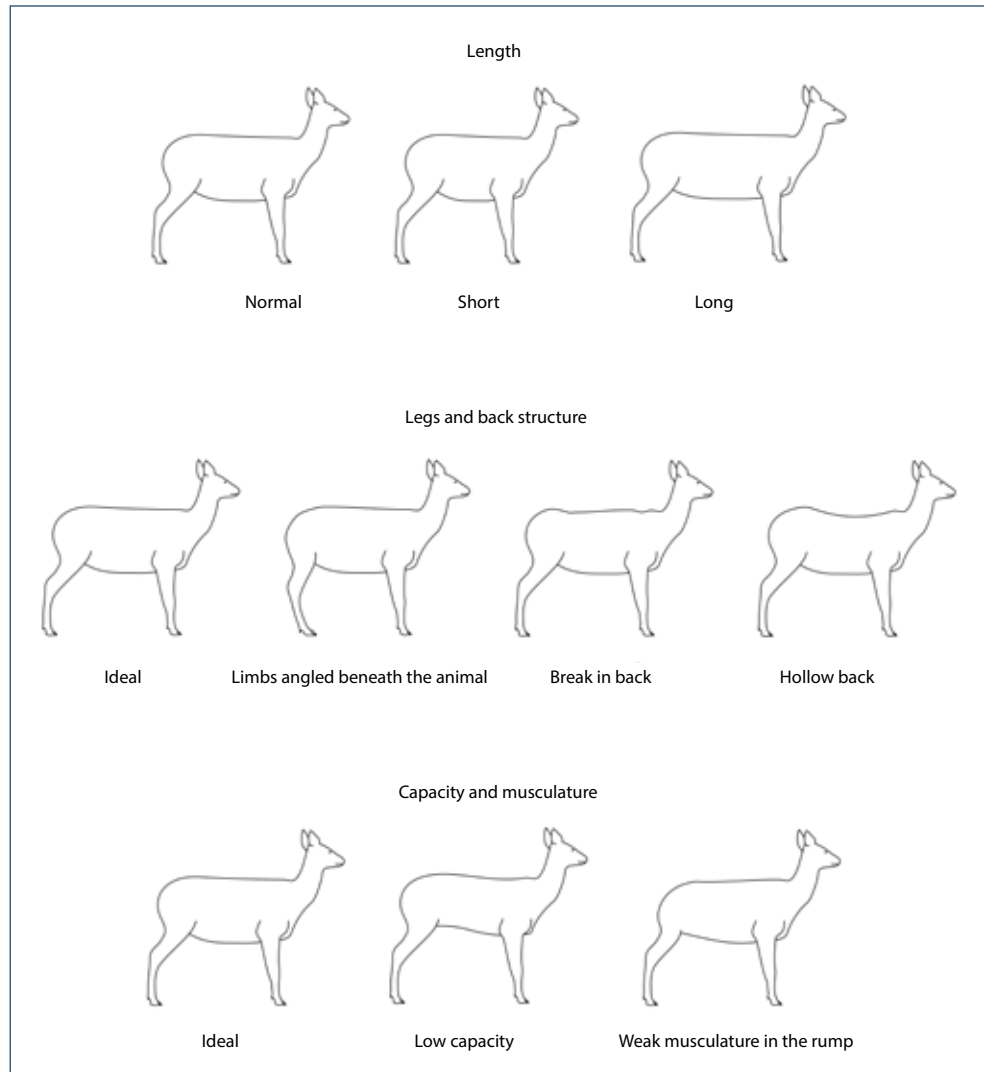


Figure 11. Relationships between certain selection traits related to conformation

Harmony

While it is imperative to select for good conformation, the harmony of the animal as a whole must also be considered. Hinds for example should have a finer head and bone structure than stags, these traits being similar to dairy traits in cows. Gait is another feature to be evaluated carefully, since a poor gait usually leads to the development of conformation problems. Finally, a breeder who is aiming for the secondary market (hunting, velvet antler production) should apply secondary selection criteria that are appropriate to that type of animal.

CONCLUSION

To improve a herd's profitability, the evaluation of prospective breeding stock must be done rigorously, both in terms of analyzing performance data and doing a visual assessment of body condition and conformation. They are complementary tools. Careful and patient selection is often what determines the price paid for breeding stock, the value of the carcasses subsequently produced, and the profitability of the business.

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Production Guide



DOMESTIC GAME FARM ANIMALS

Reproductive Management of Red Deer



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INTRODUCTION

Generating an economic profit from red deer farming depends heavily on the ability to produce superior quality animals year after year. To stay in front of the market, producers must constantly strive to improve their herds' genetics. Effective management of herd reproduction is a critical ingredient in any livestock operation. This means staying informed, keeping abreast of Canadian and international literature on cervids. By reading about new techniques like artificial insemination, producers can assess their potential impact on profitability and decide whether to apply them to their herds.

This leaflet describes the principal phases of the red deer's reproductive cycle, the steps involved in an artificial insemination program, and key factors for its success.

SEASONALITY OF REPRODUCTION

Like other cervids and small ruminants, the red deer is seasonally reproductive; more specifically, it is a "short-day breeder". When days shorten and the length of darkness increases, this sends a signal to the brain that unleashes a cascade of hormonal events in both stags and hinds.

Stags

In the male, shorter day length causes testosterone levels to increase by acting directly on the hypothalamic-pituitary axis (Figure 1), stimulating the secretion of various hormones in a precise sequence.

Summer is a period of sexual inactivity for the male, even though its velvet antlers are growing rapidly. Its testosterone level is very low, and the testicles and secondary sex glands are small and under-developed leading up to August. In August however, the increasing length of darkness stimulates receptors in the retina that transmit a nerve impulse through the superior cervical ganglia to the pineal gland via the post-ganglionic fibers. This causes the pineal gland to increase secretion of the hormone melatonin, which in turn causes the hypothalamus to increase production of GnRH (gonadotropin releasing hormone). GnRH stimulates the pituitary gland, which secretes luteinizing hormone (LH), and this is what directly induces secretion of testosterone by the testicles.

The rise in testosterone level makes the testicles enlarge and start producing sperm. The antlers calcify and the neck thickens. A few weeks before the rut begins, around mid-September, the stag's vocal tone changes: it bugles instead of bellowing. The level of testosterone reaches its peak in October or November (Haigh, 2007).

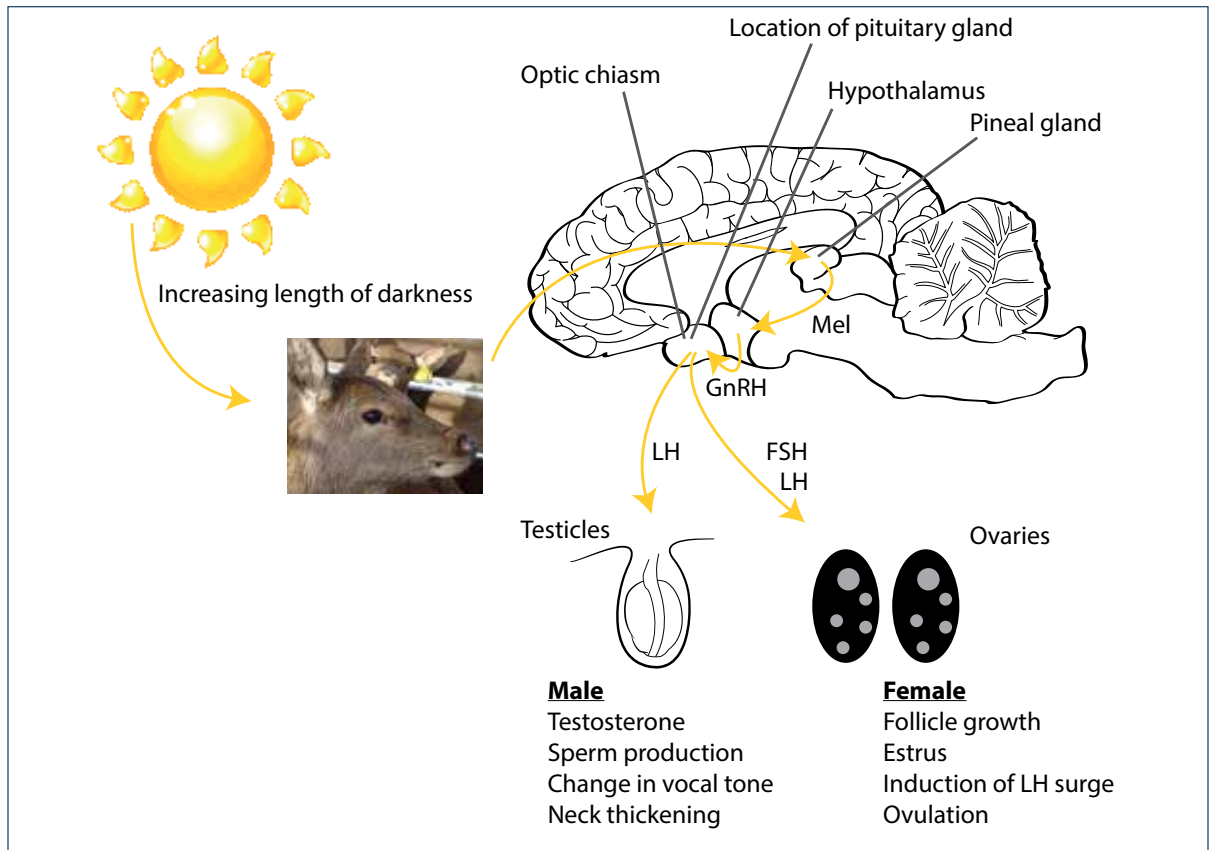


Figure 1. Effect of light on red deer (mel = melatonin, GnRH = gonadotropin releasing hormone, FSH = follicle-stimulating hormone, LH = luteinizing hormone)

Photo : Juan Pablo Soucy

Hinds

As shown in Figure 1, hinds are also affected by the increasing length of darkness, through its effect on the hypothalamic-pituitary axis. The latter regulates production of the hormones involved in the release of gonadotropins, which control the seasonal activity of the ovaries (estrus cycle) and consequently ovulation. Darkness stimulates the secretion of melatonin by the pineal gland, causing an increase in the production of GnRH by the hypothalamus. The increased levels of GnRH induce the secretion of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) by the pituitary gland. This first follicular growth induces the first heat (estrus), which is often silent (with no apparent signs). Prior to the first heat, the female's ovaries and uterus were inactive.

The hind has her first heat of the season around the end of September or early October. Throughout the reproductive season, the estrus cycle repeats every 18-19 days or until the hind conceives. The cycle can continue repeating into January or February.

Each heat lasts for a full day and the hind may be bred up to twelve times by the stag. Since ovulation occurs 24 hours after the first signs of heat (Asher, 2007), the best time for mating is 18-24 hours after the

onset of heat. Determining the onset of heat is difficult however, since the animals are shy and will hide from observers.

MANAGEMENT OF NATURAL MATING

Preparation and selection of breeding stock

For breeding, it is important to choose animals with outstanding performance in terms of the traits desired for the intended market (rapid growth or majestic antlers)¹. Though such phenotypic traits are not determined solely by genetics but also by herd management, it is essential to make these traits the focus of mate selection to ensure that their genes are transmitted to offspring. In New Zealand, the genetic selection techniques used for cattle have now been adapted for use with red deer. In future, these techniques could help identify which genes are truly superior.

Beyond superior genetics, it is important to choose male breeders with a body condition score greater than 3, the ideal being 5. A stag can lose up to 25-30% of its pre-rut weight over the course of the mating season. Young stags are fertile at around 16 months and can already be used for breeding.

Hinds should have a body condition score of 2.5 to 3.5 when mated, and should be in good health. Hinds that are too thin or too fat have lower conception rates (Table 1). Producers vaccinate and worm the hinds in mid-September, sometimes using this as an opportunity to wean the calves.

The best conception rates are obtained when the hinds are placed on a rising plane of nutrition in the mating season. Young hinds (1 ½ year old) should be put together in a paddock and mated with an experienced, very fertile stag.

Table 1. Relation between fertility and the hind's weight when bred

Weight (kg)	Fertility (%)
120	100
110	95
95	50

Source : Munyam (www.cerfsrouges.com/frameset.html)

Introduction of stags

The first step is to decide whether to rely entirely on natural mating or to use artificial insemination (AI) on hinds that have superior genetics. The latter would have been rigorously selected on the basis of traits like the weight of their calves at weaning, their own growth rate, and so on. Hinds intended for AI should be separated from the herd after weaning.

1. For more information about the choice of selection traits, the following factsheets are recommended: *Basic Principles of Genetics* and *Evaluating Red Deer for Breeding*.

In mid-September, hinds chosen for natural mating are divided into groups of at most 30 to 40 (if put with a mature stag), or groups of 10 to 15 if put with a young (1½ year old) stag. Early introduction of a stag into a group of hinds (late August to early September) advances estrus by about a week while inducing estrus synchronization in the entire group. In the first two weeks the animals establish a hierarchy within the group, which reduces stress during mating in late September to early October. The male should be kept with the hinds for at least 2 full estrus cycles, or till the end of October.

The date when the first calf of the year is born is used for determining, next year, when best to introduce the stag among the hinds. If this date (minus gestation time) coincides with when the stag was introduced, this indicates that the hinds were already in heat. The stag can therefore be introduced earlier the following year.

Ideally, 6 to 9 weeks after the stags were introduced they should be separated from the hinds. Many producers wait longer in hopes of increasing the conception rate, but this is not recommended. Calves born late in the season have a higher mortality rate. Hinds that calve late in the season are less likely to be ready for breeding the following autumn.

To ensure that an infertile stag does not have a drastic effect on the conception rate, after 3 to 4 weeks the stags can be switched to different groups of hinds. This can be a dangerous task due to the aggressiveness of rutting stags. The producer should also keep a close watch on the health and well-being of the male breeders. An estimated 10% of stags have reduced fertility due to injuries or fatigue caused by activities early in the season.

An example of reproductive management is presented in Table 2.

Table 2. Example of reproductive management in a red deer herd

Date	Steps
Early to mid-August	<ul style="list-style-type: none"> • Remove the stags' hard antlers
Early September	<ul style="list-style-type: none"> • Introduce chosen male breeders into their designated group of hinds
Mid-September	<ul style="list-style-type: none"> • Wean the calves • Vaccinate hinds, stags and calves against rabies, leptospirosis and clostridium (depending on veterinary recommendations for the region) • Worm all the animals after the first killing frost • Collect the breeding hinds and calves into groups: young hinds in groups of 10, the others in groups of 30 • Begin estrus synchronization in hinds chosen for insemination
Late October	<ul style="list-style-type: none"> • Switch the stags to different groups of hinds (if desired)
Mid to late November	<ul style="list-style-type: none"> • Worm all the animals
Late March	<ul style="list-style-type: none"> • Vermifuger tous les animaux
May-June	<ul style="list-style-type: none"> • Remove velvet antlers • Monitor births

Records

It is important to keep detailed records. Each calf's date of birth and subsequent weight gain, each stag's apparent fertility (number of births produced), health-related problems and interventions, are only part of the information that must be recorded.

GESTATION AND CALVING

Most hinds conceive in their first estrus cycle. Pregnancy can be diagnosed by the 40th day after conception. Unfortunately, due to the stress suffered by the hinds when being diagnosed, the risk of spontaneous abortion is high, sometimes as high as 50%. Generally, only genetically superior hinds that are sold pregnant will be subjected to a pregnancy test.

One diagnostic technique to determine pregnancy requires taking a blood sample after the 40th day of pregnancy. The period of 40 to 42 days is only critical if the producer wants to know whether conception occurred after artificial insemination (a detectable pregnancy) or after subsequent mating with a «backup» male (pregnancy not detectable on the 40th day). The blood sample can be sent directly to BioTracking in the United States (www.biotracking.com) or via the IDEXX Canada Laboratory (www.idexx.com/reproduction). The test used is called BioPRYN®.

The other method of diagnosis uses ultrasound. With ultrasound, a veterinarian who is experienced with red deer can distinguish between a pregnancy caused by artificial insemination and one resulting from natural mating. The test should be performed 40 to 60 days after conception.

The average gestation period is 234 ± 7 days (Figure 2). To reduce calving problems, the hinds' body condition must be monitored diligently. From December 1 to April 1, they should be able to maintain a body condition score of 3.0 to 3.5 on good forage only. A small weight loss of 10% toward the end of winter is acceptable; in fact a slight weight loss in the months before calving reduces the risk of calving difficulties. From April 15 to May 15 (the end phase of gestation) the hinds should be removed from their winter pens and transferred into clean and spacious paddocks with plenty of pasture, if possible, to regain a little weight and get some exercise. Addition of concentrates should be done very methodically, since too much can cause calving or lactation problems.

As calving time approaches, the hind stays away from the rest of the herd and remains hidden until the calf is big enough to escape predators. Calves are born with spots that disappear by late summer. After one or two weeks the hinds rejoin the herd along with their calves. The parentage of a calf can be determined for certain by mailing hair samples from the calf and adults to the Genomnz™ laboratory in New Zealand (www.genomnz.co.nz).

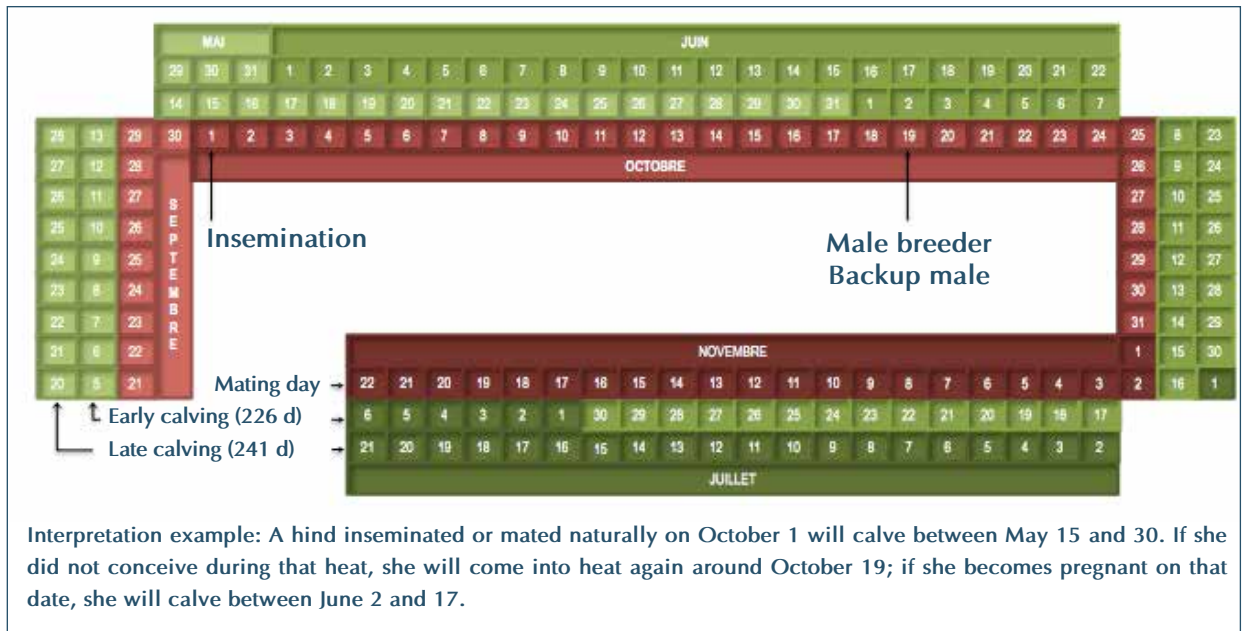


Figure 2. Prediction of calving date

ARTIFICIAL INSEMINATION

In red deer, artificial insemination is a highly effective and proven technique for genetic improvement. Semen from an elite stag can rapidly improve a herd's genetic quality in terms of the traits desired, whether it be antler size or growth rate.

Critical steps

Producers should decide in the summer whether to use artificial insemination. If so, the inseminator should be contacted as soon as possible to arrange a schedule.

Usually, due to the seasonality of reproduction in red deer, artificial insemination is performed early in the mating season, the goal being to inseminate the hinds at their first heat. When a hind transitions to ovarian activity after the long period of ovarian inactivity, there is an initial silent ovulation followed by corpus luteum formation (10-12 days); the first visible heat comes a few weeks later. To ensure that insemination coincides with the first heat of the season (whether visible or silent), the producer can implement an estrus synchronization program. If desired, subsequent heats can also be induced through synchronization later in the season. From 4 to 14 days after insemination, a backup stag is put in with the inseminated hinds and kept with them for at least two estrus cycles, to maximize chances of the hinds being pregnant by the end of the rutting season.

Selection of elite hinds

Judicious selection of hinds to be inseminated is crucial for the success of an insemination program. The ideal hinds possess superior genetics, have a calm behaviour and calve without problems every year. They should have a body condition score between 2.5 and 3.5, and be allowed at least 60 days between calving and breeding. Weaning the calves isn't mandatory, but for most producers this is done when the intra-vaginal insert is inserted for heat synchronization (see below). Young, 1½ year old hinds can be included in the insemination program if they have reached at least 80% (110 kg) of their adult body weight.

Selection of semen

The best choice of stag to inseminate a given hind will depend on which phenotypic features the producer wishes to improve. Having a good understanding of the genetic background of the herd's hinds is the essential place to start. The producer must then inquire into the genetics of stags whose frozen semen is available, and the availability of the two types of semen: sexed semen, which has a 90% chance of producing offspring of the desired sex, or non-sexed semen. For frozen semen purchased in North America, purchase and delivery should be completed at least a week before the insemination date (4 weeks in the case of semen from New Zealand). Delivery details can be worked out with the help of the inseminator.

Synchronization of heats

The inseminator is responsible for providing the producer with a heat synchronization program (Table 3). One common method of heat synchronization uses an intra-vaginal CIDR® insert (CIDR® is a trademark that stands for *controlled internal drug release*). The insert releases the hormone progesterone within the hind's vagina over a period of 10-12 days. The CIDR® 330 insert contains 0.330 gram of progesterone. When the insert is removed, the progesterone level drops rapidly, causing a rise in follicle-stimulating hormone (FSH) and a surge of luteinizing hormone (LH). To maximize the likelihood of ovulation, when the insert is removed a small dose of precisely 200 IU of equine chorionic gonadotropin (eCG) is injected into muscle.

Table 3. Example of a heat synchronization program, for artificial insemination on October 1 at 9:30 a.m.

Day of treatment relative to insemination day (ID)	Procedure	Date	Time
10-12 days before ID	Insertion of CIDR®	September 17 to 19	During the day
2¼ days before ID	Removal of CIDR® + Injection of 200 IU eCG	September 29	2:00 a.m.
Insemination Day	Artificial insemination 54-60 hours after CIDR® removal	October 1	9:30 a.m.
4-6 days after ID	Introduction of a backup male	October 5 to 17	
40-60 days after ID	Pregnancy test (optional)	November 9 to 29	

During his or her visit, the inseminator will try to predict the success of heat synchronization. Have the hinds been walking the fence lines over the last 12 to 24 hours? When they are in heat they seek a stag and walk along the fences. The presence of vaginal mucus and ruffled or missing hair at the hind quarters are other signs of estrus.

Factors to monitor

An artificial insemination program should have a success rate of at least 70%. Unfortunately, sometimes the results are very disappointing. The following considerations may shed light on potential problems.

Male fertility and semen quality

The quality of frozen semen varies widely from one stag to the next, even between different semen straws from the same stag. Also, if the seminal plasma recovered during semen collection is not separated from the sperm it can significantly reduce the fecundity of frozen semen.

It is difficult if not impossible to judge the fertility of semen by sperm motility, since sperm can appear normal despite a loss of fecundity. Motility is a poor indicator of fertility and indeed a very subjective matter, yet it is the only criterion that can be assessed on the farm. Commercially, the general rule is that a thawed dose of semen must contain at least 20 to 30 million spermatozoa with at least 40% motility.

Damage incurred during storage, packing or shipment can drastically reduce the effectiveness of semen. Exposure to air for more than a second, or storage in a defective tank or one with insufficient liquid nitrogen, can result in the semen in a straw having very low fecundity. Here again, sperm motility after thawing does not necessarily mean anything; motility can be 40 to 50% without the semen having to the same degree of fecundity.

Synchronization and quality of heats

Keeping the intra-vaginal insert in place for 10-12 days increases the risk of infection, and the potential of infection ascending into the uterus. A major vaginal infection will reduce the success rate of insemination to 30-40%, compared to 70% in a healthy animal. Strict hygiene is therefore essential during insertion and withdrawal of the CIDR® insert. With each animal to be treated, new disposable gloves should be put on and the applicator disinfected in a solution of Virkon® or chlorhexidine (Hibitane®). Also essential is to make sure the hinds are injected with precisely 200 IU of eCG when the CIDR® is removed.

Equipment

Sometimes the best equipment is the simplest. The ideal setup allows the hinds to be led to the squeeze (whether hydraulic or manual) with little or no stress and agitation. The best squeeze is one that will prevent the hind from backing out, keeping it immobilized with its rump at the back of the squeeze. A squeeze that allows too much movement could be dangerous for both the animal and the inseminator, while reducing the chances of successful insemination.

CONCLUSION

To survive in this industry, red deer producers must strive to improve the genetics of their herds. With artificial insemination, this can be achieved quickly and effectively, sharpening the focus on the producer's specific objectives (rapid growth rate or the development of majestic antlers). The technique is now affordable for every producer and generally has a high success rate.

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Production Guide



DOMESTIC GAME FARM ANIMALS

Marketing – Overview



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INTRODUCTION

On a number of points, marketing meat from farmed large game, with related activities like agritourism and hunting, is different from marketing conventional livestock (beef, pork, poultry, etc.). Farmed game meat is a high-end, niche product with a special flavour and a strong identification with small, local producers. For some people the animals themselves are more appealing, in part because they are associated with free-range farming in a natural environment. These differences present some advantages, counterbalancing the challenge of constant competition with other types of meat.

The four main types of farmed game meat in Québec are red deer, wapiti (generally referred to as “elk” outside of Québec), bison and wild boar. Not all are at the same level where marketing is concerned, but the gaps are narrowing. Some of the marketing groups formed by red deer farmers have been operating for over 10 years, while there are groups of wapiti farmers whose marketing is handled by processor/distributors. For bison and wild boar producers however, no such groups have been formed so far.

Whichever animal they raise, Québec’s large game farmers must stay on their toes, paying careful attention not only to the market but to social and economic factors. Above all, they should keep in mind that diversification (of products, services and marketing) can be the key to profitability.

FARMED GAME MEATS

Game meat can be sold either wholesale (as carcasses) or retail (as cuts and processed products). In either case, for the producer to be certain of being able to sell his production, sales agreements should be in place before animals are purchased and shipped to the farm. As well, early consideration must be given to how animals will be shipped to the abattoir, and to the proximity and type of slaughter services available.

Wholesale

The wholesale market involves producers selling whole carcasses to a processor/distributor, either directly or in a group with other producers. The group approach is popular with red deer farmers, and becoming more so with wapiti producers, while bison and wild boar producers are at the discussion stage. It is an approach that resembles how animals are marketed in more traditional livestock industries. It lets producers concentrate on their herds, focusing their efforts on optimizing performance and genetics. The potential drawbacks include production limits (depending on the group) and lower profitability. When processing, distribution and/or marketing are not handled by the producer, the farmer loses the opportunity to profit from the value added by these steps.

For a new producer, the group approach can be particularly attractive inasmuch as it provides some assurance of sales. However, the producer must be able to meet the standards of the group (or its distributor) in terms of quality and volume. Not all such groups have a large enough market to be able to take on a new producer.

The wholesale market is generally preferred by producers in remote locations, those who farm intensively to generate economies of scale, and those who focus on breeding stock or high-quality stags, bulls or male wild boars for hunting (as opposed to the sale of meat).

The main processor/distributors in the wholesale market are *Les Viandes de la Petite-Nation*, *Gibiers Canabec* and *La Maison du Gibier*. Over the years their marketing and promotional activities have made consumers more aware of venison products.

Retail

Farmers who process, distribute and market their own products can achieve greater levels of profitability, since there are fewer middlemen between them and the consumer. This is primarily how wild boar meat is marketed.

Retail sales include the sale of carcasses to individuals for méchouis, farm gate sales of cuts and/or processed products, and sales in farmer's markets, through websites, to retailers and local restaurants, and for country dining (see the section Agritourism). Retail sales require the most work and the highest initial investment. Since the best days for retail sales are when consumers are off work, this approach requires a producer who can work on weekends and holidays, and who enjoys interacting with the public. The added layer of regulations and obligations regarding processing and sales can be daunting for smaller processors.

In the retail market it takes quality products, attractive presentation, and sales personnel who are good at dealing with the public, to maintain repeat sales.

Méchouis

Perhaps in part thanks to the *Asterix* movies, wild boar has become popular for méchouis in Québec. Deer, wapiti and bison producers would do well to explore the potential of this market. Sale for a méchoui turns an entire carcass to profit, with added value since the producer provides the service. Providing a méchoui requires time, equipment and a permit. Considerable travel may be necessary, usually on weekends. Good presentation, attention to detail and cleanliness are essential for a successful méchoui business.

On-farm sales

There are several types of on-farm sales. Whether through a sales counter, farm dining, agritourism visits or photo safaris, this type of marketing enables some producers to make a good profit. They take courses about the different cuts of meat, processing methods and sales techniques, and hygiene and food safety (this is mandatory), then set themselves up with the facilities needed and the required permits. By also offering processed products (terrines, sausages, meat sauce etc.) they can extract full value from each carcass.

Some of these businesses are so successful, they also provide an outlet for other producers or distributors.

Farmer's markets and internet sales

Where customer traffic to the farm would be insufficient, producers who are good at dealing with the public can sell directly at farmer's markets, eliminating the need for marketing infrastructure on the farm. There are however costs associated with selling at farmer's markets, including sales permits and fees charged by market administrators. Another option is to set up a website and sell over the internet. This can complement other kinds of marketing while offering consumers the ultimate in convenience.

Supplying local retailers and restaurants

A number of grocery and restaurant chains have "buy local" policies that give local producers a place on store shelves and a presence on menus. Since producers deal with them directly, they can obtain better prices than when middlemen are involved. Good cooperation is essential to ensure a regular supply and consistent quality despite the seasonality of farm production. This can mean selling fresh products during the period when animals are slaughtered, while using frozen products during periods when the animals are being finished.

Special initiatives

It is worth mentioning a few initiatives currently available for developing new markets for game meat from certified farms. These include the *Cerf de Boileau* in the Outaouais, *Sélection Nordique* deer produced by 15 red deer farmers, *Cerf des Appalaches*, and the registered certification program *Grands gibiers du Québec certifiés™* (<http://www.grandsgibiers.com/certification.php>).

BREEDING STOCK

Producing quality breeding stock requires a solid understanding of genetics for informed choices to be made when selecting breeders. The animals are expected to be of superior quality, so prices are higher. Often, the seller will provide advice and follow-up if requested.

Thanks to the long experience of producers in this area, the genetic quality of Quebec's breeding stock has improved considerably in the last 30 years. Buying animals is a major investment, especially for a new producer who is building a herd. It is important to purchase quality stock¹ that will help the business achieve its production and economic goals. At the same time, the price paid for the herd must be affordable, in terms of the potential profit earned by the purchaser from the sale of meat and other products.

Demand for breeding stock is closely linked to the development potential of commercial operations, and thus to demand for meat. Prices for breeding stock are therefore higher when there is stronger demand for meat, but lower when the market is slow. In recent years, difficulties in developing new markets for farmed game meat have led to lower prices for breeding stock.

1. Two other factsheets in this series discuss the principal criteria to consider when purchasing red deer or bison: *Evaluating Red Deer for Breeding and Reproductive Management of Bison*.

AGRITOURISM

Agritourism is defined as a tourism activity associated with agriculture that takes place on a farm and brings producers and tourists together. Examples of agritourism include farm stays and educational activities, accommodation, food services, promotional activities and the sale of farm produce and regional agrifood products.

Depending on a region's agritourism potential, farm stays, on-farm sales and country meals can help make an operation profitable. Customers may be willing to pay a little more for a visit combined with a flavourful farm-cooked meal.

What is the average age and income of the surrounding population? How much do people know about large game animals and how they are raised? Successful agritourism means satisfying the interests, needs and expectations of the pool of prospective customers. Besides having the necessary permits, the premises must be clean and be equipped with adequate toilet facilities.

One does not become an "agritourism farmer" overnight. Being available, sociable, hospitable and open to others, and having pride in your business, animals and products, are just some of the qualities needed to succeed. *Le Pense-bête de l'agrotourisme* provided at http://www.mapaq.gouv.qc.ca/fr/Productions/agritourism/Pages/pense_bete.aspx (in French only) is a great source of information for producers who are interested in developing an agritourism project. Presented as a series of topical factsheets, this checklist is a practical guide to the procedures and stages involved, from the business plan to visitor reception to customer service, along with site preparation and regulations.

On the other hand, if the farm is distant from any city, major road or tourist attraction, the producer must go to his or her customers, since they will not come out to the farm. Distance to the abattoir is another factor: the business plan must include a realistic estimate of shipping costs and potential losses during shipping. Refrigeration equipment could be needed, adding to costs, while frequent deliveries of small quantities would cut into profits significantly.

VELVET ANTLER AND HARD ANTLER

Velvet antler (antler covered with velvet, early in the growth period) can be harvested and sold to be dried, ground and packaged in capsules. Velvet antler is highly prized in Asia for its therapeutic properties. In Canada, velvet antler capsules may be available in pharmacies or directly from the farmer.

Velvet antler prices have varied enormously. In the late 1990s producers could get over \$100 for a pound of frozen velvet antler, leading to high prices for breeding stock. The market dropped significantly in the early 2000s when bovine spongiform encephalopathy (BSE) was detected in a small number of cattle, while chronic wasting disease (CWD) was found in cervids in Western Canada. Countries that had been the main buyers of Canadian velvet antler closed their borders, causing velvet antler prices to plummet to less than \$20 a pound in 2010. This devastating price drop forced wapiti and red deer farmers to focus on

developing the market for game meat. The ups and downs of world markets and the presence of CWD in Canada are still affecting velvet antler sales. However, prices are slowly recovering, thanks to marketing efforts to recapture overseas customers that emphasize producers' efforts to eliminate CWD.

Hard antlers, i.e. antlers that are beyond the velvet stage, are in demand for crafts and the domestic pet food market, where a few companies process and market them as dog chews. The hard antler market is a temporary alternative to velvet antler, and prices reached record highs in 2011 and 2012.

HUNTING ACTIVITIES

Some operators have developed networks of contacts who provide them with a clientele of hunting enthusiasts eager for a trophy at any price.

Game ranches buy trophy animals from a small number of large game producers with extensive experience in advanced genetics. There seems to be a steady demand, since year after year, just before hunting season, trophy animals are sold by game farms to the game ranches. The producer should insist on being paid before the animals are shipped.

Producers interested in adding a hunting component to their business should review the applicable regulations, in particular the *Regulation respecting animals in captivity*, under the *Act respecting the conservation and development of wildlife*. They must also obtain a permit from the ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec.

Hunting activities practised in Québec primarily involve cervids. Bison and wild boar are also exploited for hunting, but to a lesser extent.

MARKETING STRATEGY

A good marketing strategy takes into account the producer's geographical location, the socio-economic environment, the markets, possible types of marketing, the producer's skills, labour needs and availability, existing or needed facilities, and the possible subcontracting of one or more parts of the marketing process. When the target clientele and product offering have been determined, a marketing plan can be developed to guide the producer's overall strategy. The marketing plan proposes activities to reach the target clientele, develop sales and position the producer in the market. A budget should be drawn up, covering not only the preparation of the marketing plan but the practical steps of implementing the strategy. Too often, producers forget to budget for promotional, distribution and marketing elements. Publicity can take different forms depending on financial means: posters, media, website, etc.

There are resources available to help the producer develop a marketing plan and strategy, including:

- the nearest local development centre (see <http://www.acldq.qc.ca>);
- companies specializing in communication and graphics;
- marketing students in universities and colleges.

SURVEY OF LEGISLATION APPLICABLE TO MARKETING

While there is no legislation specific to farmed large game animals, there are laws and regulations applying to various sectors that could affect large game producers.

Quebec legislation governs economic activities within the borders of the province. Thus, intraprovincial trade in game meat is subject to Québec legislation, while interprovincial and international trade are governed by federal legislation.

The laws and regulations of Québec are most easily consulted through the website of the Canadian Legal Information Institute (<http://www.canlii.org/en/qc/laws/index.html>). Those of greatest relevance include the:

- *Act respecting the conservation and development of wildlife (Regulation respecting animals in captivity)*. The operation of a game ranch requires a licence;
- *Animal Health Protection Act*. Sets out sanitation standards for places where animals are raised and sold;
- *Food Products Act*;
- *Act respecting tourist accommodation establishments*;
- *Act respecting reserved designations and added-value claims*.

Canada's laws and regulations are most easily consulted through the same site as above (<http://www.canlii.org/en/ca/laws/index.html>). Those of greatest relevance include the:

- *Meat Inspection Act*;
- *Canada Agricultural Products Act*;
- *Health of Animals Act* (particularly with regard to importing and exporting livestock);
- *Agricultural Products Marketing Act*;
- *Consumer Packaging and Labelling Act*.

Production Guide



DOMESTIC GAME FARM ANIMALS

Cervid Meat – Overview



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INTRODUCTION

Noble animals that for millennia have figured in the legends of peoples around the world, today the cervids represent a real opportunity for livestock production, one that despite its challenges offers considerable potential and is growing rapidly. This leaflet provides an overview of the principal aspects to master for the profitable production of venison (cervid meat): productivity, quality criteria, processing, marketing, etc., with further reference to customer satisfaction and relations with processors. The focus is on red deer and wapiti (often referred to as elk outside of Quebec), since they are the dominant species on Québec game farms. However, much of what is said here also applies to white tailed deer, sika deer, fallow deer and other cervids.

MARKETING

For an operation to be profitable, marketing considerations must be part of the business plan from the get-go. For the producer whose market is not already assured, there are two solutions: either find a market and supply it (this is practically a business in itself), or hand over marketing to a middleman. Unlike certain other farm sectors, cervid producers do not have the benefit of guaranteed sales or a system for income security. Is there a market for venison in Québec? Yes. Is there room for new producers? Yes. Will all their meat be sold? Probably not.

The more middlemen there are between producer and consumer, the lower the producer's share of the income per kilogram sold. Yet the difference in price often represents the colossal amount of work performed between the animal leaving the farm and meat arriving on the consumer's plate.

Potential markets

Potential markets for cervid meat include wholesale (whole carcasses for processors or distributors), restaurants, institutions (hospitals, schools) and retail (direct sale to consumers). Institutional markets are rare due to the higher cost of cervid meat.

It was once common for restaurants and families to buy whole carcasses to butcher themselves, but this is rare nowadays. Whole carcasses may be sold on game farms, but must follow additional food safety regulations.

PAST AND PRESENT

Farmed cervids are relative newcomers to Québec, compared to more traditional livestock like cattle and hogs. Yet cervid farms have been known for centuries in China, while in England red deer have long been farmed for hunting. In the United States, wapiti have been farmed since the late 19th Century, while New Zealand pioneered the large-scale farming of deer on pasture in the late 1970s (Roots, 2007). What was once reserved for the nobility is now a flourishing industry, producing high-end meat for the general public.

Cervid farming arose in Québec in the 1980s, with stags/bulls and velvet antler as the main products. Things changed early in the new millennium, as exports of velvet antler to China and Korea shrank, cross-border trade with the United States in animals for hunting became more difficult, and the genetic market became saturated. At the same time however, consumers began to seek healthier types of meat. All in all, things have become much more favourable to the farming of cervids for their meat, as to opposed to velvet antler and stags for hunting.

Most restaurants prefer to purchase only the cuts they need. For producers who can ensure a regular supply, consistent quality and a uniform product, restaurants can be an attractive market.

Retail marketing offers a variety of options. By order of increasing convenience for the consumer, they include: on-farm sales, country dining, farmer's markets, and selling through a website.

There are also more marginal markets, such as exports and food for domestic pets. However, these tend to be niche opportunities that arise when an operation is already established, as opposed to being integral to the start-up plan.

Sales structures

In Québec, cervid meat is primarily marketed through three different sales structures.

Marketing groups

Some producers cooperatively market their products as a group through a given processor or retailer. This approach most closely resembles how other types of livestock are marketed. Producers can concentrate on their herds, focusing their efforts on optimizing performance and genetics. Since sales are almost guaranteed, for a new producer it can be an attractive solution, provided he can meet the standards of the group or distributor. However, not all such groups have a large enough market to accept a new producer. Depending on the group there may be other drawbacks, such as a limit on production volume, or lower profitability if not enough effort is devoted to marketing.

Producer-processor-distributors

Producer-processor-distributors market their products themselves, whether on the farm, to retailers, in public markets or to restaurants. This structure demands the greatest amount of effort and the highest initial investment. If the business is short on manpower, there are significant time constraints. Since the best times for selling are when consumers are off work, this marketing approach requires a producer who can work on weekends and holidays, and who enjoys interacting with the public. Small processors also have a harder time handling the complex regulations governing meat processing.

The producer-processor-distributor model can potentially be quite profitable, since it provides control over both the initial processing (primary products, meats and expensive cuts) and any high-end processing (smoking, pâtés, etc.). It lets the producer specialize in one or more niche products.

Partnerships

Increasingly, farm businesses are forming complementary partnerships. This approach allows each partner to perform only the tasks in which it excels. For example, one partner may produce the animals, another may handle transportation, while yet another with facilities for slaughtering, butchering, processing and marketing may handle those aspects. The producer's remaining output can be sold at a group sales booth, through a nearby market gardener, or to a local grocery.

There are many possibilities, since Québec now has an extensive network of entrepreneurs in every phase of the industry, from transportation to retail. For businesses with few employees, partnership can be a good solution, letting them concentrate on aspects over which they want to retain the greatest control, whether out of interest or for greater profit. To explore these possibilities, talk with other producers and reach out to local businesses and agrifood clusters in your region. In short, grow your own network! Local development centres, chambers of commerce and producer groups are excellent resources to help you get started.

EFFECTIVENESS OF THE VALUE CHAIN

Regardless of which market and sales structure are chosen, cervid farms must be profitable. Though venison is a high-end product, customers will always want the best possible price, and will always have a price above which they will not buy. In an environment of global competition, improving profitability means evaluating the real potential of every link of the chain, so that performance can be optimized throughout. This has to begin on the farm.

Performance on the farm

A producer's first concern is to bring the animals to the desired market weight, as quickly as possible, while achieving excellent carcass quality. The factors explored below have the greatest impact on quality, but are in turn influenced by each animal's genetics, behaviour and place in the hierarchy of the herd.

Stress

Stress experienced by the animal will have an impact on the carcass. Rough handling, extreme temperatures, lack of water or food, all are stresses that have a negative effect on growth, causing it to slow, stop or even regress.

Feed

Feed has an impact on the taste and composition of meat. In New Zealand, one study found that carcass quality was good overall regardless of whether red deer were fed on pasture or concentrates. However, in meat from pasture-fed animals the omega-3/omega-6 ratio was more beneficial to human health, while a sensory analysis panel preferred the taste of meat from animals fed on concentrates (Wiklund and coll., 2003). Similar results were obtained with other cervids in Europe and North America.

Sex and age

While there are differences between meat from males and females, they are less pronounced when the animals are slaughtered young (Purchas and coll., 2010). In older animals (18 months and older), the meat of females has a stronger taste, is more tender, and has higher fat content and better water-retention (Daszkiewicz and coll., 2009).

Males should ideally be slaughtered before 15 months of age, mainly because the first rut reduces tenderness (Wiklund and coll., 2010). For females, slaughter age varies considerably, depending on economics and how the herd is managed; since it has less impact on quality, it has not been studied extensively.

Slaughter weight

Heavier animals obviously yield the most meat, but not always in the most profitable cuts. In a study of a small number of wapiti in Alberta, it was found that most of the additional weight was in fat and meat for grinding (Robertson and coll., 2003).

In red deer, studies suggest that the sensory qualities of meat are not affected by selecting for faster weight gain (Wiklund and coll., 2008).

Transportation from farm to abattoir has an impact on weight at slaughter, causing a weight loss (shrinkage) of 2 to 5%. The number of animals shipped per load also affects costs, since the rate per head tends to be less when more animals are shipped together. Good planning can reduce shipping costs.

Dressing percentage

Normally, animals are slaughtered relatively soon after arriving at the abattoir. If they do have to wait more than a few hours, providing feed and water can reduce losses in carcass weight (Robertson and coll., 2003). The quality of cervid meat is improved by taking steps to reduce pre-slaughter stress, though not as dramatically as in other species (Pollard and coll., 2002).

Dressing percentage is the ratio between live weight and the weight of the skinned, eviscerated, headless carcass. In cervids the dressing percentage is normally around 58%, plus or minus 10%. Though an interesting indicator, the dressing percentage varies depending on the type of feed. For example, pastured cervids will have a lower dressing percentage than those fed primarily on concentrates, the ruminal mass being greater in pastured animals.

Dressing percentage should be taken with a grain of salt, since sometimes the “live weight” in the calculation is the animal’s weight when it leaves the farm, while sometimes it is the weight on arrival at the abattoir. The two can produce significantly different dressing percentages for the same animal.

Cutting yield

Cutting yield is the percentage of the total weight of butchered, saleable meat to the weight of the carcass. Not all processors provide the cutting yield, but it is useful to producers. The cutting yield percentage can range from 50 to 80% depending on how the meat is cut and the quality of the butcher’s work. The butcher alone can make the cutting yield vary by plus or minus 15% depending on his or her skill (Table 1).

Table 1. Typical cutting yields for different cuts of meat¹

Cut	Typical yields
Tenderloin	1.1 to 1.8%
Strip loin	2.7 to 6%
Sirloin	2.1 to 2.4%
Rib eye	1.7 to 2.7%
Sirloin tip	3.6 to 5%
Round	11 to 20%
Ribs	1 to 4%
Chuck (Neck)	4 to 8%
Osso bucco	4 to 8.3%
Shoulder	4 to 10%
Stewing meat	6 to 14%
Trimming (ground)	17 to 40%
Bones	12 to 18%
Losses	5.5 to 15%

1. Values drawn from scientific articles, various compilations from butchers, and a symposium on large game held in Drummondville in 2002 (*Colloque sur les grands gibiers 2002*).

Sale price to the consumer

Figures 1 and 2 illustrate (for red deer and wapiti respectively) the sequence of stages in the journey from live animal to butchered carcass. With each stage there is a loss of potential yield in saleable meat, the final yield being crucial in determining what price the consumer should pay. With this data, the information in Table 1, and a producer's own production costs and sales forecasts, an average retail price can be calculated for the farm to be profitable.

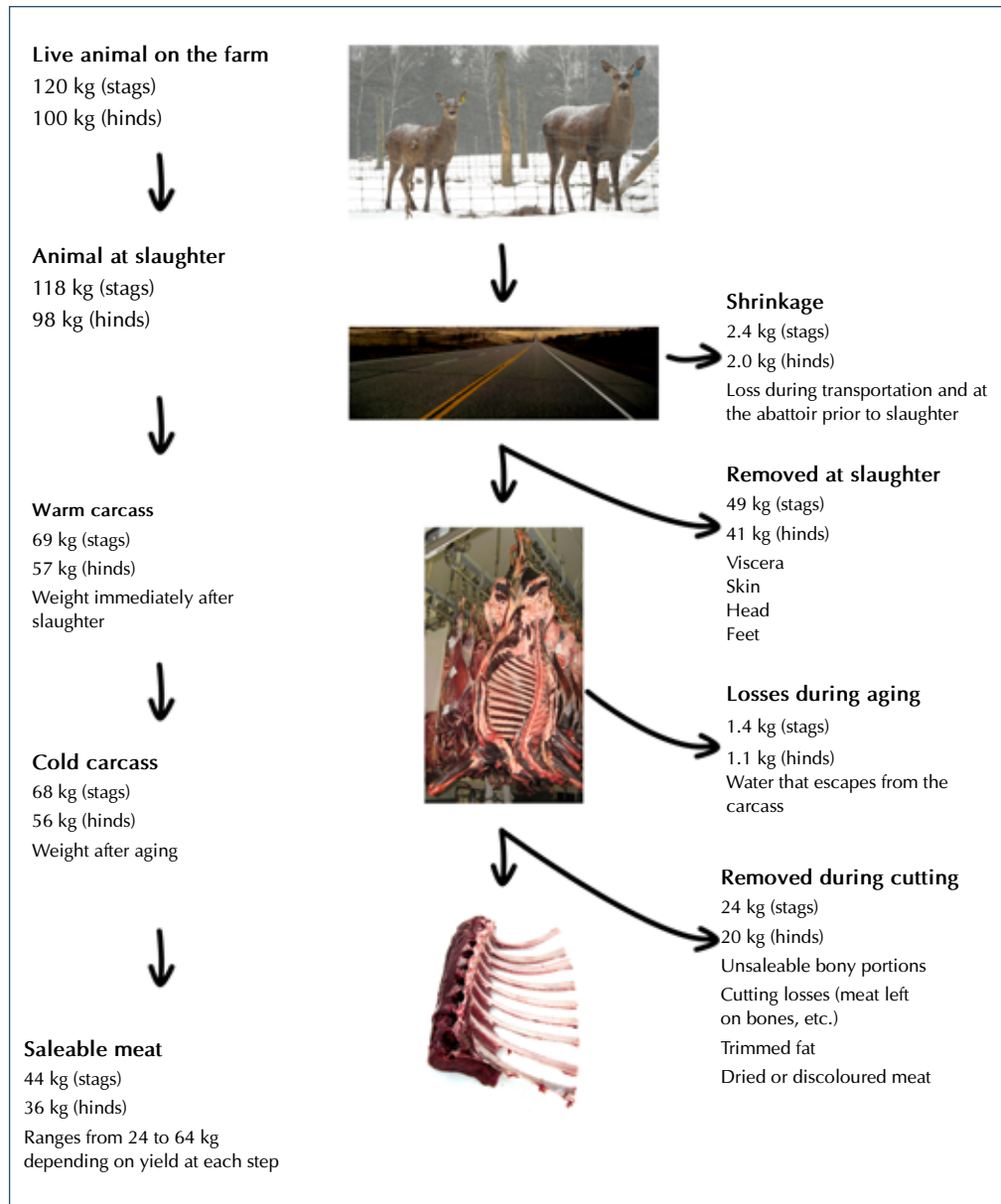


Figure 1. Stages and losses affecting the yield of saleable meat (red deer)

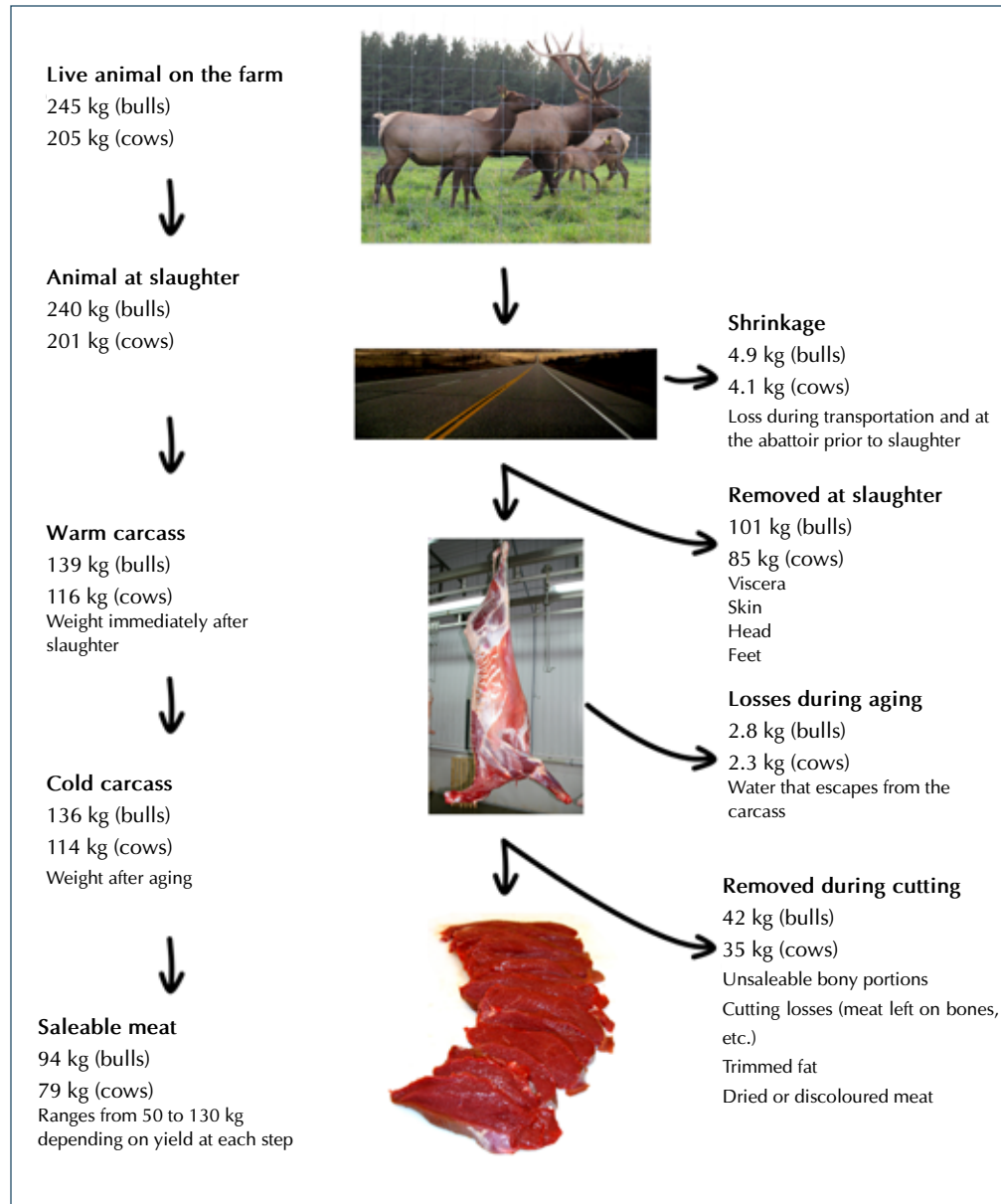


Figure 2. Stages and losses affecting the yield of saleable meat (wapiti)

VISUAL QUALITIES OF THE MEAT

Colour

The meat's colour is the first criterion judged by the consumer, who looks for meat that is bright red and does not have an excessive amount of fat. Variations in colour are primarily due to muscle myoglobin (a molecule that serves to transport oxygen). Myoglobin changes colour when it oxidizes, changing

progressively from purple to bright red, then greyish brown. These are chemical changes, as opposed to microbiological changes that could make the meat unsafe to eat. Myoglobin is denatured by cooking, thus the brown colour of cooked meat.

Raw meat that is exposed to carbon monoxide (and thereby protected from oxidation) takes on a bright red or pink colour. Protection against oxidation helps to preserve the myoglobin. This is why vacuum packing best conserves the colour of meat, and why it takes time for thawing meat to recover its colour through re-oxygenation.

Because game meat contains more myoglobin, it tends to be darker in colour than beef or lamb.

Packaging

The natural appearance of raw venison sometimes makes it more difficult to market. Various methods are used to improve its visual appeal, such as vacuum packing, butcher paper or a coloured box with a window to display the product. Good packaging is crucial to effective marketing, including every possible way of making meal preparation easier, such as frozen meals, prepared dishes, etc. Consumers buy first with their eyes.

Water loss

Water loss is perceived very negatively by consumers. No one wants to buy a package of meat swimming in juice, not to mention that such meat will shrink more during cooking and be dry and tough.

The water-retention capacity of meat is also important to the processor. Poor water retention causes problems when processing methods such as brine curing are applied. Excessive water loss represents a direct loss of saleable meat, in terms of the weight of product sold to consumers. Factors influencing water loss include stress levels before slaughter, the animal's condition when slaughtered, genetics, slaughter conditions and refrigeration.

Cervid meat has a greater water-retention capacity than beef (Farouk and coll., 2007), an advantage when it is sold fresh. On the other hand, it does not withstand prolonged freezing as well as beef. The meat of female cervids has better water-retention capacity than that of males (Daszkiewicz and coll., 2009; Purchas and coll., 2010).

SENSORY QUALITIES

Tenderness

Tenderness is the second most important criterion to the consumer after appearance. Cervid meat has a natural tenderness that is considered superior to that of beef (Farouk and coll., 2007; Wiklund and coll., 2008), perhaps due to the greater activity of enzymes during aging. However, tenderness is affected significantly by the method of cooking, so it is vital that consumers be well informed about how to properly cook venison. To maximize tenderness, cervid meat should be cooked slowly and to a lower internal temperature than that required for beef (Robertson and coll., 2003).

Meat tenderness can also be affected by the timing of slaughter (in the case of males) and by how the carcass is chilled. The meat of male cervids is a little less tender during and immediately after the rutting period (Stevenson, 1992). Also, if a cervid carcass is chilled too quickly the muscles tend to stiffen more. The chilling areas of abattoirs are generally intended for beef carcasses, which are larger and have more fat cover than cervids. The higher enzymatic activity of cervid meat is not enough to compensate for overly rapid chilling, which can cause the meat to lose a considerable degree of tenderness (Robertson and coll., 2003).

Flavour

Flavour is a combination of sensations arising from tastes, aromas and tactile sensations in the mouth. Venison has a stronger flavour than beef, and for many consumers the desire for intense flavours is greatest in the fall, perhaps through a natural association with hunting.

Succulence

Succulence refers to the liberation of juices during chewing. It is strongly related to the amount of water in the meat after cooking. In sensory analyses, venison is considered a somewhat drier meat than beef (Dhanda and coll., 2003; Wiklund and coll., 2008). However, there are significant differences between the venison from different cervid species.

pH

One factor that influences all of the characteristics mentioned above is the meat's pH (degree of alkalinity or acidity). If the pH is too high (alkaline) there is a greater risk of bacterial growth, along with problems affecting tenderness and succulence. On the other hand, if the pH is too low (acidic) the meat's colour will be less stable, and succulence and water-retention capacity will be diminished.

Factors affecting meat pH include the animal's stress levels during transportation and prior to slaughter, and the carcass temperature. If the carcass temperature is too high the pH will drop too quickly. However that is rarely a problem with cervids, since usually it is the opposite that occurs (chilling too quickly) because the refrigeration system was designed for beef, as noted above.

Though pH can vary widely in cervids due to individual differences in animals and different husbandry methods, the average pH is about 5.62 at 24 hours after slaughter (Pollard and coll., 2001; Dhanda and coll., 2003; Wiklund and coll., 2008).

HEALTH BENEFITS

Apart from the overall nutritional quality of venison, one of its principal advantages (and best selling point) is its low fat content (Table 2). The benefits of omega-3 are often touted in advertising, but since omega oils are in the fat, it is hard to demonstrate any real advantage in a product as lean as cervid meat.

Table 2. Nutritional value of cervid meat compared to other species

Element	Red deer/ Wapiti	Beef	Pork	Chicken
Water (% or g/100 g)	73 – 76	69.93	72.23	75.79
Protein (% or g/100 g)	21.6 – 23.0	21.85	21.43	21.23
Fat (% or g/100 g)	0.63 – 1.9	16.71	5.66	2.59
Iron (mg/100 g)	3.07 – 3.34	1.94	0.84	0.37
Energy (kJ/100g)	484 – 658	645	598	477

Data compiled from: Stevenson, 1992; Dhanda and coll., 2003; Farouk and coll., 2007; Wiklund and coll., 2008; Daszkiewicz and coll., 2009; Purchas and coll., 2010; Wiklund and coll., 2010.; USDA, 2011.

PRODUCT IMAGE

Cervid meat is a high-end product that consumers do not simply purchase as a matter of course, the way they do beef. The product's image is therefore very important from a marketing point of view. We should try to take advantage of how deer and wapiti are perceived in the collective imagination.

Cervid farming is relatively new in Québec, and hunting activities are still present on many cervid farms. Whether speaking of cervids in general, red deer, wapiti, or large game, most people instinctively make the connection with wildlife. Some producers are successful at capitalizing on this, focusing on a market that appreciates the "wilder" taste of game meat, a taste that can be enhanced by putting cedar branches in the paddock for the last 3 weeks before the animals are slaughtered.

Most people envision cervid being farmed on vast pastures. While it is indeed more extensive than other productions, not all producers have the land to raise their animals that way. If hard-won markets are to be gained or maintained, good husbandry practices (Canadian Cervid Alliance, 2009) and careful attention to the image of the cervid farming sector are important. Farm facilities and husbandry practices must reflect the animals' needs and the values of consumers, especially with respect to animal welfare.

There are various certifications and trademarks by which a cervid producer can gain consumer recognition and become a preferred supplier. Examples include "*Grands Gibiers du Québec*" and "*Aliments du Québec*" certification, the trademarks of various distributors, and an array of designations and certifications at the regional, provincial, national and international levels. More formal designations that would be protected by legislation are in development, but this concept is still new in Quebec. To learn more, see the website of the Conseil des appellations réservées et des termes valorisants (council on reserved designations and added-value claims), at <http://www.cartv.gouv.qc.ca>.

CONCLUSION

Whether raising red deer or wapiti, producing quality meat demands just as much work as with other types of livestock, as demonstrated by the wide variations in quality and yield. The beauty and the challenge of the cervid farming industry lies in its wealth of possibilities and the freedom of producers to create their own solutions for sales and marketing.

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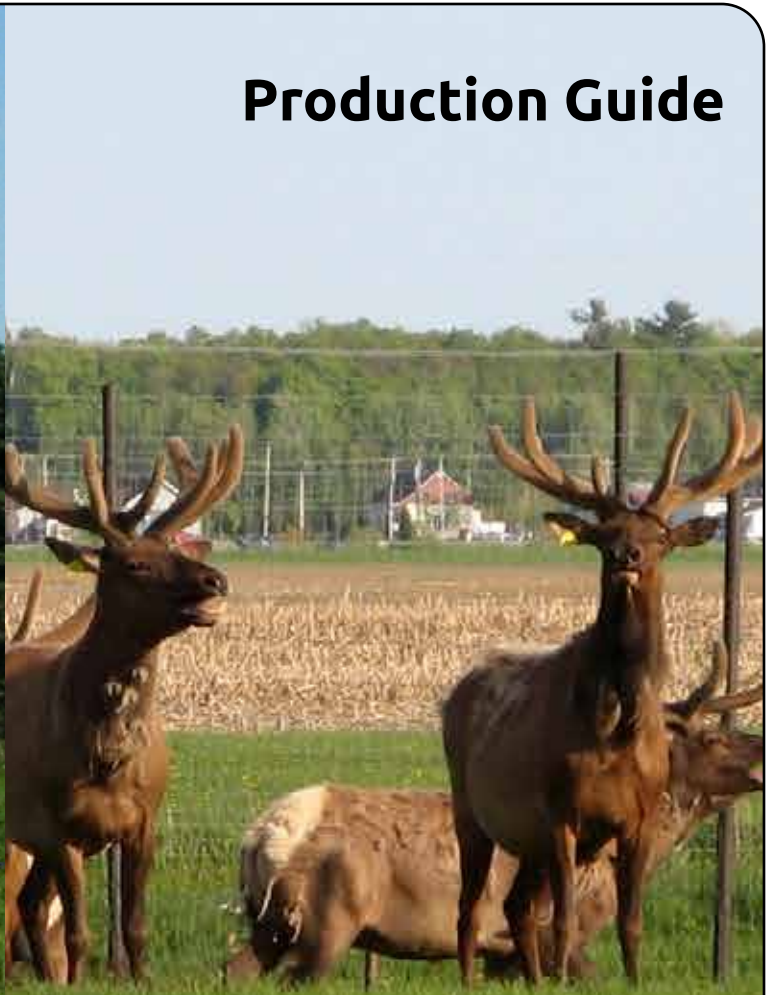
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Production Guide



DOMESTIC GAME FARM ANIMALS

Preventive Medicine – Overview



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INTRODUCTION

For anyone farming game animals like wild boar, bison, deer and wapiti (known as elk outside of Québec), disease prevention should be a priority. Healthy conditions and proper feeding will go a long way toward ensuring the health of a herd. Remember that when animals live in poor conditions they are stressed and weakened, which predisposes them to disease.

Also, since many problems are multi-factoral, the effectiveness of preventive and curative treatments can be significantly influenced by the conditions in which animals are raised.

This leaflet presents the various preventive health measures that can be used by game farmers with animals like wild boar, bison, deer and wapiti.

GENERAL RULES

Here are the fundamental rules of disease prevention in game farming:

1. For wild boar farming, keep a distance of at least 5 km from the nearest pig farm. To reduce the risk of disease transmission, keep well away from fields where pig manure is spread;
2. To reduce stress on the animals, keep a good distance from busy roads;
3. Ensure that pens and pastures are well drained, since mud and stagnant water are breeding grounds for parasites;
4. Feeders and feeding areas should be kept clean to reduce disease transmission;
5. Restrict visitor access;
6. Quarantine newly purchased animals;
7. Divide the animals into age groups;
8. Practise pasture rotation and alternative tillage to reduce the parasite load in pens and pastures;
9. Keep good records of all curative and preventive treatments performed;
10. Promptly dispose of carcasses of dead animals.

WILD BOAR

Since the wild boar is very similar to the domestic pig, it is susceptible to many of the same diseases. Unfortunately there is no documentation specific to wild boar describing their diseases and the effectiveness of vaccines and other livestock medicines.

The preventive treatments listed in Tables 1 and 2 are administered to domestic pigs. The pros and cons of applying such measures to a wild boar herd should be discussed with your veterinarian. Specifically, you must assess whether the benefits of an intervention outweigh the stress and risk of an accident associated with handling the animals.

Tableau 1. Vaccination bactérienne chez l'espèce porcine

Disease	Type of vaccine	Dose	Advantages-disadvantages
Neonatal diarrhea	Inactivated vaccine	<ul style="list-style-type: none"> Sow : two doses of 2 ml (IM¹), 3 to 6 weeks apart; then every year, 2 to 6 weeks before farrowing 	<ul style="list-style-type: none"> Withdrawal time²: 0 day Used on sows (maternal transmission in colostrum) Can be combined with a vaccine against clostridiums, which in some cases are associated with neonatal diarrhea and other less common conditions affecting sows
Porcine proliferative enteropathy	Attenuated vaccine	<ul style="list-style-type: none"> Piglet over 3 weeks: 2 ml (IM) 	<ul style="list-style-type: none"> Withdrawal time: 0 day Can be administered in water Protection after 3 weeks; lasts 17 weeks
Glasser's disease	Inactivated vaccine	<ul style="list-style-type: none"> Piglet over 5 weeks: two doses of 2 ml (IM), 2 weeks apart Sow: two doses of 2 ml, 4 weeks apart; then every year, 2 to 4 weeks before farrowing 	<ul style="list-style-type: none"> Protection about 14 weeks Important to immunize sows, since the disease mostly affects 2-week piglets Withdrawal time: 0 day
Contagious pleuro-pneumonia	Inactivated vaccine containing APX toxins	<ul style="list-style-type: none"> Two doses of 2 ml (IM), 4 weeks apart, for animals 6 weeks and over 	<ul style="list-style-type: none"> Withdrawal time: 0 day Partial clinical protection
Enzootic pneumonia	Inactivated vaccine	<ul style="list-style-type: none"> Piglet 5 days and up: two doses of 2 ml (IM), 3 to 4 weeks apart Piglet 10 weeks and up: 2 ml (IM) 	<ul style="list-style-type: none"> Most effective at weaning, but ideally the entire herd should be vaccinated Can be obtained in combined form with a vaccine against Glasser's disease
Atrophic rhinitis	Inactivated vaccine	<ul style="list-style-type: none"> Piglet over 18 months: two doses of 2 ml (IM), 6 weeks apart Sow: once a year, 2 to 6 weeks before farrowing 	<ul style="list-style-type: none"> Important to administer to sows (maternal transmission in colostrum) Withdrawal time: 0 day
Swine erysipelas	Inactivated vaccine	<ul style="list-style-type: none"> Piglet over 12 weeks: two doses of 2 ml (IM), 4 weeks apart Yearly vaccination: 2 ml before each lactation 	<ul style="list-style-type: none"> Withdrawal time: 0 day Protection for 6 months Can be combined with vaccine against parvovirus (see Table 2)

1. IM : intramuscular injection.

2. Withdrawal time: minimum time required between administration of the drug and slaughter of the animal.

Table 2. Viral vaccination in porcine species

Disease	Type of vaccine	Dose	Advantages-disadvantages
Porcine circovirus	Inactivated vaccine	<ul style="list-style-type: none"> Two doses of 2 ml (IM¹), 3 to 4 weeks apart; then 2 ml each year, 2 weeks before farrowing 	<ul style="list-style-type: none"> Withdrawal time²: 0 day Used in the sow and piglets at weaning
Influenza	Inactivated polyvalent vaccine	<ul style="list-style-type: none"> Two doses of 2 ml (IM), 3 to 4 weeks apart Repeat each year, 2 to 3 weeks before farrowing 	<ul style="list-style-type: none"> Especially during fattening Withdrawal time: 0 day
Parvovirus	Inactivated vaccine	<ul style="list-style-type: none"> Two doses of 2 ml (IM), 3 weeks apart, then annually 	<ul style="list-style-type: none"> First dose given 6 weeks before breeding Can be combined with vaccine against swine erysipelas (see Table 1) Withdrawal time: 0 day
Porcine reproductive and respiratory syndrome (PRRS)	Live vaccine for piglets Inactivated vaccine for sows	<ul style="list-style-type: none"> Piglet 4 to 5 weeks: 2 ml (IM) Sow: 2 ml (IM), 3 weeks before breeding 	<ul style="list-style-type: none"> Withdrawal time: 2 days

1. IM: intramuscular injection.

2. Withdrawal time: minimum time required between administration of the drug and slaughter of the animal.

Depending on production conditions, parasites can cause a lot of problems in wild boar. In principle, de-worming efforts should focus on the periods of highest risk. Thus, it is strongly recommended that de-worming be done at the following times: in spring before the animals are put in pens; whenever they are rotated from one pen to another; in autumn before the first frosts; and in the case of sows, before farrowing. The various treatments available are listed in Table 3.

Table 3. Antiparasitic drugs that can be used in wild boar

Product	Dose	Withdrawal time ¹	Use
Amprolium	20 mg/kg (oral)	7 days	Coccidiosis
Doramectin Injectable	300 µg/kg (IM ²)	35 days	Intestinal worms Lungworms Lice, mites
Febendazole 20%	9 mg/kg for 3 days (oral)	7 days	Intestinal worms Lungworms
Ivermectin Injectable	300 µg/kg (SC ³)	28 days	Intestinal worms Lungworms Lice, mites
Ivermectin (oral)	100 µg/kg	7 days	Intestinal worms Lungworms Lice, mites
Levamisole 10%	2 kg of ration at 0.04% per 100 kg of weight	4 days	Intestinal worms Lungworms
Levamisole Injectable	1 ml/10-20 kg (SC)	28 days	Intestinal worms Lungworms
Sulfaquinoxaline	1 g/4 litres water	14 days	Coccidiosis

1. Withdrawal time: minimum time required between administration of the drug and slaughter of the animal.

2. IM: intramuscular injection.

3. SC: subcutaneous injection.

CERVIDS AND BISON

Many of the diseases to which cervids and bison are susceptible are similar to those seen in cattle. As a result, experience gained with bovines has provided many preventive measures that are applicable to game animals. However, since very few studies have focused on the vaccination of cervids and bison, its use is largely up to the experience of the veterinarian. The main preventive measures applying to large game animals (according to the literature available) are presented in Tables 4 and 5.

Table 4. Principal vaccines used with large game animals, particularly cervids and bison

Disease	Type of vaccine	Dose	Advantages-disadvantages
Neonatal diarrhea <i>E.coli</i> -Rotavirus- Coronavirus	Bacterin and inactivated vaccine	<ul style="list-style-type: none"> Two doses of 2 ml (SC¹), 1 month apart Repeat annually 	<ul style="list-style-type: none"> Withdrawal time²: 60 days Rota and corona viruses have not been proven in cases of diarrhea in deer and bison, despite having been isolated
Clostridium family	Bacterin with 8 serotypes	<ul style="list-style-type: none"> Two doses of 5 ml (SC or IM³), 21 days apart Repeat annually 	<ul style="list-style-type: none"> Used for several years now on deer and bison Withdrawal time: 21 days
IBR-BVD-PI3-BRSV ⁴	Modified live vaccine Inactivated vaccine	<ul style="list-style-type: none"> Live vaccine (SC or IM): two doses of 2 ml, 1 month apart, then annually Inactivated vaccine: two doses of 5 ml (SC or IM), 3 weeks apart, then annually 	<ul style="list-style-type: none"> Live vaccine used for bison during fattening Inactivated vaccine used for females Withdrawal time: 21 days Despite the presence of antibodies in bison and deer, these diseases have not been diagnosed with certainty
IBR-PI3	Attenuated vaccine (intra-nasal)	<ul style="list-style-type: none"> 1 ml/nostril 	<ul style="list-style-type: none"> Withdrawal time: 21 days Can be used on the entire herd Handling difficulties
Pasteurellosis	Bacterin	<ul style="list-style-type: none"> Two doses of 2 ml (IM), 3 weeks apart Then annually 	<ul style="list-style-type: none"> Use on bison farms in Montana seems to have given some protection Withdrawal time: 21 days

1. SC: subcutaneous injection.

2. Withdrawal time: minimum time required between administration of the drug and slaughter of the animal.

3. IM: intramuscular injection.

4. IBR: infectious bovine rhinotracheitis; BVD: bovine virus diarrhea; PI3: parainfluenza type 3; BRSV: bovine respiratory syncytial virus.

Vaccines against leptospirosis, infectious keratoconjunctivitis, anaplasmosis and babesiosis are not recommended for these species.

Cervids and bison are susceptible to parasitic infection after being confined in pens, but with good production conditions and a de-worming program parasites can be controlled. Generally, de-worming is recommended in the spring to prevent pastures from being contaminated, and in the fall after the first frosts. The principal livestock medicines used are presented in Table 5.

Table 5. Principal antiparasitic drugs used with cervids and bison

Product	Dose	Withdrawal time ¹	Use
Albendazole	• 10 mg/kg (oral)	27 days	Flukes
Amprolium	• 5 ml per 100 lb (oral), once a day for 5 days	7 days	Coccidiosis
Cyfluthrin 1%	• 2 to 12 ml (pour-on ²) depending on weight • Repeat after 21 days	1 day	Flies, lice
Doramectin	• 200 µg/kg (SC ³ and IM ⁴) • 500 µg/kg (pour-on)	40 days (SC and IM) 55 days (pour-on)	Intestinal worms Lungworms Lice, mites
Eprinomectin	• 500 µg/kg (pour-on)	0 day	Intestinal worms Lungworms Lice, mites
Febantel	• 7.5 mg/kg (oral)	21 days	Intestinal worms Lungworms
Febendazole	• 7.5 mg/kg (oral)	14 days	Intestinal worms Lungworms
Ivermectin	• 200 µg/kg (SC) • 500 µg/kg (pour-on)	49 days	Intestinal worms Lungworms Lice, mites
Levamisole	• 7.5 mg/kg (oral and SC) • 10 mg/kg (pour-on)	10 days (oral and SC) 7-28 days (pour-on)	Intestinal worms Lungworms
Moxidectin	• 500 µg/kg (pour-on)	36 days	Intestinal worms Lungworms Lice, mites
Permethrin 1%	• 15 ml/45 kg up to a maximum of 150 ml (pour-on)	1 day	Flies, lice
Permethrin 10%	• Ear tags	0 day	Horn flies Face flies

1. Withdrawal time: minimum time required between administration of the drug and slaughter of the animal.

2. Pour-on: applied locally on the animal's back, the product being absorbed through the skin.

3. SC: subcutaneous injection.

4. IM: intramuscular injection.

CONCLUSION

Farm production of large game animals is still a recent phenomenon in Québec, and little research has been done on the subject. The veterinary medicine required, both preventive and curative, has yet to be developed and registered for use in game animals. As a result, the veterinary interventions currently practised on game farms in Québec are essentially based on experience gained with cattle and hogs.

Raising game animals in pens contributes to the development of disease because they are held together in greater concentration than in their natural environments. Good production conditions and practices are therefore very important for the herd's health. At the same time, since disease cannot be controlled by livestock medicines alone, regular preventive treatments are essential.

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Production Guide



DOMESTIC GAME FARM ANIMALS

Principal Diseases of Red Deer and Wapiti



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INTRODUCTION

Red deer and wapiti (often referred to as “elk” outside of Québec) are rarely sick. Many of the diseases that can affect them are also observed in domestic cattle. Detection is exceedingly difficult however, because cervids do not become domesticated. This means that a sick cervid will instinctively try to conceal its abnormal condition, to avoid being noticed by predators. The result is that producers must be very attentive, observing their animals regularly to detect whether an animal is unwell. Early detection of disease will prevent propagation in the herd, limiting the economic impact on the producer. With some diseases (referred to as zoonotic) there is a risk of animal-to-human transmission, making early detection especially important.

To facilitate the veterinarian’s work when conducting examinations and administering treatment, the farm must be equipped with good facilities for handling the animals. With a crowding pen to guide the animals in the desired direction, and a squeeze to immobilize them, administering preventive and curative treatments is relatively straightforward. This will ensure both the animals’ safety and that of the humans working with them.

This leaflet presents most of the bacterial, parasitic and viral diseases that can affect red deer and wapiti, together with the various treatments that can be administered by a veterinarian.

BACTERIAL DISEASES

Table 1 presents the bacterial diseases that are encountered most often in red deer and wapiti herds. Various treatments can be provided by the herd veterinarian.

Table 1. The most common bacterial diseases

Name	Causal agent(s)	Symptoms	General treatment
Anthrax ¹	<i>Bacillus anthracis</i> (contamination by ingestion)	<ul style="list-style-type: none"> • Sudden death frequently occurs • Dehydration • Constipation • Blood loss through natural orifices 	<ul style="list-style-type: none"> • Follow Canadian Food Inspection Agency (CFIA) guidelines
Brucellosis ¹	<i>Brucella abortus</i>	<ul style="list-style-type: none"> • Abortion • Lameness with joint damage 	<ul style="list-style-type: none"> • Follow CFIA guidelines
Blackleg ²	<i>Clostridium chauvoei</i> (contamination by ingestion)	<ul style="list-style-type: none"> • Rare in cervids • Mostly young animals under 2 years old • Lameness, depression, muscle swelling with joint clicking • Death within 24-48 hours • Swift post-mortem decomposition 	<ul style="list-style-type: none"> • Primarily high-dose penicillin for 3 to 5 days • Tetracyclines

Table 1 (continued). The most common bacterial diseases

Name	Causal agent(s)	Symptoms	General treatment
Colibacillosis	<i>Escherichia coli</i>	<ul style="list-style-type: none"> • Mostly young animals under 3 weeks old • Abundant whitish diarrhea • Complicated by arthritis and pneumonia 	<ul style="list-style-type: none"> • Bolus of oral antibiotics • Parenteral antibiotics (various means of administration) • Fluid therapy, either intravenous or oral
Enterotoxemia (oedema disease) ²	<i>Clostridium perfringens</i>	<ul style="list-style-type: none"> • Mostly young animals • Anorexia • Diarrhea • Depression • Sudden death 	<ul style="list-style-type: none"> • Long-acting intramuscular tetracyclines at first, followed by oral treatment in feed
Kerato-conjunctivitis (Pink eye)	<i>Moraxella bovis</i>	<ul style="list-style-type: none"> • Corneal opacity • Tearing • Conjunctival inflammation • Corneal ulcer 	<ul style="list-style-type: none"> • Subconjunctival injection of penicillin and streptomycin • Tetracyclines orally for the entire herd • Topical ointment in the eyes
Leptospirosis	<i>Leptospira</i> (various serotypes; contamination by food, water, urine and semen)	<ul style="list-style-type: none"> • Young animals most susceptible • Abortion, anorexia and loss of coordination • Hematuria and jaundice 	<ul style="list-style-type: none"> • Streptomycin: 25 mg/kg/day for 4 days
Listeriosis ²	<i>Listeria monocytogenes</i> (found especially in haylage/silage)	<ul style="list-style-type: none"> • Abortion • Septicemia • Meningoencephalitis • Unilateral facial paralysis • Circling • Abnormal head carriage • Difficulty eating feed 	<ul style="list-style-type: none"> • Chlortetracycline: 10 mg/kg/day intravenously for 5 days • Penicillin: 44,000 UI/kg/day intramuscularly for 7 to 14 days <p>(treatment is often unsuccessful, requiring that the animal be culled)</p>
Malignant oedema	<i>Clostridium chauvoei</i> , <i>C. septicum</i> , <i>C. perfringens</i> , <i>C. novyi</i> , <i>C. sordellii</i> (after calving, a bad injection or an injury)	<ul style="list-style-type: none"> • Mostly white-tailed deer and wapiti • Fever, lameness, depression, difficulty breathing • Muscle swelling with presence of gas 	<ul style="list-style-type: none"> • Long-acting high-dose penicillin

Table 1 (continued). The most common bacterial diseases

Name	Causal agent(s)	Symptoms	General treatment
Para-tuberculosis ²	<i>Mycobacterium paratuberculosis</i> (contaminated water or feed)	<ul style="list-style-type: none"> • Many asymptomatic carriers • Deer, 1 year old • Wapiti, 18 months to 2 years old • Dramatic weight loss • Death within a few weeks or months • Diarrhea 	<ul style="list-style-type: none"> • No satisfactory treatment • Often the best thing is to cull the animal
Pasteurellosis	<i>Pasteurella multocida</i> , <i>Mannheimia hemolytica</i>	<ul style="list-style-type: none"> • Difficulty breathing • Drooling • Anorexia and depression 	<ul style="list-style-type: none"> • Long-acting tetracyclines: 20 mg/kg intramuscularly • Trimethoprim-sulfa: 3 to 5 ml/45 kg/day for 3 days • Penicillin: 20,000 to 30,000 UI/kg/day for 3 days • Draxxin®: 2.5 mg/kg subcutaneously • Ceftiofur: 6.6 mg/kg subcutaneously in the ear • Tetracyclines in feed
Foot rot, interdigital dermatitis ²	<i>Fusobacterium necrophorum</i>	<ul style="list-style-type: none"> • Lameness, revealed especially when the animal is supported in the squeeze • Necrosis in the interdigital space 	<ul style="list-style-type: none"> • Penicillin and tetracyclines • Copper sulfate footbath
Salmonellosis ²	<i>Salmonella</i> (various serotypes; ingestion of contaminated feed)	<ul style="list-style-type: none"> • Mostly young animals under 2 weeks old • Acute diarrhea • Anorexia and depression • Septicemia 	<ul style="list-style-type: none"> • Various antibiotics: ampicillin, gentamicin, trimethoprim-sulfa • With fluid therapy
Bovine tuberculosis ¹	<i>Mycobacterium bovis</i> , <i>M. tuberculosis</i> (air-borne transmission)	<ul style="list-style-type: none"> • Carriers often asymptomatic • Emaciation • Respiratory problems 	<ul style="list-style-type: none"> • Follow CFIA guidelines
Pseudo-tuberculosis (yersiniosis)	<i>Yersinia pseudotuberculosis</i> (primarily) and <i>Y. enterocolitica</i> (following stress due to inadequate feeding or overpopulation)	<ul style="list-style-type: none"> • Mostly young animals under 1 year old • Anorexia and diarrhea 	<ul style="list-style-type: none"> • Treatment based on tetracyclines, trimethoprim-sulfa (success varies) • With fluid therapy

1. This disease must be reported to the CFIA. For information on treatment, see the factsheet provided on the CFIA's website at <http://www.inspection.gc.ca>.
2. Annually notifiable disease for which Canada must present a report to the World Organization for Animal Health (OIE) indicating its presence in the country, if any.

A number of other bacterial diseases, such as actinobacillosis, actinomycosis and tetanus, are occasionally encountered in cervid herds.

PARASITIC DISEASES

Parasitic diseases are probably the most important health related problem in cervid herds. Promoted by the animals' confinement in pens, they can quickly infect the entire herd. Their various manifestations and principal recognized treatments are presented in Table 2.

Table 2. The principal parasitic diseases

Type	Causal agent(s)	Symptoms	General treatment
Cestodes	<i>Echinococcus</i> <i>Monezia</i> <i>Taenia</i> <i>Thysanosoma</i>	<ul style="list-style-type: none"> Rarely causes problems In a heavy infestation: <ul style="list-style-type: none"> - Stunting - Weight loss - Diarrhea 	<ul style="list-style-type: none"> No specific treatment known Fenbendazole and cambendazole have been used
Coccidiosis ¹	<i>Eimeria isospora</i> (primarily)	<ul style="list-style-type: none"> No clinical signs described for cervids, but in cattle, diarrhea with weight loss is noted 	<ul style="list-style-type: none"> Amprolium: 5 ml/45kg/day orally for 5 days Sulfonamides
	Cryptosporidiosis Sarcocystosis Toxoplasmosis	<ul style="list-style-type: none"> Occasionally found in cervids 	<ul style="list-style-type: none"> No specific treatment
Nematodes	<i>Heamonchus</i> <i>Ostertagia</i> <i>Trichostrongylus</i>	<ul style="list-style-type: none"> Weight loss Diarrhea Anemia 	<ul style="list-style-type: none"> Ivermectin: 1 ml/10 kg transcutaneously² Mebendazole: 10 mg/kg/day for 3 days
	<i>Dictyocaulus viviparus</i> (a lungworm)	<ul style="list-style-type: none"> Weight loss Unexplained mortality over several weeks Respiratory signs infrequent in deer 	<ul style="list-style-type: none"> Ivermectin: 1 ml/10 kg transcutaneously
	<i>Parelaphostrongylus tenuis</i> (a brainworm)	<ul style="list-style-type: none"> Loss of coordination Loss of fear of humans Lameness Paralysis Abnormal carrying of head and neck 	<ul style="list-style-type: none"> Ivermectin: 0.1 to 0.2 mg/kg subcutaneously in third larval stage Albendazole: 25 mg/kg/day for 2 weeks in feed for adult forms
	<i>Elaphostrongylus cervi</i> (a muscle worm)	<ul style="list-style-type: none"> Interstitial pneumonia in the larval stage Nervous problems 	<ul style="list-style-type: none"> Ivermectin: <ul style="list-style-type: none"> - 0.1-0.2 mg/kg subcutaneously - 1 ml/10 kg transcutaneously

Table 2 (continued). The principal parasitic diseases

Name	Causal agent(s)	Symptoms	General treatment
Nematodes (continued)	<i>Elaeophora schneideri</i> (an arterial worm)	<ul style="list-style-type: none"> • Chronic dermatitis • Bilateral blindness in wapiti • Sudden death after thrombosis 	<ul style="list-style-type: none"> • No known treatment, since the lesions are too advanced when symptoms appear
Trematodes	<i>Dicrocoelium dendriticum</i> <i>Fasciola hepatica</i> <i>Fasciolides magna</i>	<ul style="list-style-type: none"> • Depending on the severity of the infestation, which primarily affects the liver: <ul style="list-style-type: none"> - Weight loss - Stunting 	<ul style="list-style-type: none"> • Triclabendazole 24%: 50 mg/kg orally, repeat after 7 days • Albendazole in feed for 7 days
External parasites	Mites Flies Lice Ticks	<ul style="list-style-type: none"> • Implicated in the transmission of diseases and other parasites: <ul style="list-style-type: none"> - Biting insects: arterial worms - Flies: Pink eye - Ticks: anaplasmosis 	<ul style="list-style-type: none"> • Lice and mites: <ul style="list-style-type: none"> - Ivermectin: 0.2 mg/kg by injection or 1 ml/10 kg transcutaneously² - Delice® transcutaneously - Cylence® (cyfluthrin 1%) transcutaneously • Ticks: Flumethrin 1% • Flies: Delice® transcutaneously

1. Annually notifiable disease for which Canada must present a report to the World Organization for Animal Health (OIE) indicating its presence in the country, if any.
2. Transcutaneous: applied locally on the back of the animal, the drug is absorbed through the skin (pour-on products).

VIRAL DISEASES

There is little documentation on viral diseases in cervids. In Canada, a number of viral diseases have occasionally been detected through the presence of antibodies, without the animals displaying any clinical signs. The principal viral diseases that can affect cervids are presented in Table 3.

Table 3. The principal viral diseases

Name	Causal agent(s)	Symptoms	General treatment
Bluetongue ¹ (epizootic hemorrhagic disease in deer)	Orbivirus (transmitted by midges)	<ul style="list-style-type: none"> • Respiratory distress • Lameness and diarrhea • Abortion and fever • 90% mortality 	<ul style="list-style-type: none"> • Follow CFIA guidelines
Neonatal diarrhea	Coronavirus Rotavirus	<ul style="list-style-type: none"> • These viruses are often associated with <i>E.coli</i> in neonatal diarrhea • 50% mortality 	<ul style="list-style-type: none"> • Supportive treatment with antibiotics and oral fluid therapy
Bovine viral diarrhea / mucosal disease (BVD-MD)	Togavirus	<ul style="list-style-type: none"> • No known clinical manifestation in red deer and wapiti, even though antibodies have been found 	<ul style="list-style-type: none"> • Supportive treatment with antibiotics and fluid therapy

Table 3 (continued). The principal viral diseases

Name	Causal agent(s)	Symptoms	General treatment
Bovine malignant catarrhal fever ²	Herpesvirus	<ul style="list-style-type: none"> • Infection transmitted in the first 3 months of life • Bloody diarrhea • Fever, drooling and tearing • Death within 48 hours 	<ul style="list-style-type: none"> • Massive doses of antibiotics in the acute phase, but results often disappointing. The animals are left with the chronic forms.
Poxvirus	Parapoxvirus	<ul style="list-style-type: none"> • Encountered in wapiti • Scabs on the muzzle, at the junction of lips and gums, on the ears and velvet antlers 	<ul style="list-style-type: none"> • No specific treatment • Often spontaneous recovery
Rabies ¹	Rhabdovirus	<ul style="list-style-type: none"> • The aggressive form is rare in deer • Primarily the progressive paralytic form is encountered in cervids 	<ul style="list-style-type: none"> • Follow CFIA guidelines
Infectious bovine rhinotracheitis (IBR) ²	Herpesvirus-1	<ul style="list-style-type: none"> • No known clinical signs in red deer and wapiti • Mule deer: anorexia, drooling, respiratory distress 	<ul style="list-style-type: none"> • Supportive treatment with antibiotics for secondary infections

1. This disease must be reported to the CFIA. For information on treatment, see the factsheet provided on the CFIA's website at <http://www.inspection.gc.ca>.
2. Annually notifiable disease for which Canada must present a report to the World Organization for Animal Health (OIE) indicating its presence in the country, if any.

OTHER DISEASES

Other diseases not belonging to the categories above may also be encountered in red deer and wapiti herds. They are presented in Table 4.

Table 4. Other diseases

Name	Causal agent(s)/ Disease	Symptoms	General treatment
Prion disease	Chronic wasting disease (CWD) ¹	<ul style="list-style-type: none"> • Emaciation • Increased salivation and urination • Head tremors • Wide posture • Lack of coordination 	<ul style="list-style-type: none"> • Follow CFIA guidelines
Rickettsia	<i>Anaplasma marginale</i> (anaplasmosis ¹)	<ul style="list-style-type: none"> • Severe anemia • Weakness, listlessness 	<ul style="list-style-type: none"> • Follow CFIA guidelines
	<i>Coxiella burnetii</i> (Q fever ²)	<ul style="list-style-type: none"> • Primarily abortions • Transmissible to humans 	<ul style="list-style-type: none"> • No known treatment
Fungal disease	<i>Absidia</i> sp. <i>Aspergillus</i>	<ul style="list-style-type: none"> • Rumenitis • Abomasal ulcers • Pneumonia • Abortion • Granulomatous abscess • Renal damage 	<ul style="list-style-type: none"> • Nystatin and Copper sulfate

1. This disease must be reported to the CFIA. For information on treatment, see the factsheet provided on the CFIA’s website at <http://www.inspection.gc.ca>.
2. Annually notifiable disease for which Canada must present a report to the World Organization for Animal Health (OIE) indicating its presence in the country, if any.

REPORTABLE DISEASES AND IMMEDIATELY NOTIFIABLE DISEASES

A number of diseases are listed as either reportable or immediately notifiable under Canada’s *Health of Animals Act*. Table 5 presents all such diseases that may affect cervids. The CFIA is the authority responsible for updating and administering the Act.

Reportable diseases present a danger to human or animal health and can have a significant economic impact on international trade. Animal owners, veterinarians and laboratories are required to immediately report the presence of an animal that is contaminated or suspected of being contaminated with one of these diseases to a CFIA district veterinarian. Control or eradication measures will be applied immediately.

In general, immediately notifiable diseases are diseases exotic to Canada for which there are no control or eradication programs. Only laboratories are required to contact the CFIA regarding the suspicion or diagnosis of one of these diseases.

Table 5. Reportable and immediately notifiable diseases that may affect cervids^{1,2}

<p>Diseases reportable by animal owners, veterinarians and laboratories</p>	<ul style="list-style-type: none"> • Anaplasmosis (15 in 2010, 6 in 2011) • Brucellosis • Bovine cysticercosis³ (parasite) (1 in 2010) • Foot-and-mouth disease³ (virus) • Bluetongue (virus) • Anthrax (5 in 2010) • Rift Valley fever³ (virus) * • Chronic wasting disease of cervids (spongiform encephalopathy associated with the presence of an abnormal protein called a prion (3 in 2010, 3 in 2011) • Rinderpest³ (virus) * • Sheep and goat pox³ (virus) * • Contagious bovine pleuropneumonia (bacterium)³ • Pseudorabies³ (virus) * • Rabies (123 in 2010, 115 in 2011, but none were in cervids) • Vesicular stomatitis³ (virus) • Bovine tuberculosis (1 in 2011)
<p>Diseases that are immediately notifiable by laboratories</p>	<ul style="list-style-type: none"> • Herpes virus of cervidae

1. Diseases with an asterisk have never been declared in Canada.
2. Figures in parentheses indicate the number of infected herds reported in 2010 and 2011 in Canada, for all farmed animals combined.
3. Disease not described in the present leaflet because it is infrequent. See the corresponding fact sheet on the website of the CFIA.

Source: <http://www.inspection.gc.ca>

CONCLUSION

This factsheet presents a summary of the principal diseases that affect cervids, together with the known treatments. Note however that few livestock medicines have been registered for treating cervids. Their use depends on the experience of veterinarians who work with these animals.

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Production Guide



DOMESTIC GAME FARM ANIMALS Livestock Production Equipment for Cervids – Key Concepts



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INTRODUCTION

This factsheet presents several types of equipment that can be used for cervids. It draws in part on information in the literature, but mostly from producers who agreed to share their experience.

Before cervids are delivered to a production site, you must have:

- the basic facilities to keep them there (fences);
- a system for handling the herd in small groups (the corral);
- facilities to sort the animals in each group into stalls before introducing them one at a time into the restraining equipment (squeeze);
- a means to ship and receive animals easily (the loading chute).

This document brings together a number of interesting concepts. Anyone who is interested in raising cervids should, before anything else, spend some time visiting several farms, partly to get familiar with the animals' behaviour, but also to see how all the equipment is set up and how it works. It's a good way to learn the practical details of certain equipment and get some ideas for how each farm could be improved. Your best source of information will always be an actual farm and of course the farmer.

While consulting the documentation available, especially the videos produced by the *Fédération des éleveurs de grands gibiers du Québec* on the handling of cervids (FEGGQ, 2008a and b), interested persons can also communicate with the *Association des éleveurs de wapitis du Québec* or the *Association Cerfs rouges du Québec*. You can also contact an Agriconseil network to find an advisor in your region.

To design and operate functional equipment that is safe for both workers and animals, an understanding of cervid behaviour is essential. You will be more efficient, there will be less stress on the animals, and the general well-being of all will be ensured.

CERVID BEHAVIOUR

The domestication of cervids is relatively recent, going back about 350 years for red deer and 100 years for wapiti (often referred to as “elk” outside of Québec). This means they must be handled with greater care than traditional livestock.

Return to the start. Instinctively, when cervids are fleeing a stress factor, they will try to return to where they came from. Pens should be designed to take advantage of this behaviour. For example, a pen with a single gate is preferable to one with a separate entry and exit.

Security is in the group. Cervids are usually gregarious animals, meaning they live in a group. Consequently, an animal should not be left alone for very long. Avoid narrow alleys in which the animals cannot move as a group, since they will become anxious and try to return to the herd.

Feet on the ground. Cervids are stressed by having anything above them. Although catwalks alongside the crowding alleys can be useful, they should be avoided since they make the animals nervous. If catwalks are to be used, install high sides to conceal the workers from the animals.

Dark means a hole. Dark areas are perceived by cervids as being dangerous. Cervids will see a hole where there is a shadow, a roofed working area or a dark chute. They will often balk and refuse to move forward.

We turn for you. When cervids feel trapped, they will mill in a circle to look for an exit. Sharp corners in traffic areas should therefore be avoided, since the animals can bunch up violently and injure themselves. Curved alleys encourage movement. Gates should be easy for them to see, located in a corner of the pen rather than in mid-fence, so the animals are easily encouraged to move towards and through the gate.

Let's walk in the woods. A wooded place, even some distance away, represents security for cervids. For this reason the sorting facility should be located so the animals can simultaneously see both the woods and the facility, instead of having to leave the woods behind them.

All-weather facilities

Besides considering how cervids naturally behave, remember that your facilities will be used year-round. To avoid shovelling snow, either provide the facilities with a roof or leave enough room for a tractor and snow blower to get around. An enclosed area, protected from the weather, can also be used to store records and electronic equipment (scales, tag readers, computer, etc.).

PADDOCKS

The ideal stocking density (the number of animals per unit of paddock area) depends on the genetics of the herd, feed management, the soil type and plant cover, and the region. In pastures, the animals' weights and growing rates must also be considered. In non-grazing paddocks, the most common densities range from 4 to 60 animals per hectare. With forages used for grazing, densities range from 3 to 10 animals per hectare for red deer, or from 1 to 6 per hectare for wapiti.

Fencing

In Québec, the *Regulation respecting animals in captivity* sets out rules for the keeping of animals like cervids. In the 2012 version, the Regulation (division III, section 9) defines the fencing equipment required for raising cervids:

- 9. Anyone who keeps cervidae listed in Schedule II in captivity without a licence shall erect and maintain an enclosure surrounded by a game fence at least 2.4 m high, having square meshes not larger than 15 cm between the vertical strands and at least 20 horizontal strands; the outside and inside lateral clearance of that perimeter fence must be at least 3 m from any obstacle that could reduce the minimum height of 2.4 m and the fence must be stretched tight near the ground so that no cervidae may pass under it; the distance between the posts of the fence may not exceed 8 m.*

Furthermore, the perimeter fence must have no trap or barrier to capture animals outside the enclosure; in addition, the gates of the perimeter must remain closed, even in the absence of animals.

Depending on the budget available, fence posts can be of metal or treated or non-treated wood. In the short term, cedar posts are the most economical solution. Treated posts are more durable, but more expensive. Metal posts have the advantage of being more durable, easier to repair (they can be straightened if bent) and smoother, reducing the risk of animals snagging on them. However, metal posts cost more than twice as much as wooden posts.

Electric fences have not been found effective in Quebec, since cervid antlers can easily get tangled in them.



Figure 1. Example of game fencing

Photo: Juan Pablo Soucy

FEEDING

Water troughs

Water is the most important food to provide for cervids. In winter they can eat snow, but a heated trough (Figure 2) should be provided for growing calves to minimize energy losses. All watering systems, whether heated or not, should be regularly inspected throughout the winter to make sure they are working properly. In early spring and late autumn, when snow in the paddocks tends to be mixed up with animal waste and so on, it is important to provide the animals with good quality water in sufficient quantity.

Factsheet **Livestock Production Equipment for Cervids – Key Concepts**

Water troughs of the type equipped with a float valve (Figure 3), which always contain water, are vastly preferable to the water bowls used for cattle (Figure 4). The animals will drink more water because the trough lets them drink as they would in nature. Since trough water is stagnant however, in warm weather the troughs should be regularly cleaned to avoid the proliferation of microorganisms.



Figure 2. Example of a heated water trough

Photo: Juan Pablo Soucy



Figure 3. Examples of water troughs

Photos: Juan Pablo Soucy



Figure 4. Example of a water bowl for cattle (less effective in summer, ineffective in winter)

Photo: Juan Pablo Soucy

Some tips

- If water pipes cannot be buried, run them along the base of the fence so they are shaded by the forages to keep the water cooler.
- When designing pens, locate water troughs at the junction of two or more pens. This lowers costs since you can install a single water pipe, perhaps even a single trough serving more than one pen.
- Make sure there is good flow at the delivery end of the water line.

Feeding racks

Forage losses can range from 10 to 40% depending on the type of feeding rack and the season. The best way to reduce such feed losses is to not set the forage directly on the ground.

Here are the main points to consider when choosing a feeding rack:

- the space between bars should be wide enough (20 cm for red deer, 40 cm for wapiti) for the head of a single animal;
- vertical bars are preferable to bars at an angle;
- round bars are preferable to square bars;
- a roof will protect forage from the weather, but should not interfere with filling;
- solid sides at least 30 cm high will save some of the hay that would otherwise be lost on the ground (10 to 30%);
- the rack should be easy to move.

Figure 5 presents several rack designs: a classic open rack, a roofed rack and a rack with a trough to reduce waste and provide supplements.



Classic rack



Roofed rack



Rack with a trough

Figure 5. Different types of feeding rack

Photos: Juan Pablo Soucy

Feeding troughs

To avoid problems related to herd hierarchy, provide about 1 m of trough length per wapiti, or 60 cm of trough per red deer. This lets the animals eat whenever they wish, without having to compete with each other.

The type of trough to use depends on the chosen feeding method. A mobile trough (Figure 6) is more suited to ad lib feeding, while a trough along a fence (Figure 7) is more suited to a system with mechanized feed delivery. Trough systems protected by a barrier and placed directly in the paddock provide a good length of trough without requiring more fence alongside the farm road.

Factsheet **Livestock Production Equipment for Cervids – Key Concepts**

As for minerals, there are many distribution systems. Some producers put minerals in the feeding troughs, while other attach them to the rack. There are also feeders made just for minerals (Figure 8), with a flexible cover to protect the contents from the weather while allowing easy access. Whichever system you choose will be better than setting out mineral blocks on the ground.

In paddocks near a building, the low side of the building can be used to feed the animals under eaves while also protecting the feed from the weather.



Figure 6. Examples of mobile troughs
Photos: Juan Pablo Soucy



Figure 7. Troughs installed along the fence
Photos: Juan Pablo Soucy



Figure 8. Mineral trough
Source: Juan Pablo Soucy

Creep feeding

Creep feeding is reserved exclusively for young animals, access being restricted by the judicious use of barriers. Creep feeding offers a ration that complements maternal milk and any feed already in the paddock, to improve weight gain before weaning. Make sure however that the extra weight gain is profitable, since there will be less compensatory gain (catch-up growth) in the spring. This can vary considerably from herd to herd.

With creep feeding, the feeding area (whether trough or pasture) is reserved for the calves by a barrier that only they can get through. Metal posts are best, spaced 20 cm apart for red deer or 40 cm apart for wapiti. If using wood posts, they should be 20 cm in diameter and set to a depth of 1.6 m (40% of their length), rising at least 2.4 m above the ground. A sturdy barrier is needed because the mothers will be very tenacious about trying to reach their young.

There are also portable creep feeders with barriers that can be lowered into position once the trough is in the pen. They are more expensive, but more versatile.



Wooden barrier (more economical)



Metal barrier (more durable)

Figure 9. Barriers for creep feeding

Photos: Juan Pablo Soucy

CORRAL

The corral is where the herd or part of the herd (i.e. animals from one paddock) is collected and sorted. It consists essentially of a collecting yard and an area where the animals are sorted for handling. For information on various aspects of corral design, including details on construction that can be very useful when building new facilities or modifying existing ones, see the document entitled *Aménagement pour l'élevage des grands cervidés* (MAPAQ, 2005), available online (in French only) from Agri-Réseau. Information in English is available from several sources, especially for wapiti (elk), such as the Government of Saskatchewan website at www.agriculture.gov.sk.ca/Ground_Level_Elk_Handling_Facilities.

Collecting yard

Before the herd can be moved into the sorting area, you must first be able to get the animals out of their paddock. Providing food and water in the collecting yard will draw the animals into the yard and keep them there awhile. The yard should be large enough to contain a complete group of animals. Depending on the size of your herd you may need several yards of different sizes, but all should be suitable for a stay of several days. For wapiti, the ideal seems to be 25 m² per adult head, while for red deer it seems to be 12 m² per adult head. Allot half those areas for young animals.

Sorting area

The sorting area comprises the crowding alley, stalls (Figure 10) and squeeze.

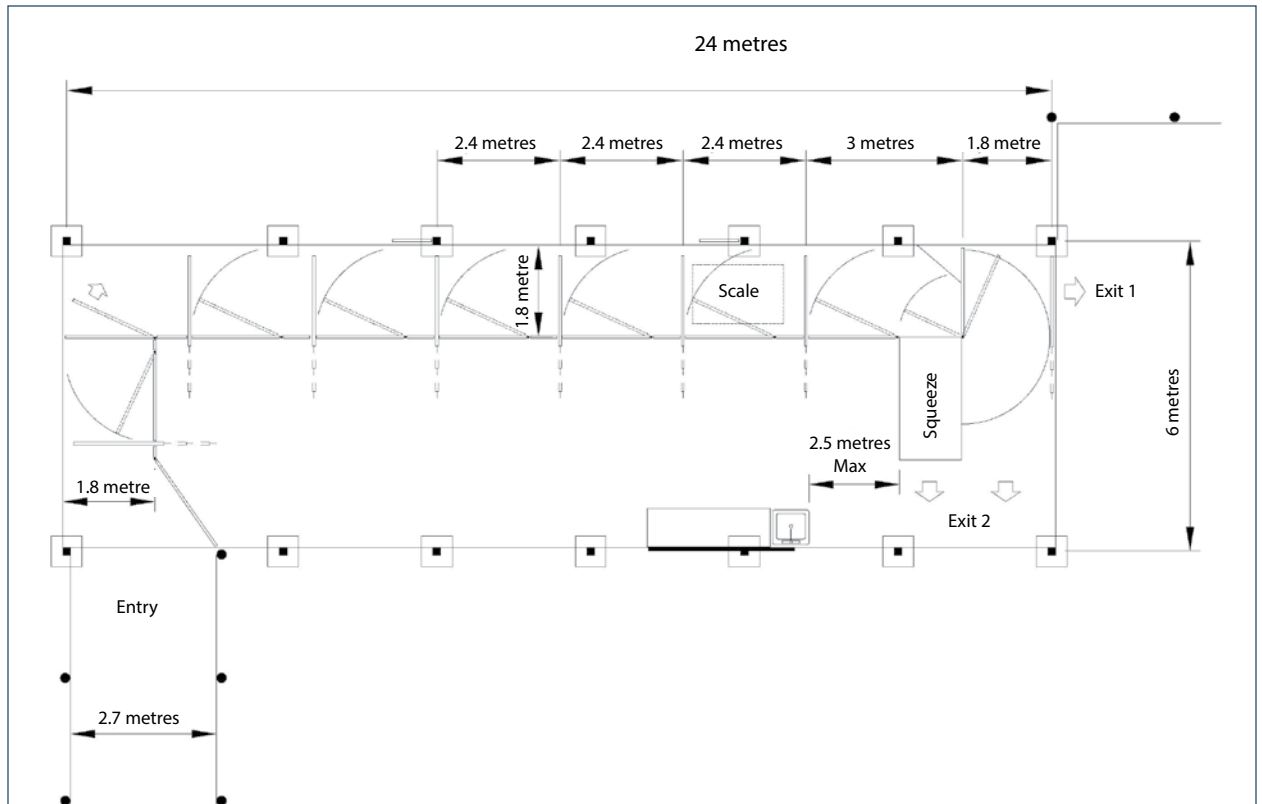


Figure 10. Sorting area for cervids (plan 80203, modified)

Source: Sébastien Cartier

The crowding alley (Figure 11) is used to guide the animals from the collecting yard into the stalls. It gradually narrows the space available, leading the animals quickly but without jostling to where they can be separated into smaller and smaller groups in the stalls. From there they enter the squeeze, which holds just one animal at a time.

Since animal density is higher in the sorting area than in the yard, its sides should be even sturdier and preferably solid or opaque. Tarps or plastic sheeting can be used to make slatted walls opaque, firmly attached to avoid flapping in the wind. A low-cost yet sturdy solution is to use 2x4 or 2x6 wooden slats, set horizontally (ideally) to avoid injury to the animals' shoulders. A few openings at man height allow the animals to be observed and flags to be waved to move them along.

The crowding alley should have safety exits every 3 metres, so workers can get out quickly in case of danger. A safety exit can be as simple as a place where the fence itself can serve as a ladder.



Figure 11. Example of a crowding alley

Photo: Juan Pablo Soucy

Stalls consist of a series of sliding horizontal doors by which the animals can be separated into smaller and smaller groups (Figure 12). Guillotine doors are easier to construct, but less practical and more dangerous to operate. Sliding doors ride on a rail that should be protected from the weather, easy to maintain and silent. Door stops and rubber wheels (Figure 13) help to reduce any sounds that could make the animals nervous. When the stall doors close they should lock automatically to avoid undesired movement, reducing the risk of injury. As shown in Figure 12, doors should be solid at the bottom to avoid hoof injuries, while from 1.5 m up they can be open with horizontal bars.

The last stall before the squeeze should have a scale. Plan for enough space for a scale to be installed, so that each animal can be weighed before it enters the squeeze.

Also very important is to have an emergency exit from each stall into an alley leading to a temporary pen. If an animal becomes sick or panicky, the emergency exit allows it to be redirected elsewhere without having to move any other animals first, and without having to force it through the squeeze.



Red deer (stalls 1.5 m wide)



Wapiti (stalls 1.8 m wide)

Figure 12. Examples of stalls for red deer and wapiti

Photos: Juan Pablo Soucy

**Figure 13. Rubber wheels on the rail**

Photo: Juan Pablo Soucy

Squeeze

The squeeze serves to immobilize the animals one at a time so that various interventions can be performed (identification, vaccination, veterinary tests, semen collection, insemination, etc.). There are numerous suppliers in North America for both hydraulic and manual models. Immobilization is achieved by either of two principles: horizontal cushions or a V shape with drop-out floor.

Factsheet **Livestock Production Equipment for Cervids – Key Concepts**

The squeeze with horizontal cushions (Figures 14, 15 and 16) is very effective for all cervids. It is more expensive to purchase, but can be used for handling cervids of all sizes in all situations. The cushions immobilize the animal without harming it, holding the animal along the length of the body with only its head above the cushions. Access ports allow all the necessary handling and treatments to be performed. When the squeeze is opened the animal can easily exit.



Figure 14. Squeeze with horizontal cushions, wide open
Photo: Juan Pablo Soucy



Figure 15. A calm animal safely immobilized in a squeeze with horizontal cushions
Photo: Juan Pablo Soucy



Figure 16. Taking a blood sample from an animal immobilized in a squeeze with horizontal cushions (interior view)

Photo: Juan Pablo Soucy

For smaller cervids (calves, red deer without antlers), a V-shaped squeeze called a drop-floor chute (Figure 17) is more economical and faster to operate. This is a raised squeeze with tapering sides. The floor swings down when the animal is inside, leaving the animal suspended (Figure 18) by the shoulders, abdomen and hips. This type of squeeze is operated manually.

Whichever type of squeeze is used, it should have the following characteristics:

- adjustable width and height to accommodate cervids of different sizes;
- multiple openings (ports) in the upper part to allow various interventions without opening the entire unit, and regardless of the animal's position;
- one or two ports in the lower part for treating hooves and collecting semen;
- self-locking gates;
- preferably a lighting system inside (protected by a wire grill) so the animal will not be afraid to enter. The light should be easy to switch off, to calm the animal once it is inside. A head gate with a translucent or slotted section could also help;
- a safety mechanism allowing for quick opening in case of emergency (e.g. animal in a bad position or too excited);
- easily accessible levers that do not impede operator movement around the unit.



Figure 17. Two examples of drop-floor chutes, exterior and interior views

Photos: Juan Pablo Soucy



Figure 18. Feet of an animal immobilized in a drop-floor chute

Photo: Juan Pablo Soucy

At the exit from the squeeze, it is important to have a system of yards or alleys that can be easily reconfigured to direct the animals into different pens. This can be useful at weaning for example: one pen for the mothers, separate pens for male and female calves. While it is initially cheaper to use exterior gates for directing the animals, it is much more practical to have multiple exit alleys leading directly away from the squeeze.

Loading area

On cervid farms, the loading area is often just a loading chute with a horizontally sliding gate that can open and close quickly when shipping animals. Receiving is generally done directly at the receiving yard, but can also be done at the corral if the animals are to be treated first.

The loading area should be:

- easy to access from the sorting area;
- bright and well-lit, since shipping is often done in the early morning;
- curved in shape (ideally);
- easy to clear of snow in winter, or protected by a roof.

GATES AND LATCHES

All gates on a game farm must be easy to open, and ideally should latch automatically on closing. When working with cervids, it is often necessary to close a gate quickly to prevent them from going back and forth (a cause of stress).

Latch mechanisms (Figure 19) should be located at middle height instead of at ground level, where litter, ice and dirt could prevent them from functioning properly.

A variety of latches are available, but whichever you choose they should:

- latch securely as soon as the gate closes;
- open with one hand, even with gloves on;
- not be susceptible to being opened by animals;
- not be susceptible to jamming with frost or rust.

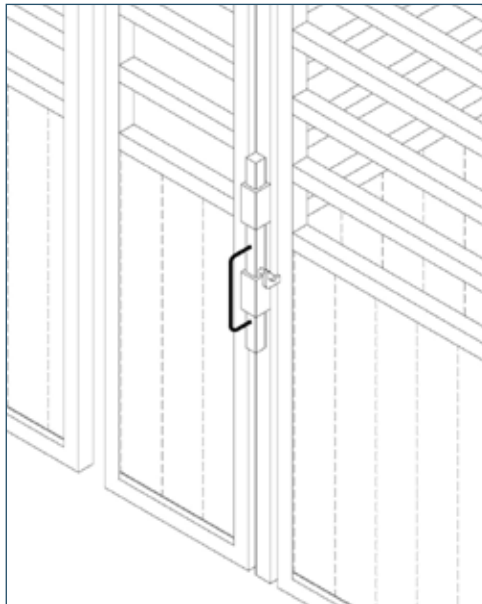


Figure 19. Latch mechanism located at middle height

Source: Sébastien Cartier

It goes without saying that gates should be adjustable so they can swing over snow, and should open in the direction where the animals are moving, e.g. from the pen into the alley where they will be led to the collecting yard, and so on.

CONCLUSION

At first glance, all of the foregoing may seem very complex. But it is precisely these small, down-to-earth details, combined with a design that takes into account the natural behaviour of cervids, that will make for safe equipment and an efficient, satisfying work environment.

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Production Guide



DOMESTIC GAME FARM ANIMALS

Basic Principles of Feeding and Nutrition



CULTIVER L'EXPERTISE
DIFFUSER LE SAVOIR

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INTRODUCTION

Bison, wapiti (often called elk outside of Québec), red deer and wild boar are four species of large game that are raised in Québec for meat and other purposes. The same basic nutritional principles apply, whether to monogastrics like wild boar or to ruminants like bison, wapiti and deer: the animal ingests a given quantity of food composed of water and dry matter, the latter providing nutrients (energy, protein, minerals and vitamins). The importance of drinking water must be emphasized.

“DRY MATTER,” “AS FED,” “VOLUNTARY DRY MATTER INTAKE”

The percentage of water and dry matter (DM) in food varies widely. Hay for example is made up of 15% water and 86% DM. Ten kg of hay is therefore 8.5 kg of DM (the hay minus its moisture content), plus 1.5 kg of water, for a total of 10 kg. Concentrates (grain and commercial feed) contain less than 12% water, and thus over 88% DM. In contrast, forage can contain up to 80% water, for only 20% DM.

In animal nutrition, particularly for herbivores, nutritional value is expressed on a 100% DM base. A herbivore diet can include grazing, grass silage and hay, all of which have different moisture contents. Different food sources are therefore more easily comparable on a common basis of 100% DM.

Nutritional values can also be expressed on an “as-fed” basis (i.e. the nutrient content of the feed as it is fed). As for food intake, it is defined in terms of voluntary dry matter intake (VDMI), i.e. the quantity of dry matter voluntarily ingested by the animal over a given period.

NUTRIENTS

Energy

Food provides animals with energy essential to maintenance, growth and activity. The energy is obtained from food through the body’s digestion of various elements, such as structural and non-structural carbohydrates (cellulose, hemicellulose and starch), fats (lipids) and proteins.

The energy content of food is expressed in calories (cal) or joules (J). One calorie is equivalent to 4184 joules. The terms kilocalorie (kcal), megacalorie (Mcal), kilojoule (kJ) and megajoules (MJ) are often used:

$$1 \text{ Mcal (or MJ)} = 1000 \text{ kcal (or kJ)} = 1\,000\,000 \text{ cal (or J)}.$$

Total energy intake is called gross energy (GE), and is not fully used by the body. Subtracting the energy excreted in the feces leaves the digestible energy (DE), which is used to calculate rations for wild boar. Apparent metabolizable energy (ME), which is used to calculate deer rations, is the digestible energy minus the energy lost in urine and gas. Lastly, the measurement used for calculating bison rations is net energy (NE), which takes into account the thermic effect, or “specific dynamic action” (SDA) of digesting food. Particularly in ruminants, a significant amount of heat can be produced during digestion. The efficiency with which NE is produced depends on the food source. NE can be subdivided in terms of how

the animal uses it; for example, NE can serve for maintenance (NEm), lactation (NEl), weight gain (NEg), and so on (Figure 1).

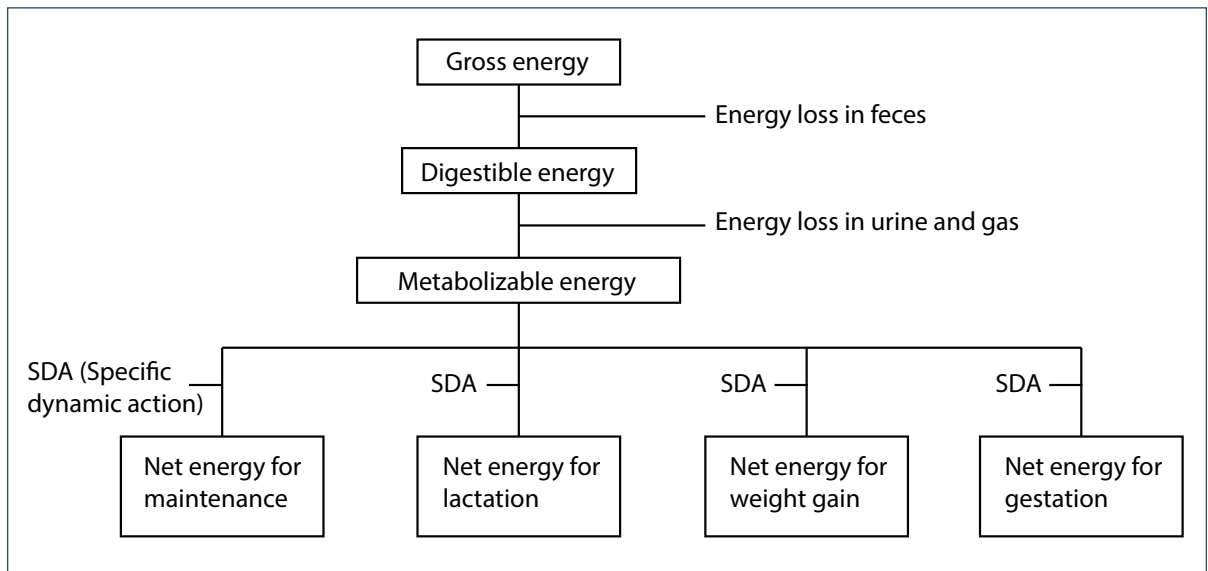


Figure 1. Energy use

Adapted from St-Pierre and Bouchard, 1980

Protein

Like energy, proteins are essential to maintenance, as well as for muscle and bone growth and for tissue repair. Besides playing a structural role, proteins also serve metabolic functions (enzymes, immunoglobulin, etc.). All proteins are composed of a series of peptides, which in turn are made up of combinations of the 20 amino acids involved in protein formation:

Aspartic acid	Isoleucine
Glutamic acid	Leucine
Alanine	Lysine
Arginine	Methionine
Asparagine	Phenylalanine
Cysteine	Serine
Cystine	Threonine
Glutamine	Tryptophan
Glycine	Tyrosine
Histidine	Valine

Monogastrics like wild boar digest the protein in food to extract amino acids, which are then absorbed and reassembled according to the animal's needs. While the body can synthesize some amino acids,

others (known as “essential” amino acids) are only available from food. “Limiting” amino acids are those that are not present in food in sufficiently high quantities (as in the case of lysine, for wild boar).

Gross protein (%GP) refers to the protein content of a given food. In ruminants (deer and bison), a significant portion of the gross protein can be degraded by rumen bacteria, and is therefore referred to as rumen degradable protein (RDP). The resulting microbial proteins then supply the animal’s protein requirements. Other proteins, called non-degradable proteins, arrive intact in the abomasum (or rennet-bag), and are digested as they are in monogastrics. Finally, proteins that are not degraded in the rumen or digested in the abomasum are eliminated in the feces. Rumen bacteria can also transform nitrogen from non-protein sources such as urea into microbial protein.

Minerals

Major minerals and trace elements (i.e. dietary minerals that are needed in very small quantities) are integral nutritional components involved in structural and metabolic functions (Table 1). Most minerals are obtained from food sources. Intake of calcium and phosphorus, significant amounts of which are needed by the body, must be monitored particularly closely. Deficiencies in iodine and selenium may also occur, due to the low levels of these trace elements in Québec soil.

Note that there are both positive and negative interactions between various elements, and that cervids are sensitive to copper deficiency.

Table 1. Basic functions of minerals

Mineral	Primary functions
Major minerals	
Calcium (Ca)	Bone and tooth formation, muscle contractions, milk production
Phosphorus (P)	Bone and tooth formation, energy metabolism, enzyme activity, DNA
Magnesium (Mg)	Bone development, enzyme activator (reduction of blood pressure)
Sodium (Na)	Cellular acid/base balance, muscle contractions, bile production
Chlorine (Cl)	Cellular acid/base balance, gastric juices (HCl)
Potassium (K)	Cellular osmotic pressure, muscle tone, enzymes, carbohydrate metabolism
Sulphur (S)	Sulphur-containing amino acids, lipid and carbohydrate metabolism
Trace elements	
Cobalt (Co)	Ruminants: vitamin B ₁₂ synthesis by rumen bacteria
Copper (Cu)	Hemoglobin formation, enzyme activity, hair, bone development
Iodine (I)	Thyroxin production by the thyroid
Iron (Fe)	Transports oxygen in the blood (hemoglobin)
Manganese (Mn)	Bone formation, growth and reproduction, enzyme activity, amino-acid and energy metabolism
Selenium (Se)	Antioxidant (with vitamin D), fertility, immune system
Zinc (Zn)	Enzyme activity for protein synthesis

Adapted from Saskatchewan Agriculture, 2000

Vitamins

Vitamins are organic compounds classified as either water-soluble (vitamins C and B-complex) or fat-soluble (vitamins A, D, E and K). Vitamins serve various metabolic functions (Table 2). Most are obtained from food, while some are synthesized by the body (notably vitamin D, synthesized with the help of sunlight, and vitamin K). In ruminants, rumen bacteria synthesize the B-complex.

Table 2. Basic functions of vitamins

Vitamins	Primary functions
Fat-soluble vitamins	
A	Vision, integrity of mucous membranes, immunity
D	Calcium and phosphorus metabolism
E	Cellular respiration, antioxidant, membrane integrity
K	Normal blood clotting
Water-soluble vitamins	
Thiamine (B ₁)	Nervous system, carbohydrate and protein metabolism
Riboflavin (B ₂)	Antioxidant, ligament integrity
Niacin (B ₃)	Carbohydrate, protein and lipid metabolism, cellular respiration, skin integrity
Pantothenic acid (B ₅)	Amino-acid metabolism (coenzyme A), skin integrity
Pyridoxine (B ₆)	Protein metabolism
Biotin (B ₇)	Carbohydrate, protein and lipid metabolism
Folic acid (B ₉)	Methyl-group reactions
Choline	Phospholipid metabolism
Cobalamine (B ₁₂)	Protein metabolism
Ascorbic acid (C)	Antioxidant, Vitamin D metabolism

Sources: Nutrient Requirements of Swine (NRC, 1998); Nutrient Requirements of Beef Cattle (NRC, 2000)

Water

Water is essential to life, milk production and nutrient absorption. Free access to good quality water at all times is crucial, and all the more so in the warm summer months. Troughs should be cleaned as often as possible. Creeks, ponds and dugouts should not be used as sources of water, since animal activity along the edges causes erosion (increasing the risk of injury to limbs), and pollutes the water (increasing the transmission of water-borne disease). It is prohibited in Québec for livestock to have access to bodies of water.

Water should be monitored frequently for clarity, odour and taste. If any of these become abnormal, and/or as part of the annual prevention protocol, chemical and bacteriological analyses should be done. Table 3 outlines the basic water quality guidelines for livestock.

Water pH is also important. On a scale from 1 to 14, with neutral pH being 7, acidity increases as pH drops (from 7 to 1), while alkalinity increases as pH rises (from 7 to 14). The acceptable range for water pH is 6.5 to 8.5.

For sound water management, the flow of water in the troughs should be monitored regularly, and their height adjusted if the animals are on accumulated litter. Troughs that are too low will become contaminated, which will ultimately reduce performance.

Daily water consumption varies depending on the water content of feed, water temperature, ambient temperature, animal weight, trough type, etc.

Table 3. Water quality guidelines for livestock

Substance	Maximum recommended amount (mg/L)
Aluminium (Al)	5.0
Arsenic (As)	0.5
Beryllium (Be)	0.1
Boron (B)	5.0
Cadmium (Cd)	0.02
Calcium (Ca)	1 000.0
Chromium (Cr)	1.0
Cobalt (Co)	1.0
Copper (Cu)	0.5 - 5.0 ¹
Fluorine (F)	2.0
Mercury (Hg)	0.003
Molybdenum (Mo)	0.5
Nickel (Ni)	1.0
Nitrate and nitrite	100.0
Nitrite alone	10.0
Lead (Pb)	0.1
Selenium (Se)	0.05
Sulphate	1 000.0
Uranium (U)	0.2
Vanadium (V)	0.1
Zinc (Zn)	50.0
Total Dissolved Solids (TDS)	3000.0

1. 0.5 mg/L for sheep; 1.0 mg/L for cattle; 5.0 mg/L for swine and fowl.

Sources: Manitoba Agriculture, Food and Rural Initiatives; FAO, 2002

CONCLUSION

It is important to understand that an animal ingests a certain quantity of food on an “as-fed” basis, and the dry matter contained in that food is what provides the nutrients it needs (energy, protein, minerals and vitamins). Also, we must always remember that water is an essential nutrient, one to which producers must pay special attention.

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Production Guide



DOMESTIC GAME FARM ANIMALS

Feeding and Nutrition – Red Deer and Wapiti



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INTRODUCTION

Deer are the ruminants that make up the family Cervidae, which includes several species, among them red deer and wapiti (often referred to as elk outside of Québec). They are raised primarily for meat and breeding stock, and to a lesser extent for hard-horn and velvet antlers. Some producers also raise deer specifically for hunting.

The species differ in size and feeding behaviour, and specific nutritional requirements must be met to ensure optimum breeding and growth. There are two basic principles of deer nutrition. First, as ruminants, deer mostly consume forage material, along with grain supplements. Second, feeding must be planned in keeping with seasonal reproductive patterns.

DIGESTIVE SYSTEM AND FEED INTAKE

There are many categories of herbivores. Most prefer grasses, others eat leaves, twigs and bark, and still others, like wapiti and red deer, are well adapted to a range of vegetable matter. Wapiti and red deer are able to digest plants with extremely high fibre content.

Rumen bacteria digest fibre and starch to produce volatile fatty acids (VFAs): acetic acid, propionic acid, and butyric acid. VFAs pass through the rumen walls, and are absorbed into the blood and converted into energy in the liver. Forage contains higher amounts of fibre than starch. Starch-rich grain increases VFA levels in the rumen. Premature introduction in feed may result in liver abscesses, rumen ulcers and acidosis.

SEASONAL PHYSIOLOGY

The metabolic rates and feed intake of deer and wapiti fluctuate seasonally. As the days get shorter, after the rut (in late fall and winter), metabolic rates slow by 40% to 60%. The slower metabolism leads to lower energy needs and therefore reduced feed intake, an adaptation to the lack of available food in the natural habitat. A decrease in winter weight is normal and even inevitable, sometimes in animals as young as 18 months. Rutting males (in the fall) stop feeding almost entirely. For these reasons, a well-planned annual feeding schedule is important to avoid excessive and potentially harmful weight loss. Underweight females will have more difficult gestations and lower conception rates. Also, feed costs will be higher for animals (whether male or female) that were underweight at the start of winter.

During the rutting period, weight loss of up to 30% is not unusual in dominant males; the weight is regained in spring. Voluntary Dry Matter Intake (VDMI) drops from approximately 2.5% of live weight to 1% during rutting season, and increases slightly to 1.6% in winter.

Red deer hinds and wapiti cows also go through seasonal fluctuations. The VDMI of gestating females increases to nearly 3% of live weight in the spring, not only as a response to the change of seasons, but also to the nutritional needs of the fetus, generally born in May or June. Excessive feeding of females in the winter, as an attempt to avoid complications during calving, is not recommended. Feeding that meets

maintenance requirements is sufficient. After calving, the nutritional requirements of females remain high – approximately 3.55% of live weight – to ensure adequate lactation. A decrease in the energy requirements of lactating females around July allows hinds and cows to regain weight. A consistent increase in body weight is necessary to return to estrus. Underweight females may risk lower conception rates. After mating, females will have until December to regain their ideal winter weight.

NUTRITIONAL NEEDS AND FEEDING

The nutritional needs of deer differ from those of other domestic ruminants (such as dairy cattle) in three ways. First, though deer and wapiti are selective and prefer higher-protein over fibrous food, they do have the ability to digest high-fibre foods, which are less digestible.

Second, their slower winter metabolic rate means any feed program must be based on two periods: the summer grazing season from May to October, and the farm-feeding winter months, from November to April. Winter feed consists particularly of forage, the nutritional value of which varies widely (Table 1). On-farm forage analyses are critical to ensure the needs of each operation are adequately met. During the summer, lactating females and breeding males, because of their higher energy needs, must be monitored closely. In the fall, preparations in anticipation of winter are essential.

Finally, deer are more sensitive than other ruminants (such as sheep) to copper (Cu) deficiencies. Rations with less than 5 ppm of Cu may have harmful consequences on the nervous system. Deer tolerate concentrations of copper up to 30 ppm. As well, because of the frequent selenium (Se) deficiencies seen in Québec soils, ration levels of Se should be monitored.

Tables 2 and 3 outline the nutritional values of various grains, by-products, fruits and vegetables that may be fed to deer.

Table 1. Sample nutritional value analysis – forages (100% DM)

Description	DM (%)	ME (Mcal/kg)	GP (%)	ADF Fibre (%)	Ca (%)	P (%)	Mg (%)	K (%)	S (%)	Fe (mg/kg)	Cu (mg/kg)	Se (mg/kg)	Zn (mg/kg)	Mn (mg/kg)	Co (mg/kg)	
HAY																
Legumes 100%																
Green	88.1	2.29	21.1	30.3	1.60	0.35	0.32	2.56	0.33	213	10.0	0.20	26	49	0.65	
Vegetative	88.1	2.16	18.7	34.0	1.33	0.29	0.28	2.45	0.31	207	9.0	0.20	24	46	0.65	
Mature	88.1	2.03	16.4	37.5	1.04	0.25	0.20	2.38	0.23	250	9.0	0.20	24	44	0.65	
Grain 100%																
Green	88.4	2.30	14.5	34.9	0.73	0.29	0.20	2.57	0.24	199	9.0	0.06	27	84		
Vegetative	88.4	2.18	12.3	37.5	0.58	0.23	0.19	2.13	0.24	194	9.0	0.06	25	72		
Mature	88.4	2.07	10.1	40.1	0.43	0.20	0.12	1.97	0.17	180	8.0	0.06	25	90		
Legumes 60%																
Green	88.1	2.33	19.1	32.0	1.37	0.34	0.30	2.41	0.20	167	10.0	0.15	24	58		
Vegetative	88.1	2.21	16.6	35.0	1.07	0.28	0.25	2.34	0.26	141	9.0	0.15	24	49		
Mature	88.1	2.08	14.2	38.3	0.83	0.24	0.18	2.23	0.26	141	8.0	0.15	24	43		
Grain 60%																
Green	88.3	2.17	16.5	36.0	1.03	0.32	0.26	2.83	0.28	117	9.0	0.09	25	53		
Vegetative	88.3	2.15	14.2	36.5	0.70	0.25	0.21	2.45	0.27	358	9.0	0.09	26	75		
Mature	88.0	2.03	11.8	39.5	0.56	0.22	0.14	2.09	0.29	124	8.0	0.09	24	74		
SILAGE																
Legumes 60%																
Green	40.0	2.34	19.9	31.8	1.44	0.35	0.30	2.95	0.32	279	11.0	0.17	36	70		
Vegetative	40.0	2.21	17.6	35.0	1.12	0.30	0.24	2.88	0.25	244	9.0	0.17	28	64		
Mature	40.0	2.09	15.2	38.0	0.90	0.26	0.18	2.77	0.26	339	9.0	0.17	29	66		
Grain 60%																
Green	38.0	2.33	18.2	32.0	1.22	0.34	0.27	2.88	0.27	234	9.0	0.11	27	74		
Vegetative	38.0	2.18	15.7	35.7	0.78	0.27	0.21	2.64	0.25	264	9.0	0.11	30	78		
Mature	38.0	2.05	13.2	39.0	0.64	0.24	0.15	2.50	0.34	241	9.0	0.11	28	73		
Corn	33.0	3.15	8.0	28.0	0.20	0.19		1.20	0.14	104	5.7	0.04	24	36		
PASTURE																
Grain	26.1	2.68	21.3	31.0	0.55	0.45	0.32	3.16	0.20				21			
Legumes	19.3	2.46	25.8	33.0	1.27	0.35	0.42	2.40	0.16				20			

Sources: NRC, 2000; CPAQ, 1997

DM = Dry Matter; ME = Metabolizable Energy; GP = Gross Protein; Ca = Calcium; P = Phosphorus; Mg = Magnesium; K = Potassium; S = Sulfur; Fe = Iron; Cu = Copper; Se = Selenium; Zn = Zinc; Mn = Manganese; Co = Cobalt

Table 2. Sample nutritional value analysis – grains and by-products (100% DM)

Description	DM (%)	ME (Mcal/kg)	GP (%)	ADF Fibre (%)	Ca (%)	P (%)	Mg (%)	K (%)	S (%)	Fe (mg/kg)	Cu (mg/kg)	Se (mg/kg)	Zn (mg/kg)	Mn (mg/kg)	Co (mg/kg)	Mo (mg/kg)
Oat																
Grain	89.20	2.78	13.6	14.0	0.01	0.41	0.16	0.51	0.21	94.1	8.6	0,24	40.8	40.3	0.06	1.70
Wheat																
Grain	90.2	3.18	14.2	4.2	0.05	0.44	0.13	0.40	0.14	45.1	6.48	0,05	38.1	36.6		0.12
Bran	89.0	2.53	17.4	14.0	0.14	1.27	0.63	1.37	0.24	163	14.2	0,57	110	134	108	
Flour by-product	89.3	2.50	18.7	11.7	0.17	1.01	0.40	1.81	0.19	170	12.6		102	124		2.10
Corn																
Grain, cracked	88.1	3.25	9.4	3.4	0.04	0.30	0.12	0.42	0.10	54	3.0	0,07	27	11		0.60
Grain, ground	88.1	3.25	9.1	3.4	0.04	0.30	0.12	0.42	0.10	54	3.0	0,07	27	11		0.60
Grain, flaked	88.1	3.25	9.4	3.4	0.04	0.30	0.12	0.42	0.10	54	3.0	0,07	27	11		0.60
Gluten	86.4	3.22	65.0	8.2	0.06	0.60	0.14	0.46	0.86	138	4.0	0,34	49	15		0.94
Ethanol by-product	90.2	3.18	29.7	19.7	0.22	0.83	0.33	1.10	0.44	178	8.0	0,39	65	27		1.80
Barley																
Grain	88.1	3.03	13.2	5.77	0.05	0.35	0.12	0.51	0.15	59.5	5.3		13	18.3	0.35	1.16
Soy																
Whole grain	86.4	3.40	40.3	11.1	0.27	0.65	0.27	2.01	0.35	182	14.6		59.0	345		3.98
Soymeal	90.9	3.04	51.8	7.0	0.46	0.73	0.32	2.42	0.46	277	19.1	0,46	68	48		6.67
Brewer's grain																
Dried	90.7	2.39	29.2	22.2	0,0	0.67	0.26	0.50	0.38	224	11.0	1,06	85	45		
Wet	21.8	2.39	28.4	23.1	0.35	0.59	0.21	0.47	0.33	247	9.0	1,06	91	49		

DM = Dry Matter; ME = Metabolizable Energy; GP = Gross Protein;
 Ca = Calcium; P = Phosphorus; Mg = Magnesium; K = Potassium; S = Sulfur; Fe = Iron; Cu = Copper; Se = Selenium; Zn = Zinc; Mn = Manganese; Co = Cobalt; Mo: Molybdenum
 Sources : NRC, 2000; NRC, 2001

Table 3. Sample nutritional value analysis – fruits and vegetables

Description	DM (%)	ME ¹ (Mcal/kg)	GP (%)	ADF Fibre (%)	Ca (%)	P (%)	Mg (%)	K (%)	Fe (mg/kg)
Vegetables									
Artichoke	13.0		17.5	20.7			0.06	0.35	12.50
Asparagus	7.0		19.9	12.4			0.01	0.20	7.77
Broccoli	10.0		31.2	14.6			0.02	0.32	6.52
Cabbage	9.0	3.04	20.6	10.4	0.64	0.35	0.02	0.25	5.41
Carrot	12.0	3.04	9.9		0.40	0.35	0.01	0.32	3.28
Cauliflower	6.0		26.5	17.2			0.02	0.30	3.77
Celery	5.0		17.2	12.6			0.01	0.26	2.50
Cucumber	4.0		16.8	15.5			0.01	0.14	3.57
Lettuce	4.0		21.9	13.1			0.01	0.14	3.45
Mushroom	7.0		31.0	10.6			0.01	0.31	5.56
Onion	10.0		9.1	7.4			0.01	0.14	2.44
Pea	12.0	2.68	30.8				0.02	0.17	10.00
Potato	23.0	2.93	9.5		0.04	0.24	0.03	0.54	10.98
Squash (butternut)	8.0		26.0	14.7			0.03	0.29	5.56
Squash (spaghetti)	11.0		17.2	24.2			0.01	0.12	3.66
Spinach	9.0		38.7	11.70			0.08	0.55	28.13
Sweet potato	33.0	2.93	5.0		0.10	0.15	0.02	0.38	6.58
Tomato	13.0	2.24	21.7				0.01	0.24	2.44
Zucchini	4.0		24.9	10.2			0.02	0.26	2.50
Fruits									
Apple	13.0		3.0	6.0				0.11	1.45
Banana	19.0		5.4	4.5			0.03	0.35	2.54
Cantaloupe	8.0		13.1	20.4			0.01	0.27	2.35
Grape (green)	16.0		3.6	1.8			0.01	0.19	4.00
Grape (red)	14.0		2.7	8.5			0.01	0.19	4.00
Grapefruit	15.0		4.8	6.1			0.01	0.13	0.81
Orange	16.0		6.0	7.1			0.01	0.18	0.76
Pear	13.0		3.7	8.1			0.01	0.12	1.81
Plum	10.0		6.1	3.6			0.01	0.16	1.52
Watermelon	7		7.8	9.9			0.01	0.11	2.50

1. The energy content of certain foods is not currently available in existing reference tables.

DM = Dry Matter; ME = Metabolizable Energy; GP = Gross Protein; Ca = Calcium; P = Phosphorus; Mg = Magnesium; K = Potassium; Fe = Iron

Sources: NRC, 2000; Health Canada, 2008

Breeding

A number of factors, including nutrition, affect reproductive performance and therefore profitability.

Females

The nutritional needs of red deer hinds and wapiti cows vary depending on their physiological stage (Tables 4 and 5).

More than two-thirds of birth weight is gained over the last 2 months of pregnancy. Hind/cow nutrition is crucial, especially because this period follows the end of winter, during which gestating females will have lost weight and fat stores. High-quality forage must be freely available, with mineral supplements added as necessary. Grain or meal can be introduced 2 weeks prior to calving, with quantities adjusted depending on the nutritional value of forage. Development of a nutrition program by a qualified professional is key in establishing the specific needs of each operation.

Lactation begins immediately after calving. At this stage, the nutritional requirements of hinds and cows are at their highest, all the more so because the milk of these species is richer than that of other ruminants. Despite adequate feed and abundant pastures, females may lose weight at the start of lactation. Excessive weight loss will delay the return to estrus. Calves should ideally be weaned prior to the rut, to allow females to recover from the stress of weaning and restore good body condition. Excessive weight loss during the winter and at the start of lactation will result in reduced fertility. Lactating females should have access to the highest quality pasture and forage, with supplemental feed as necessary. Flushing is also recommended for adult breeding stock (male and female) 6 to 8 weeks prior to mating; this high-energy, high-protein concentrated intake improves conception rates and gets the younger animals used to eating feed, which reduces weaning stress.

During the winter, minimal fetal needs mean lower appetites in gestating females. Except in cases of excessive weight loss, maintenance feeding is sufficient. High-quality forage should be made freely available.

Replacement females

Replacement females especially require fine-tuned nutrition programs. Reproductive maturity is determined by weight rather than age. Rapid growth will lead to early reproduction, and therefore to increased productivity and profitability. As in most ruminants, females are considered sexually mature once they have reached at least 66% of their adult weight. The ideal conception weight is 75% of adult weight. As a general rule, females are ready for mating at 2 years of age.

The nutritional needs of replacement females are greater (maintenance, growth, gestation and lactation) during their first gestation and lactation, because they are still growing. High-quality forage should be freely available. Underweight females will be unable to conceive.

Males

The nutritional requirements of breeding males increase seasonally (Tables 4 and 5), notably during rutting season.

Males are generally fed medium-quality forage-based maintenance rations. Males should be neither overweight (which could cause low libido and fertility, limb and liver problems) nor underweight (which could cause a lack of energy during the rut). In late summer, during the rut, stags have increased nutritional requirements but lower appetites due to mating-related activities. As with hinds/cows, it is recommended that males be flushed 6 to 8 weeks prior to the mating period, taking care to avoid excessive fat accumulation. Males may lose up to 30% of their live weight during the mating period. Following mating, high-quality forage with 500 g/day of supplemental feed will allow males to recover body condition before winter.

Antler growth begins in spring, when testosterone levels are at their lowest, and continues all through summer. Once the antlers have hardened, testosterone levels once again begin to rise, and the rut begins. Antler growth does not entail significant nutritional requirements, although underfed animals will produce smaller, lower-quality antlers. Animals suffering from mineral imbalances or calcium and phosphorus deficiencies may also draw the required elements from bone mass.

Velvet antler harvesting, in May and June, involves cutting the antlers. Wapiti antlers should be harvested after reaching 55% of their total size (approximately 60 to 80 days of growth), at which point they will weigh from 3 to 15 kg, depending on the animal's age. Red deer antlers should be harvested at the same growth stage (after approximately 50 to 60 days), when they will weigh from 1 to 8 kilograms.

Table 4. Energy, protein, mineral and vitamin requirements of red deer (est.)

Age	VDMI (% LW)	ME (Mcal/d)	GP (%)	Ca (%)	P (%)	Mg (%)	K (%)	S (%)	Fe (ppm)	Cu (ppm)	Se (ppm)	Zn (ppm)	Mn (ppm)	Co (ppm)	Vit. A (IU/ kg)	Vit. D (IU/ kg)	Vit. E (IU/ kg)
Females																	
3-6 months	2.1	11.2	20	0.60	0.30	0.20	0.65	0.50	50	15	0.20	50	40	0.10	4000	800	30
6-12 months	1.9	7.1	16	0.60	0.30	0.20	0.65	0.50	50	15	0.20	50	40	0.10	4000	800	30
12-18 months	1.9	8.1	14	0.50	0.30	0.20	0.65	0.50	50	15	0.20	50	40	0.10	3000	600	30
Pre-reproduction (Sept.-Oct.)	2.0	7.1	10	0.50	0.40	0.20	0.65	0.50	50	15	0.20	50	40	0.10	3000	600	30
End of gestation (April-May)	2.1	7.1	14	0.50	0.40	0.20	0.65	0.50	50	15	0.20	50	40	0.10	5000	1000	40
Lactation (June-Aug.)	3.0	8.7	15	0.65	0.40	0.20	1.00	0.50	50	15	0.20	50	40	0.20	5000	1000	40
Maintenance (winter)	1.8	4.3	8	0.35	0.25	0.20	0.65	0.50	50	15	0.20	50	40	0.10	3000	600	30
Maintenance (summer)	1.9	5.5	10	0.35	0.25	0.20	0.65	0.50	50	15	0.20	50	40	0.10	3000	600	30
Males																	
3-6 months	2.0	11.2	20	0.60	0.30	0.20	0.65	0.50	50	15	0.20	50	40	0.10	4000	800	30
6-12 months	1.9	7.1	16	0.60	0.30	0.20	0.65	0.50	50	15	0.20	50	40	0.10	4000	800	30
12-18 months	1.7	8.1	14	0.50	0.30	0.20	0.65	0.50	50	15	0.20	50	40	0.10	3000	600	30
Antler growth	1.8	11.2	8-10	0.70	0.40	0.40	1.00	0.50	50	15	0.20	50	40	0.20	5000	1000	40
Maintenance (winter)	1.8	8.7	6	0.35	0.25	0.20	0.65	0.50	50	15	0.20	50	40	0.10	3000	600	30
Maintenance (summer)	1.8	11.2	9	0.35	0.25	0.20	0.65	0.50	50	15	0.20	50	40	0.10	3000	600	30

VDMI = Voluntary Dry Matter Intake; LW = Live Weight; ME = Metabolizable Energy; GP = Gross Protein; Ca = Calcium; P = Phosphorus; Mg = Magnesium; K = Potassium; S = Sulfur; Fe = Iron; Cu = Copper; Se = Selenium; Zn = Zinc; Mn = Manganese; Co = Cobalt; ppm = Parts Per Million; IU = International Unit

Adapted from Saskatchewan Agriculture, 2008; NRC, 2007; Wapiti.net, 2000; CPAQ, 1997

Table 5. Energy, protein, mineral and vitamin requirements of wapiti (est.)

Age	VDMI (% LW)	ME (Mcal/d)	GP (%)	Ca (%)	P (%)	Mg (%)	K (%)	S (%)	Fe (ppm)	Cu (ppm)	Se (ppm)	Zn (ppm)	Mn (ppm)	Co (ppm)	Vit. A (IU/ kg)	Vit. D (IU/ kg)	Vit. E (IU/ kg)
Females																	
3-6 months	2.1	11.2	20	0.60	0.30	0.20	0.65	0.50	50	15	0.20	50	40	0.10	4000	800	30
6-12 months	1.9	7.1	16	0.60	0.30	0.20	0.65	0.50	50	15	0.20	50	40	0.10	4000	800	30
12-18 months	1.9	8.1	14	0.50	0.30	0.20	0.65	0.50	50	15	0.20	50	40	0.10	3000	600	30
Pre-reproduction (Sept.-Oct.)	1.8	10.5	9	0.50	0.40	0.20	0.65	0.50	50	15	0.20	50	40	0.10	3000	600	30
End of gestation (April-May)	1.7	12.8	14	0.50	0.40	0.20	0.65	0.50	50	15	0.20	50	40	0.10	5000	1000	40
Lactation (June-Aug.)	3.0	15.5	16	0.65	0.40	0.20	1.00	0.50	50	15	0.20	50	40	0.20	5000	1000	40
Maintenance (winter)	1.8	8.2	6	0.35	0.25	0.20	0.65	0.50	50	15	0.20	50	40	0.10	3000	600	30
Maintenance (summer)	1.8	10.5	9	0.35	0.25	0.20	0.65	0.50	50	15	0.20	50	40	0.10	3000	600	30
Males																	
3-6 months	2.0	11.2	20	0.60	0.30	0.20	0.65	0.50	50	15	0.20	50	40	0.10	4000	800	30
6-12 months	1.9	7.1	16	0.60	0.30	0.20	0.65	0.50	50	15	0.20	50	40	0.10	4000	800	30
12-18 months	1.7	8.1	14	0.50	0.30	0.20	0.65	0.50	50	15	0.20	50	40	0.10	3000	600	30
Antler growth	1.8	11.2	8-10	0.70	0.40	0.40	1.00	0.50	50	15	0.20	50	40	0.20	5000	1000	40
Maintenance (winter)	1.6	12.1	6	0.35	0.25	0.20	0.65	0.50	50	15	0.20	50	40	0.10	3000	600	30
Maintenance (summer)	2.0	15.5	7	0.35	0.25	0.20	0.65	0.50	50	15	0.20	50	40	0.10	3000	600	30

VDMI = Voluntary Dry Matter Intake; LW = Live Weight; ME = Metabolizable Energy; GP = Gross Protein; Ca = Calcium; P = Phosphorus; Mg = Magnesium; K = Potassium; S = Sulfur; Fe = Iron; Cu = Copper; Se = Selenium; Zn = Zinc; Mn = Manganese; Co = Cobalt; ppm = Parts Per Million; IU = International Unit

Adapted from Saskatchewan Agriculture, 2008; NRC, 2007; Wapiti.net, 2000; CPAQ, 1997

Meat production

Breeding stock and game meat (venison) are the main commercial products of deer farming. The nutritional requirements of animals raised for meat production are different from those of animals raised as breeding stock, so they must be kept separate.

Animals destined for meat production are fed on the basis of target slaughter weights at different ages. In Québec, red deer and wapiti are usually slaughtered at 6 to 26 months, with live weights varying from 90 kg to 136 kg for red deer, and 90 kg to 250 kg for wapiti. Producers should exercise caution in providing supplemental feeding: since deer are sensitive to acidosis, concentrates should be added gradually.

Feed for breeding stock should be less rich, since excessive feeding can be harmful to both males and females (causing low libido and fertility, limb and liver problems).

Offspring

The first few hours after birth are critical. Colostrum (the first maternal secretion) is essential to the survival of newborn fawns and calves, providing the first antibodies for their immune systems, since no antibodies are transmitted from the mother: at birth, offspring lack any immune protection. In the 6 hours after calving, newborns should consume the equivalent of at least 5% of their live birth weight in colostrum. After this initial period, the mother's colostrum production and the ability of the offspring's intestine to absorb antibodies are significantly reduced. Frozen cow colostrum may also be fed to newborns in the event of the mother's death or if her milk does not come in. The colostrum should be thawed at room temperature (never in the microwave, which would deactivate the antibodies). Bottle-fed newborns' defecation reflex must be artificially stimulated by massaging the edge of the rectum with a wet towel. Meconium (first feces) should be evacuated in the first few hours following birth.

A few months after birth, creep feeding may be introduced. It has been found that offspring with exclusive access to feed designed for their needs will show better growth and undergo less weaning stress. Creep feeding is best introduced as early as possible, at least 3 to 4 weeks prior to weaning, to reduce weaning stress.

Fawns and calves may be weaned before or after the rutting season. High-quality forage and concentrates should be freely available, to maintain growth in spite of stress in deer that were weaned before the rut.

CONCLUSION

Annual nutrition planning must take into account the time of year and whether the animals are intended for meat or breeding. Quality forage is the foundation of cervid nutrition, and supplemental feed should only be used in particular situations.

A qualified agronomist can prepare a nutrition program adapted to each physiological stage, based on an analysis of the available forage.

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