XII. MINK

A. INTRODUCTION

1. History

Mink (*Mustela vison*) are small, rather vicious carnivores, indigenous to North America and found throughout Canada. In the wild state they are concentrated along the waterways from which they derive much of their food.

Until the early 1900's, mink pelts for the fur trade were acquired entirely by trapping. The raising of mink in captivity commenced early this century and they have adapted well to ranch rearing, though they have not become tame. Many of the numerous, early problems encountered, particularly those relating to reproduction, fur quality, and disease, have been successfully addressed. The resultant mink industry, in sharp contrast to that of fox farming, has shown a relatively steady progression in both growth and prosperity. Today, in Canada, mink provide well over a million pelts annually valued at more than $40 million (Stats Cda, 1983). The farming of these animals constitutes the most important single source of pelts in the fur industry and is carried on nationwide.

2. Biological Characteristics

Mink, being members of the family Mustelidae, have well developed anal sacs, the glands of which produce a characteristically odoriferous secretion.

Mink lack a cecum and have a very short intestinal tract (4x body length) with a small stomach. Consequences of these features are the need for frequent food intake in small amounts (nine to 10 meals daily in the wild) and a rapid rate of food assimilation. The average daily intake is 40-53 g with a transit time of approximately three hours (Bleavens and Aulerich, 1981).

A majority of mink in captivity are pelted as yearlings. Breeders are rarely kept in ranch herds for more than four to five years, although their life expectancy may be considerably greater.

Several strains or subspecies of mink are found in the wild, occupying different geographic regions and varying mostly in size. Those from the northwest are generally the largest. Domesticated mink are a mixture of these strains and are of a relatively uniform intermediate conformation.

Coat colour in the wild ranges from light to a very dark brown. The basic colour of domesticated mink is the so-called standard dark, a dark brown to near black shade. There are at least three major gene loci for coat and eye colour, mutations at which will interact to produce various colour varieties. These major genes are in turn influenced by numerous modifying genes resulting in approximately 200 possible variants or phases, of which only a few have gained favour commercially (U.S. Fur Rancher, 1980; Hutt and Rasmusen, 1982).

3. **Research Uses**

The rapid growth of mink ranching as a specialized agricultural industry has generated a substantial volume of mission oriented research. A major portion of these applied investigations have been undertaken in the producer countries of Scandinavia, North America and the USSR, at government and university agricultural experimental stations. Publications put out by these institutes from time to time, provide comprehensive reviews on the husbandry (Ag. Cda, 1975) health care (Ag. Cda, 1976) and nutrition (Ag. Cda, 1975; NRC U.S., 1982) of ranch mink.

Investigations on the interactions involved in coat colour inheritance in this species have provided useful models to basic genetic research as well as for exploitation by the fur industry (U.S. Fur Rancher, 1980; Shackleford, 1967). Attention has also been paid in recent years to the mink as a natural animal model for several specific diseases affecting humans and other domestic animals (Padgett, Gorham and Henson, 1968). Examples of such models, discussed in more detail under Health Care below, include Aleutian disease (*plasmacytosis*), Chédiak-Higashi syndrome, and muscular dystrophy. Comprehensive bibliographies of research publications that utilize and/or deal with mink are also available (Shump, Shump *et al.* 1974; U.S. National Board of Farming Org. 1984; Mink Ranchers' Research Foundation, 1984).

B. **HUSBANDRY**

1. **Procurement and Conditioning**

Ranch bred stock is readily available all across Canada and the northern states of the USA. A listing of registered breeders in Canada may be obtained from the Canadian Mink Breeders Association*.

Several colour phases are usually raised on any given ranch and the genotype, vaccination history, and other pertinent information should be obtainable for each animal purchased.

It is generally good practice to obtain research mink from local ranches whenever possible, in order to minimize the stress of transportation. However, mink travel long distances quite well if suitable caging is provided (IATA, 1989). Where automotive transport is involved, ventilation is of particular importance, as mink are highly susceptible to carbon monoxide poisoning from exhaust fumes.

Unless contraindicated for research reasons, all mink acquired for experimental purposes should, prior to shipment, have received vaccination against distemper, virus enteritis, pseudomonas pneumonia, and botulism. They should also have been tested (negative) by the counter immuno-electrophoresis test (CEP) for Aleutian disease. If for any reason these procedures have not been carried out, they must be undertaken immediately on arrival whilst the animals are under quarantine.

Quarantine, in a compound or room as isolated and separate as possible from the main holding area, should last for a minimum of two weeks to allow for

recovery from the stress of transportation and for the overt expression of any disease that may have been in incubation. During this period, the animal should be routinely examined and, if indicated, treated for ecto and endo-parasites.

Mink are usually individually caged from, or shortly subsequent to weaning; consequently, the identification of individual animals is accomplished through cage card records. If it is necessary to identify individual kits at an early age, they may be tattooed. A method for this, using the front foot pad, has been described (Einarsson, 1979).

2. Housing

Under commercial ranch conditions and those generally practised at experimental stations, mink are housed in raised wire pens, located in sheds and surrounded by a fence to prevent the entry of unwanted animals and people. Shed side walls should have adjustable shutters and/or screens for ventilation and protection against excessive sunlight and drafts. Care must be taken in the arrangement of the rows of cages within sheds to ensure that animals for breeding receive adequate natural light (see Breeding below).

Nest boxes for breeders are made of wood, filled with hay and/or shavings, with wire tops to provide ventilation. Dimensions may vary, but are usually about 40 x 25 x 30 cm (16 x 10 x 12 in). The boxes open into 75 x 50 x 40 cm (30 x 20 x 16 in) pens of 6 x 13 mm (0.24 x 0.52 in) wire mesh, provided with a much finer false floor to prevent the tiny kits from falling through.

Holding pens for individual mink (till pelting age) are usually 60 x 35 x 45 cm (24 x 14 x 18 in). Their nest boxes should be removable, suspended through the pen roof, approximately 20 x 20 x 25 cm (8 x 8 x 10 in) in size, with a removable wire top for ventilation and access. The opening into the nest box should be provided with a sliding door to facilitate capture.

3. Environment

Cold is not a problem for mink provided they are kept dry, well bedded, and free from excessive drafts. On the other hand, they are highly susceptible to heat prostration and should be protected from prolonged direct exposure to hot sun and a hot, humid atmosphere. An ample water supply and more than 70% moisture level in the feed, as well as shade shutters on sheds and wire nest box tops, will all help to avoid this potentially serious problem. The neonatal kit is particularly prone to fatal heat exhaustion as it is born hairless with an undeveloped temperature regulating mechanism.

As a general rule, mink, particularly breeding females, are best maintained under natural light conditions and the use of artificial light should be avoided as it will interfere with their natural breeding cycle (see under Breeding).

C. NUTRITION

1. Nutrient Requirements

Several reviews of these requirements for mink are available (Ag. Cda, 1975; NRC U.S., 1982). Water should always be available ad libitum even when wet feeds which may provide up to 85% of the animal's moisture requirements, are used. Mink will adapt well to automatic watering devices; however, under conventional mink holding conditions, care must be exercised to prevent freezing, or alternative sources of water must be provided.

Mink do not require a notably high protein diet and eight to nine per cent is considered adequate for maintenance, with 11-12% required by pregnant and growing animals. The quality of the protein is, however, important and a considerable portion of the diet should be of meat or fish in order to provide the necessary levels of certain essential amino acids.

Fat requirements vary with the season, from about 5% in fall and winter to 8 to 9% during the summer (Ag. Cda, 1975). Although mink are carnivores, grain products are a good source of carbohydrates for these animals and may make up to 25-30% of the diet.

Due to their lack of a cecum and short colon, mink cannot digest cellulose; however, some vegetables in their diet will provide necessary bulk. Supplementation of the diet with additional calcium, phosphorus, and vitamins may be advisable, depending on the nature and source of the main components of the ration.

2. Feeding

The general (traditional) ranch feeding program utilizes a combination of offal from poultry, fish, and beef with a commercial cooked cereal. The whole is ground and mixed to a consistency that will stay on top of the wire pen floor, thus avoiding the need for food containers. Traditional wet mink feed may be purchased in frozen blocks from local suppliers. Ingredients and their proportions will vary with the season of year, with a maintenance ration being fed during the winter to reduce weight for spring breeding. Mink normally accumulate fat during the late summer and fall.

Several dry diet pelleted feeds are available commercially. Both cost and convenience make the use of these particularly attractive where relatively small numbers of mink are to be held as laboratory animals. Prepared pelleted mink rations produced by reputable feed companies are an adequate single source of nutrition. However, it is essential that water be provided when pelleted dry feeds are used.

D. REPRODUCTION

1. Estrous Cycle

The reproductive physiology of mink of both sexes is markedly dependent on the naturally occurring seasonal photo periods. The normal progressive reduction in daylight hours in the fall, followed by the gradually increasing light periods of winter, are necessary for a normal cycle. Artificially lengthening the light period at any of these times may interfere with the process of estrus in these essentially monestrous animals, which may then fail to come into heat at all that season. The key factor is the duration of light, rather than its intensity. The level of sensitivity is such that even indirect light from an adjacent room or premises may be sufficient to disrupt the cycle. However, once estrus is achieved and immediately following the first breeding, implementation of a 14 1/2 hour light period has been shown to shorten gestation by an average of five days (Ag. Cda, 1975). Estrus is "silent", but females become receptive to males starting in early March.

2. Breeding

Most males will perform adequately when kept under conditions of natural daylight. Prolonging light to 13 1/2 hours daily, from late January till mating time in early March, is effective in hastening the onset of spermatogenesis and sexual activity. However, females must not on any account be exposed to this artificial photoperiod.

Females should be taken to the male's pen for breeding and must be watched to ensure against fighting. A savage male may severely harm and even kill a female or conversely, fighting may destroy the male's confidence to the extent of rendering him useless for the rest of that season. A good male should service five females effectively. Copulation, which normally has about a 20 minute duration, should be followed by an examination for the presence of mobile sperm.

Mink are induced ovulators, ova being released from 24-36 hours after the stimulus of coitus. After first mating and rupture of initial follicles, a second crop of ova will become mature in seven to 10 days. It is normal practice to rebreed mink at this time, often two days in a row. It has been clearly demonstrated that a majority (up to 90%) of the kits will derive from this latter mating.

Implantation in mink is normally delayed about 10 to 40 days, with the delay becoming shorter following matings that take place later in the season, as the days get longer. Gestation proper (implantation to parturition) is 30-32 days, though the actual time lapse from breeding to birth will be quite variable, averaging 51 days.

3. Parturition and Weaning

An average of four (but up to 10 or 11) young are born per litter. The neonatal kit is without fur, blind, deaf, and weighs about 10 g. Whelping

occurs from mid April through May. Occasional abortions also occur but are rarely documented or studied, and so their cause and frequency are not known. Infectious abortion is discussed below under Infectious Diseases.

Dystocia, lack of milk, and weakness are three main problems causing losses at birth. Mothers will push stillborn or weak offspring out of the nest; cannibalism is rare. Kits can be fostered with ease and it is advisable to routinely remove some of the newborn of mothers with large litters onto ones with only one or two kits.

Growth rates are very rapid with kits averaging 100 g at 21 days, at which time they will commence eating solid food.

Weaning can take place at six to 10 weeks of age. The latter is a convenient time for separation, as young kits should be vaccinated at 10 weeks (see Health Care). They may be penned in pairs, but should be segregated into individual pens by four months of age.

E. RESTRAINT

1. Handling

When disturbed, a mink may utter a high pitched shriek and will usually retreat into its nest box. This facilitates capture provided the box is of the drop-in type with a sliding door and removable top. The animal may be caught by hand using heavy leather gloves and restrained by grasping around the neck with one hand and at the hips or by the base of the tail with the other. It should always be kept in mind that mink are both vicious and quick moving.

Small catching cages are available and may prove useful in situations where hand holding interferes with the desired manipulation, and for in-house transportation.

The mink's mouth may be held open by inserting an appropriate sized block of wood as a gag. The animal may be muzzled by a proper sized "split key ring" placed over the muzzle with its pin being positioned in the mouth behind the canine teeth.

2. Manipulation and Sampling

Administration of medicines, etc., is most readily accomplished by mixing in the food, providing that the animal is eating. Substances may also be given orally by spoon or eye dropper. A stomach tube of soft rubber may be passed fairly readily by using a gag with a hole in it, taking care to ensure entry into the esophagus for force feeding. Fluids for therapy and the nutrient support of sick animals are quickly absorbed if passed by rectal instillation high into the colon, a procedure that involves relatively little stress to the animal.

The preferred sites for subcutaneous injections are under the loose skin of the axillary or flank areas. Intramuscular injections may be given readily into the

thigh muscles, and intraperitoneal injections just lateral to the umbilicus. All these procedures may be done while the animal is restrained manually by an assistant (see above).

Blood sampling and injections by the intravenous route are not routinely practised, although, if necessary, cannulation of the jugular vein or cardiac puncture can be performed on animals under chemical restraint. The former procedure can be successfully utilized for the collection of large and/or repeated blood samples (Fletch and Woebeser, 1970). Small blood samples may be readily collected into a microcapillary tube after clipping a toe.

3. Chemical Restraint and Anesthesia

In general, the agents and procedures described for chemical restraint and tranquillization of ferrets (see chapter on Ferrets) are appropriate to the mink, with ketamine being particularly useful.

The use of xylazine (Rompun) is not recommended as it causes excessive excitation. Reserpine at 0.05 mg/kg given in the food has been used as a tranquillizer (Lafortune and Rhéault, 1960); promazine 2 mg/kg i.m. has also proven effective for this purpose (Seal and Erickson, 1969).

Prior to surgical anesthesia, mink should be fasted for 12 hours. Thiopental is well tolerated but should be given i.v. (1% solution slowly to effect) which may present technical difficulties, although the cephalic or tarsal veins can be successfully used with experience. Chamber induction can be successfully accomplished with N_2O:O_2 in proportions of 3:2, followed by mask anesthetic maintenance using methoxyflurane in N_2O:O_2 at 1:1 (Green, 1979). Halothane when used repeatedly may cause liver and kidney damage and is therefore not recommended.

4. Euthanasia

Various methods are used to kill mink commercially for pelting. Acceptable methods of euthanasia for either ranch or laboratory must be humane, inducing a rapid and painless death. Cervical dislocation is suitable, but requires an expertise not usually available in the research laboratory. Cervical dislocation or injection of a lethal agent immediately following stunning with a Norwegian electrical stunner (Euthanos type 2) is the recommended procedure when a number of animals must be killed. This stunner is small, safe, inexpensive, battery operated instrument that is commercially available and widely used on mink ranches (Finley, 1980).

The method of euthanasia of mink used for research will, in the final analysis, be dependent on the demands of the experimental protocol. Where a stunner is not available and/or cervical dislocation is not acceptable, carbon monoxide or carbon dioxide (provided the chamber is prefilled), or an overdose of an injectable anesthetic given i.v., may also be used for this purpose.

F. HEALTH CARE

1. Disease Prevention

Mink are generally hardy, healthy animals. However, in domestication they are usually maintained under close, relatively dense caging conditions, subjected to intensive breeding and a restricted, far from natural, environment. These conditions invite exposure to numerous infectious, nutritional and inherited health hazards.

A majority of the potential problems may be avoided if sound management principles are practised and an enlightened preventive program is followed. Such a program should be designed and implemented with proper veterinary consultation and should include:

a. Vaccination at ten weeks of age against distemper, virus enteritis and pseudomonas pneumonia, with revaccination as required.

b. Vaccination against botulism for animals on standard ranch rations; may not be necessary under laboratory conditions.

c. Assurance that all newly acquired animals are negative to the counter immunoelectrophoresis test (CEP) for Aleutian disease.

d. Proper feed handling and storage facilities.

e. Regular disposal of droppings, cleaning of dishes, with the periodic removal of blowtorch of hair from wire pens, and disinfection of wood nest boxes for fly control.

f. Precautions against access by wild rodents, pets, and other animals to the mink pen area.

2. Infectious Diseases

Bacterial and viral diseases of mink are dealt with in detail in the veterinary literature (Davis, Karstad and Trainer, 1981; Kaufmann, 1978; Siegmund, 1979) and professional veterinary advice should always be sought, both in establishing a herd health program and where an infectious disease outbreak is suspected. Useful, practical manuals and references for the recognition and immediate handling of health problems in mink are available (Ag. Cda, 1976; Siegmund, 1979).

a. **Distemper**: Distemper in mink is due to the same virus that causes canine distemper. The disease is most severe and contagious among kits, but affects all ages. Incubation is about two weeks from exposure, with initial signs being watery eyes and a nasal discharge; later, the feet and nasal region may be encrusted and markedly swollen. Treatment is not effective and should not be attempted. Affected animals should be killed and the area of the outbreak isolated and all exposed equipment, caging, etc., should be thoroughly disinfected. The virus is inactivated by heat

(40°C or 104°F), formaldehyde (1%) and Lysol (1%). The disease should not prove a problem if proper vaccination is practised.

b. **Mink Virus Enteritis (MVE)**: The causal parvovirus is comparable, if not identical, to that responsible for feline panleukopenia, with cross infection occurring between cats and mink (MacPherson, 1976) but not from inoculation with canine parvovirus-2 (Barker, Povey and Voigt, 1983). The infection is expressed as a highly contagious, inflammatory gastroenteritis, particularly among kits, with mucus covered and hemorrhagic feces. Death usually occurs in a few days, with those animals that may recover remaining as carriers of the virus. Treatment is of little avail; however, prevention by vaccination is effective.

c. **Aleutian Disease (*Plasmacytosis*)**: The most common disease currently encountered in mink is a chronic viral infection resulting in a severely impaired immune response (Porter, Larsen and Porter, 1980). As its name implies, the condition was first recognized in mink of the Aleutian (blue gray) colour phase, although it may affect mink of any colour. Vertical transmission occurs from dam to offspring, both via body excretions and by transplacental passage. Signs are relatively non-specific, of a chronic, debilitating disease leading to emaciation, sometimes with nervous symptoms and eventually to death. There is no treatment or effective vaccination, however, the specific immunological tests available should be used to identify carrier animals (Ag. Cda, 1976). Aleutian disease occurring among experimental mink can be contained and eliminated by isolation, testing, slaughter, and disinfection. The virus is quite resistant to disinfectants, however, agents such as gluteraldehyde (2%), formaldehyde (2%), and halogen derivatives have been shown to inactivate the virus (Shen, Leendertsen and Gorham, 1981).

d. **Pseudomonas (Hemorrhagic) Pneumonia**: Acute bacterial infections with *Pseudomonas aeruginosa* may occur among mink, most often in the fall. Affected animals are usually found dead with a blood tinged exudate at their mouths and nose, as well as sometimes a small pool of blood on the ground under them. Sporadic deaths of individuals from this disease are probably quite common, although herd outbreaks with up to 50% mortality may also occur (Long and Gorham, 1982). The causative organism is commonly present in overtly healthy mink. Immediate vaccination of the remaining animals with an autogenous bacterin as soon as the disease is identified will usually stop its spread. Routine prophylactic vaccination with commercially available polyvalent vaccines is now recommended.

e. **Infectious Abortion**: Abortions in sheep and women have occasionally been caused by *Campylobacter jejuni* infection. Recently an 18% incidence of abortions has been attributed to infection with this bacteria among 1,059 bred female mink on a single Ontario ranch (Hunter, Prescott, Petit *et al.* 1983). An additional 29% of the bred females failed to produce young, reducing kit production that season to 2.3/female from an animal average 4/female. Infection was probably from well water contaminated with *C. jejuni* by ducks and/or cattle. Addition of erythromycin 20 g/tonne to the feed was effective in arresting the

incidence (Hunter, Prescott, Petit *et al.* 1983). *C. jejuni* may also cause enteritis in mink and other animals.

3. **Parasites**

Parasitic disease should not prove a problem in experimental mink if the animals are housed on wire with good sanitation, and the proper quarantine of incoming animals has been practised. However, there are at least two protozoan infections that are still fairly common and should be watched for:

a. **Coccidiosis**: Although not as frequent or severe as before mink were housed on wire, infestations with coccidia are encountered with an incidence reported to be as high as 50% in some areas (Myers, Foreyt, Hartsough *et al.* 1980). Coccidiosis may retard growth of kits and many even cause some deaths. Diagnosis is by microscopic identification of the oocysts in the feces and treatment is with one of the several coccidiostats available commercially. Use of sulfa drugs for this purpose, however, is generally contraindicated, as these are toxic to mink.

b. **Toxoplasmosis**: *Toxoplasma gondii* infections are acquired by mink eating meat containing infective oocysts, or from feed contaminated by cats that are shedding oocysts in their feces. Intrauterine infection of feti from chronically infected mothers may also occur, leading to abortion or a high neonatal mortality (Ag. Cda, 1976; Pridham, 1961). No effective treatment is available; prevention involves rodent control, keeping cats away, and feeding oocyst free of cooked rations.

4. **Miscellaneous Conditions**

a. **Chastek Paralysis**: A Vitamin B (thiamine) deficiency occasionally encountered from feeding uncooked fish such as fresh water smelt, suckers, and herring, that are high in thiaminase.

b. **"Screw Neck"**: In pastel coloured mink this shows as a defect of equilibrium associated with reduced otoliths in the semicircular canal ampullae of the inner ear occurring in this genotype. The condition can be prevented by the addition of manganese sulfate to the food at the level of 3.1 g/kg (Ag. Cda, 1976).

c. **Muscular Dystrophy**: Although not common, this recessive mutation is of interest as a model of human disease. The anomaly can be detected at about two months of age and involves a progressive wasting of the skeletal muscles.

d. **Salt Poisoning**: Sodium chloride in excess of that normally present in the diet may cause toxic symptoms in mink, particularly if the supply of drinking water is limited.

e. **Polychlorinated Biphenyls (PCBs)**: PCBs may affect mink indirectly through foods such as fish from contaminated waters. Low levels of PCBs may cause reproductive failure. Pentachlorphenols (PCP), wood preservatives present in shavings, may also adversely affect mink fecundity.

f. **Chédiak-Higashi Syndrome (C-HS)**: A recessive trait among Aleutian mink and other partial albino colour phases it is largely responsible for their susceptibility to infections such as abscesses, boils, and empyema. Like Aleutian disease, C-HS is associated with malfunction of the inflammatory process, due to fusion of isozymes in neutrophils and failure in release of their enzymes. This, in turn, leads to a failure in the enzymic breakdown and destruction of phagocytized materials (Prieur and Collier, 1978).

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