# X. FERRETS

## A. INTRODUCTION

### 1. Classification

Ferrets are carnivores belonging to the family Mustelidae. This section will deal specifically with the domesticated ferret (*Mustela putorius furo*), a species that is not found in the wild state, except in New Zealand where domestic ferrets have established themselves as feral animals.

The ferret is closely related to the European polecat or fitch ferret (*Mustela putorius*) with which it will interbreed (Hammond and Chesterman, 1976). The endangered North American black-footed ferret (*M. nigripes*), on the other hand, is a completely separate species which is rarely, if ever, encountered in the laboratory.

### 2. Colour Varieties

Laboratory ferrets are either of the wild types or albinos. The former have buff coloured coats with a distinctive black face mask, feet and tail markings, collectively referred to as fitch or polecat, and is the most common laboratory variety seen In North America. The albino ferret is pink eyed with a white coat, which tends to become yellowish with age from sebaceous secretions. A typical allelic series is present at the ferret's albino gene locus, giving rise to such colour phases as Siamese, silver, silver mitt, etc., (Ryland, Bernard and Gorham, 1983).

### 3. Behavior

The ferret's usefulness to man was originally based on its capabilities as an exterminator of snakes and rodents. Later, it became popular in Europe for rabbit hunting and as a pet. The ferret was not introduced into North America until about 100 years ago.

Despite the *furo* of its scientific name and an earned reputation as a ferocious rat catcher, the ferret is, in fact, an easily trained, friendly, and inquisitive little animal that adapts well to laboratory conditions, showing no natural animosity to man, cats, or dogs (Ryland, Bernard and Gorham, 1983).

The male ferret is referred to as a "hob", the female as a "jill" and their offspring as "kits" by ferret breeders and fanciers.

## B. RESEARCH USES

The introduction of the ferret as a laboratory animal dates back to the turn of this century. Although its utilization has never been very extensive (Hammond and Chesterman, 1976) the ferret's contributions to human health, as well as to that of companion and farm animals have been very significant. Notable in this regard has been its role in the early transmission studies on such virus diseases as canine distemper and human influenza (Francis, 1982). Other virus diseases for

which the ferret has proven to be an exceptionally appropriate model include measles, vesicular stomatitis, Aleutian disease (see under Mink) and bovine rhinotracheitis (Smith, 1978).

While the ferret's major contributions to date have probably been in the field of virology, it has also found extensive use in studies on reproductive physiology and pharmacology; recently, it has been advocated as being particularly well suited to toxicology testing (Hammond and Chesterman, 1976; Thornton, Wright, Sacrap *et al.* 1979).

## C. BIOLOGICAL CHARACTERISTICS

The ferret, in common with other Mustelidae, exhibits a number of anatomical peculiarities, including the absence of either a cecum or an appendix, with the male also lacking a prostate gland. The great blood vessels have also been described as exhibiting some unusual features (Willis and Barrow, 1971). The ferret has typical bilateral mustelid musk secreting anal glands which are potential defensive organs. As in other Mustelidae such as skunks, the ferret may empty these glands if angered or frightened. Secretory activity and odour from the musk glands tend to be increased in female ferrets during estrus. These glands may be removed surgically, if desired, preferably at six to eight months of age (Creed and Kainer, 1981).

Sweat glands are relatively poorly developed in this species which as a consequence, proves to be prone to heat prostration at temperatures in excess of 32$^{o}$C (90$^{o}$F). Heat loss is by evaporation from the lungs; thus, adequate air circulation is important, particularly in transport cages during warm weather.

The usual useful lifespan of laboratory and breeding colony ferrets is five or six years; however, their life expectancy may reach as much as 14 years.

The variations in body weight that may be encountered amongst ferrets are extraordinarily great. Sex accounts for almost a twofold difference, with males being nearly double the size of females. Seasonal fluctuations of from 30-40% of total body weight occur, due to the accumulation of subcutaneous fat in the fall and its loss in the spring (Ryland, Bernard and Gorham, 1983). Selection in ferret breeding colonies for size is a further factor that undoubtedly has contributed to these variable recordings of weight ranges from different colonies which include: 400-3500 g (Hammond and Chesterman, 1976), 600-2000 g (Ryland, Bernard and Gorham, 1983) and, 700-1300 g (Carde, Moye, Nixon *et al.* 1983).

Hematological values for normal young adult (four to eight months) fitch ferrets have recently been reported, along with detailed serum chemistry profiles (Lee, Moore, Fryer *et al.* 1982). The hematological profiles of the fitch ferret, although similar to those recorded for the albino ferret (Thornton, Wright, Sacrap *et al.* 1979), do show considerable variability in their total and differential leukocyte counts, possibly due to the relatively small samples examined. Some of these values are shown in the accompanying table. The ferret, like the mink (Kennedy, 1935), has very numerous megakaryocytes normally present in its spleen.

**SOME HEMATOLOGICAL VALUES FOR FITCH AND ALBINO FERRETS***

| | Males | | Females | |
|---|---|---|---|---|
| | **Fitch** | **Albino** | **Fitch** | **Albino** |
| Hematocrit (PCV %) | 43.4 | 55.4 | 48.4 | 49.2 |
| Hemoglobin (g/di) | 14.3 | 17.8 | 15.9 | 16.2 |
| Leukocytes ($10^3/mm^3$) | 11.3 | 9.7 | 5.9 | 10.5 |
| (Range) | (7.7-15.4) | (4.4-19.1) | (2.5-8.6) | (4.0-18.2) |
| Neutrophils (%) | 40.6 | 57.0 | 32.8 | 59.5 |
| Lymphocytes (%) | 49.7 | 35.6 | 58.3 | 33.4 |
| Monocytes (%) | 6.6 | 4.4 | 4.5 | 4.4 |
| Eosinophils (%) | 2.4 | 2.4 | 3.6 | 2.6 |
| Basophils (%) | 0.7 | 0.01 | 0.8 | 0.2 |

* Adapted from Thornton, P.C. *et al.* and Lee, E.J. *et al.*.

## D. HOUSING

Ferrets, unlike mink and wild mustelids, need not be housed outdoors; nor do they need runs. They are gregarious animals that are playful and, when young, they should be housed two or more to a cage. Older animals will sleep a great deal of the time and may be held singly or in sexually segregated groups.

Standard rabbit cages are satisfactory for ferrets, provided that the attached feed hoppers are modified to prevent escape.

Ferrets are best kept on a solid floor with wood shavings for bedding. They will always defecate in one corner of the cage and can easily be trained to use a litter box. Placing a nest box in the cage, particularly if a wire mesh floor is being used, provides the animal with a quiet, comfortable place to sleep.

Group housed males may show belligerence towards each other, particularly during the breeding season. During estrus, females should be kept separate from each other to avoid pseudopregnancy.

Ferrets will thrive at ambient temperatures of anywhere from $0^oC$ to $32^oC$ ($32^o$ to $90^oF$); in fact, litters can be successfully raised at $7^oC$ ($45^oF$) (Hammond and Chesterman, 1976). Humidity should preferably be from 40-60% during warm weather, as high humidity and temperatures above $30^oC$ ($86^oF$), tend to stress adult ferrets as, as already noted, they have few and poorly developed sweat glands.

## E. **BREEDING**

An excellent and concise review of ferret reproductive behavior, mating, and breeding is available (Hammond and Chesterman, 1976). Points of particular importance and interest in regards to reproduction in this species are summarized below:

a. Both male and female ferrets are seasonal breeders, becoming sexually active in the Spring for five to six months.

b. The breeding season may be extended and manipulated by alterations to the photoperiod (14-15 hours for optimal and six to eight hours for minimal activity).

c. The female ferret is an induced ovulator (coitus required), whose ovarian activity is reliably reflected through estrogen-dependent vulval swelling and regression.

d. Females, if not bred, may stay in heat for four or more months.

e. An abnormally protracted estrus (one and a half to nine months), under laboratory conditions in the absence of the male, may cause fatal aplastic anemia, as ferrets are subject to severe bone marrow depression (hypoplastic anemia) from high plasma estrogen levels (Kociba and Caputo, 1981; Bernard, Leathers, Brobst *et al.* 1983).

f. Breeders, during the season, should be caged singly to avoid pseudopregnancy amongst females and possible fighting between males (see Housing).

g. Gestation lasts from 41-43 days, as also does the duration of pseudopregnancy.

h. Two litters per season may be obtained, each averaging eight kits (range 2-14). These are born blind, deaf, and hairless.

i. Eyes and ears open at between three and four weeks of age and kits will begin to eat solid food at two to three weeks with the eruption of their milk teeth. Weaning will occur naturally at about six weeks of age and adult weight will be achieved by about four months old (Bernard, Leathers, Brobst *et al.* 1983; Carde, Moye, Nixon *et al.* 1983; Shump and Shump, 1978).

j. Neonatal mortality is quite high in ferret litters, with contributing causes including maternal lactation failure, maternal neglect, and unsanitary and poorly ventilated nesting boxes. The incidence of congenital malformations, particularly of the Central Nervous System (CNS), is relatively high in this species (Willis and Barrow, 1971).

k. An eclamptogenic toxemia may occur a few days prior to whelping. The cause is not well understood, but the condition can usually be prevented by the addition of uncooked, fresh liver during the pregnancy.

## F. MANIPULATIONS AND RESTRAINT

### 1. Handling

Ferrets are by nature friendly and easily trained. Those destined for experimentation should be handled as much as possible. The use of gloves should be avoided, if possible, as ferrets will rarely bite unless brightened, hurt, or with a litter of young. When approaching an unknown animal, give it time to indulge its natural inquisitiveness and to compensate for its shortsightedness; this it will do by sniffing your hand.

The hand should be presented to it as the knuckles of a clenched fist; then, if perchance the ferret should attempt to bite, it will only manage at most to graze the skin, due to the smallness of its mouth. Usually, no attempt at biting will be made, and once it is clear that the animal is not going to attack, it may be picked up by gently placing the hand over its shoulders, with thumb and forefinger around its neck and the remaining fingers behind its front legs under the chest. It may be necessary to hold the animal with two hands for injection, in which case it should be first held gently at the nape of its neck, then grasped and pulled back by the tail, pinning head, neck and shoulders. Ferrets will not tolerate being stretched between hind legs and neck, nor having their hind legs manipulated. Pregnant females should be supported by a hand under their hind quarters when being lifted up (Hammond and Chesterman, 1976; Lewington, 1983; Feller and Benson, 1980).

A ferret will usually signal quite clearly if alarmed or on the defensive by arching its back, fluffing out its tail hairs like a bottle brush and, as a final protest, by expressing its musk glands (Lewington, 1983).

An intractable ferret may often be acclimatized if handled frequently on successive days whilst tranquillized with diazepam at 2 mg/kg, i.m (Green, 1979).

### 2. Sampling

Subcutaneous injections may be given unassisted whilst the animal is held with one hand. Allowance must be made for the thick fat layer acquired by ferrets in the Fall which must be penetrated for intramuscular injection. Intraperitoneal and i.m. injections are best undertaken whilst the animal is being held by a second person. The jugular vein is the preferred puncture site as intravenous entry into either the cephalic or tarsal veins may be difficult due to their smallness. Cardiac puncture may also be carried out, but is not without risk. All of these procedures should be performed with the animal under chemical restraint (Lee, Moore, Fryer *et al.* 1982; Feller and Benson, 1980). Small amounts of blood may be collected by means of toe clipping.

Oral dosing and the passage of a stomach tube are procedures readily employed on ferrets; the latter requires the use of a bit or speculum (Ryland and Goorman, 1978).

3. **Chemical Restraint**

Ferrets should be food-deprived for at least six hours before being anesthetized, as they vomit very readily.

Atropine at 0.05 mg/kg, either s.c. or i.m. is recommended (Green, 1979).

Diazepam (see above) or acepromazine 0.05 mg/kg are both satisfactory tranquillizing agents. Sedation and short-term chemical restraint may be achieved safely with ketamine HCI at 10-20 mg/kg, i.m. (Green, 1979), or with a "cocktail" of xylazine (1-4 mg/kg) and ketamine (20-30 mg/kg) i.m. (Ryland, Bernard and Gorham, 1983).

4. **Surgical Anesthesia**

The use of barbiturates is limited by the difficulty of intravenous injection in this species (Ryland, Barnard and Gorham, 1983).

Deep surgical anesthesia may best be induced and maintained by mask delivery of either halothane or methoxyflurane (Ryland, Bernard and Gorham, 1983; Green, 1979).

## G. NUTRITION

The nutritional requirements of the ferret have not been determined; however, those for mink have been (NRC U.S., 1968) and are generally accepted as being applicable.

A standard wet feed mink diet of 35% protein and 30% fat with 5 or 6% ash has proven an adequate ferret colony diet in which no nutritional deficiencies have been noted to develop over a 25 year period (Ryland, Bernard and Gorham, 1983). Dry or canned commercial dog and cat foods or dry milk ration may also be used with success if they provide at least 10 mg of Vitamin E daily (Carde, Moye, Nixon *et al.* 1983).

Young ferrets, after weaning, have been raised on pig-starter pellets. >From about three weeks of age onwards, kits may be given a supplement of a meat based wet diet. The mother will also bring meat to her young in their nest, but not pellets (Hammond and Chesterman, 1976). A moistened dry ration may be offered to the young prior to weaning.

Orphaned kits may be successfully hand raised on cows' milk if it is enriched with either cream or egg yolk (Hammond and Chesterman, 1976; Carde, Moye, Nixon *et al.* 1983). Prepared milk replacers may also prove useful for this purpose.

## H. HEALTH CARE

### 1. Quarantine

Subjecting the newly-acquired ferret to a minimum 40 days of quarantine isolation has been recommended (Hammond and Chesterman, 1976) and is undoubtedly justifiable when introducing outside stock into a large breeding and research colony. However, in most facilities where relatively small numbers of ferrets are maintained and breeding is not being undertaken and where (as should be the case) all the ferrets have been vaccinated against canine distemper, a quarantine period of half that length (21 days) should provide adequate protection. Unvaccinated animals should immediately receive a primary distemper vaccine on arrival.

All new arrivals should be examined for external and internal parasites and receive the appropriate treatment(s) as indicated (see Parasites, below).

### 2. Viral Diseases

a. **Canine Distemper**: Ferrets are extremely susceptible to canine distemper, with very high mortality in natural outbreaks. Distemper in the ferret usually has an incubation period of seven to ten days; then the initial signs of loss of appetite occur. A sticky, mucopurulent discharge from the eyes and nose soon develops, followed by a skin rash, particularly noticeable beneath the chin and in the inguinal regions. Foot pads often swell and become hyperkeratotic. The animal's condition will rapidly deteriorate, with death in approximately 14 days.

   Ferrets should be vaccinated against canine distemper by intramuscular or subcutaneous vaccination with modified live virus (MLV) of chick embryo origin. MLV distemper vaccine of canine tissue culture origin may prove to be ferret virulent and is contraindicated. Initial vaccination should be at eight to ten weeks of age; four to six weeks if kits are from an unvaccinated dam. A booster is sometimes given two weeks later (Ryland, Bernard and Gorham, 1983). Revaccination every two to three years should provide continuous protection. It is important to realize that the virus of canine distemper can be carried to susceptible ferrets on the persons of the animal attendants.

b. **Rabies**: Ferrets are susceptible to rabies; however, the likelihood of infection in laboratory bred and housed animals is almost nonexistent. Vaccination, other than in pets, is probably unnecessary. Killed virus vaccines, while not tested for efficacy in this species, should be used if vaccination is considered necessary.

c. **Feline Panleukopenia**: Although it has been suggested that the vaccination of ferrets against this disease is not necessary (Ryland and Gorham, 1978) it should be noted that feline panleukopenia virus does cause a cerebellar hypoplasia in experimentally infected neonatal animals of this species (Johnson, Margolis and Kilham, 1967). Consequently, the vaccination of valuable experimental ferrets against this disease is

probably an advisable precaution to take, particularly in mixed animal colonies that also house felines.

d. **Human Influenza**: Ferrets are susceptible to several strains of human influenza virus. The disease produced in ferrets, in its very early stages, may be confused with the early signs of distemper. However, the course is much more rapid, with complete recovery usually occurring naturally.

e. **Aleutian Disease**: This infectious plasmacytosis can occur in ferrets and apparently may be transmitted from mink to ferrets (Kenyon, Howard and Briko, 1967) (see chapter on Mink).

3. **Bacterial Diseases**

a. **Botulism**: The ferret is considered to be moderately susceptible to botulism Types A and B and highly susceptible to Type C (Ryland and Gorham, 1978). However, this need not be a problem within the laboratory as the disease can be readily prevented by excluding from the diet food ingredients of unknown origin. Prepared wet mink rations may contain botulinus toxins, and their use should be restricted to vaccinated animals.

b. **Tuberculosis**: Ferrets are susceptible to infection by *Mycobacterium tuberculosis* of avian, bovine, and human origin. Signs may not be apparent until quite late in the stage of active infection, at which time, in addition to emaciation, they may include a progressive paralysis of the limbs. Palpable mesenteric lymph nodes should be considered suggestive of this disease, as the infection in ferrets primarily involves the alimentary tract and abdominal lymph nodes (Ryland, Bernard and Gorham, 1983). Chicken wastes used in preparing wet mink ration are a potential source of *M. tuberculosis* infection.

c. **Diarrhea**: This may occur in ferrets as a sign in several enteric infections of unknown or ill defined origin. Amongst these is an enteritis that appears most frequently in warm weather. Acute signs include bloody diarrhea, anorexia and death within three to four days. In chronic cases, the diarrhea may be intermittent, with appetite normal, but the food failing to be digested; the animal becomes emaciated and usually dies within one month. Neomycin at 10-20 mg/kg may be used in treating this condition (Ryland and Gorham, 1978).

A proliferative colitis manifest by diarrhea, weight loss and partial prolapse of the rectum, probably attributable to a *Campylobacter* infection, has been reported (Fox, Murphy, Ackerman *et al.* 1982). A 61% incidence of subclinical infection with *C. fetus* subspecies *jejuni* has been demonstrated in ferrets obtained commercially for research in the USA. This is of particular note in that these bacteria have in recent years become suspect as causal organisms in diarrhea disease of humans and laboratory animals (Fox, Ackerman and Newcomer, 1983).

d. **Superficial Infections**: These are of fairly frequent occurrence, involving *Staphylococci*, *Streptococci* and *Corynebacteria*.

Abscesses, particularly around the neck and jaw, are common, but will usually respond to conventional antibiotic therapy and the establishment of proper drainage. Most antibiotics are satisfactory for use in this species; however, streptomycin at high dosages can be toxic (Ryland and Gorham, 1978).

4. **Parasites**

Ferrets are very susceptible to infestation with *Sarcoptes scabiei*. This quite often affects the feet, particularly at the base of the nails, causing the feet to become swollen and scabby; if left untreated, the loss of the claws occurs. More widespread infestations may cause a severe, generalized dermatitis, necessitating euthanasia. Localized infestations will usually respond to judicious removal of the scab and the application of sulphur preparations or benzyl benzoate.

Ringworm (*Microsporum canis*) can infect young ferrets and may be transmitted to them from cats (Hagen and Gorham, 1972). Clinical signs tend to be transient; however, the organisms will persist in a subclinical state. Infections should be treated orally with griseofulvin at 25 mg/kg dosage (Ryland, Bernard and Gorham, 1978).

Fleas and mites, particularly the ear mite (*Otodectes cynotis*), can infest ferrets and will usually respond to rotenone and pyrethrin powders (Ryland and Gorham, 1978).

Ferrets are also susceptible to various species of gastrointestinal helminths, which may be identified by standard fecal examination procedures. In general, the treatment of internal parasites in the ferret should be based on procedures applicable to cats (Ryland, Bernard and Gorham, 1978).

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