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The print on the cover is from Heptner et al. 1967 p. 720

EUROPEAN MINK, *MUSTELA LUTREOLA* LINNAEUS 1761, CAPTIVE BREEDING AND HUSBANDRY PROTOCOL

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A. Introduction

The European mink is one of the most critically endangered carnivores in Europe and is in need of urgent conservation action. The general decline of the species has been alarmingly rapid in the last fifty years and is thought to be due to a number of anthropogenic factors including habitat loss, pollution, hunting & trapping and the introduction of the more robust and opportunistic American mink. Nearly all known wild populations are near to extinction and there is little hope for the survival of the species without intensive protective and management programmes, both in the wild and captivity. Until more is known about the species' biology and ecology, effective conservation measures in the wild are limited. Thus, placing an ever increasing importance on a co-ordinated captive conservation programme as part of an overall conservation strategy to aid the species recovery.

Several attempts to breed the European mink in captivity have been made during recent decades; for commercial, scientific research and conservation reasons. Unfortunately the results of these attempts have not always been successful (for more details see Maran T. 1994: Studbook for the European mink, *Mustela lutreola* Linnaeus, 1761, vol.1). However, these projects have provided a great deal of valuable knowledge about the captive management of the species. Furthermore, a lot of useful information applicable to the European mink has been accumulated by several institutions and experts concerned with the maintenance of other mustelid species in captivity (e.g. Black-footed ferret, European otter).

This first edition of the guidelines integrates the knowledge from several sources:

- knowledge about keeping the European mink gained at Tallinn Zoo.
- an enormous amount of data, ideas and advice was received from the Black-footed ferret programme in the United States of America.
- information derived from the Black-footed ferret captive propagation protocol at the Metro Toronto Zoo, Canada.
- other information was taken from various European Endangered Species Programme (EEP) husbandry guidelines, particularly the EEP Guidelines for otter.

As the European mink is highly endangered, every single individual is of vital importance to the conservation of the species and must therefore be handled with utmost care and in the safest possible way. Therefore, the various protocols set out in these guidelines must be stringently adhered to wherever possible. However, there will always be a need to improve our captive husbandry that will necessitate some modification and experimentation to determine more effective management techniques. Although this may appear to be in direct contravention of each other, adoption of these two approaches (as indicated below) will ensure best practices in a continuous and evolving programme:

- the protocols must be rigorously adopted providing uniformity for all holding facilities to ensure maximum success, based on current knowledge and experience.
- the protocols must incorporate a degree of flexibility to encourage improvements in the quality of the programme and implementation of new ideas.

To achieve this goal all the participants must follow the protocol and, where improvements are proposed, permission must be first sought from the species co-ordinator, and thereafter, where necessary, with the European Mink Conservation & Breeding Committee (EMCC). If no justifiable objection is found the proposer will be encouraged to implement the proposed new or improved technique(s) and, based on its success, it will thereafter be incorporated into the guidelines.

The guidelines places an emphasis on maintaining the European mink in large numbers held in off-show breeding facilities. However, details of facilities on view to the visiting public in zoos and wildlife parks, are also discussed.

The current guidelines should not be seen as a definitive or final document, but as an evolving document where it will be subject to continuous change in the course of improving the captive conservation programme. Any comments or constructive criticism about the guidelines are welcomed.

The authors would like to thank and acknowledge the assistance of Leif Blomqvist from Helsinki Zoo and Mati Kaal from Tallinn Zoo in compiling the guidelines. We are grateful to the British Government Darwin Initiative for financial support.

B. Staffing

Every breeding facility should designate one member of the senior staff who is fully responsible to the EMCC for breeding and keeping of European mink. This person should preferably also be the contact person for the EMCC. One (or more) full-time mink keeper(s) will be responsible for the day to day care of the mink and who will report to the designated EMCC contact. Following current guidelines the number of keepers necessary to provide adequate cover at all times, especially during the breeding season, days off and holiday periods must be determined, along with their daily routine.

C. Disease Prevention Control

1. Other animals

Other animals (i.e. feral cats) should be kept away from the vicinity of the European mink facility. Live-traps should be maintained around the surrounding fence and trapped animals removed immediately on inspection. In addition an electric fence may be used to accompany the exterior fence to discourage unwanted animals climbing into the enclosed area.

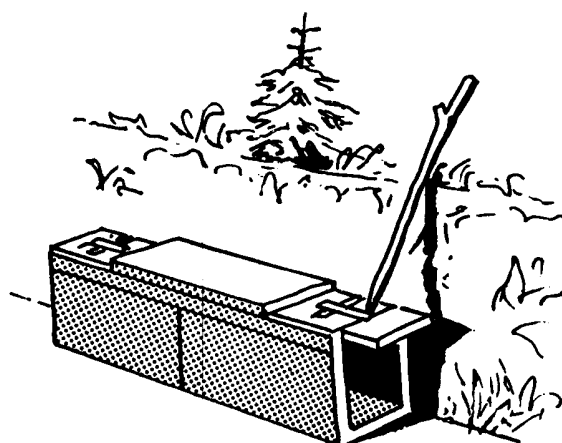


Figure 1.(from Behnke, 1982)

2. Other precautions

Excessive noise or uncontrolled artificial light could be detrimental to the animals well-being, particularly during the breeding season (March - May), parturition and the initial rearing period of kits (late-May to late-July). **Therefore the immediate area surrounding European mink facility must be kept as private as possible.**

D. Housing Management Protocol

1. Enclosure for public viewing

AREA:

A minimum area of 10m² per individual animal is recommended to meet the spatial requirements of the species, but wherever possible larger enclosures should always be encouraged. The design should be based on a three-enclosure module: two separate smaller (off-show) holding pens with basic accommodation that may include a small pool; a large enclosure (on-show to the public) with a diverse and enriched natural environment to accommodate a breeding pair and young. This type of design promotes normal behavioural expression in a highly active and inquisitive species, and is equally attractive to both the mink and for the visiting public. The rotation of individuals in each of the enclosures adds further stimulation especially in scent-marking behaviour a highly important means of social communication.

WATER/LAND RATIO

The ratio of land to water should be > 4:1. It is important to make the bank-line of the water-body as long and intricate as possible. Small islets, stones and bridges are good in this respect.

OUTDOOR POOL

Although a semi-aquatic species, the European mink is not a deep water inhabitant. The pool depth should be no more than 0.5m with running water to typify the preferred natural habitat, with various cascades and rapids. The banks should also be as diverse as possible with logs, stones and dense vegetation for cover. In addition, submerged and/or partially submerged logs and stones are also recommended. Mink also enjoy wallowing in a mixture of mud and sand, therefore, a muddy depression would enrich the behaviour of the mink. The water in the pool should be renewed constantly, or filtered, as reduced water quality has a marked effect on the protective ability of fur.

It would be preferable to have water in the pool throughout the year, and where freezing may occur running water may help to prevent ice -formation.

OUTDOOR ENCLOSURE (LAND AREA)

A grassed enclosure with good plant coverage is preferable, with areas containing sand and gravel. Natural rocks, stones, tree trunks & stumps, provide shelter and facilitate scent-marking behaviour.

In order to prevent the mink digging out from the enclosure the ground under the soil should be covered with mesh or concrete.

FENCING

The height of the boundary fence should be no less than 1.2m (NB! snow-coverage should also be taken into account). The fence can be either solid or steel mesh (10 x 10 mm). A mesh fence must have its upper part covered with ~30cm - wide of sheet-metal. The lower section of the sheet should be set apart from the fence (Figure 2). The use of an electric fence is also recommended. The corners of the fence should be examined with particular care as they may provide an easy way to escape (wherever possible it would be better to design the enclosure without sharp corners). Trees in the enclosure must be at least 1m away from the boundary fence, as any overhanging branches may provide another means of escape.

A service corridor for the keeper with a double -door for security is essential.

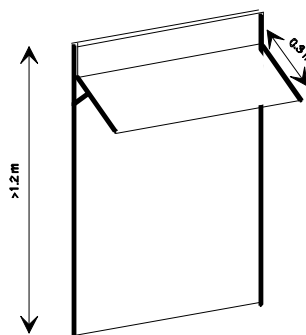


Figure 2.

2. Enclosure for breeding facility (off-show)

SPACE :

A minimum area of 6m^2 per individual animal should be provided. The design should be based on a two-enclosure module to accommodate a breeding pair and young, to include a service corridor for the keeper with interconnecting doors (Figure 3).

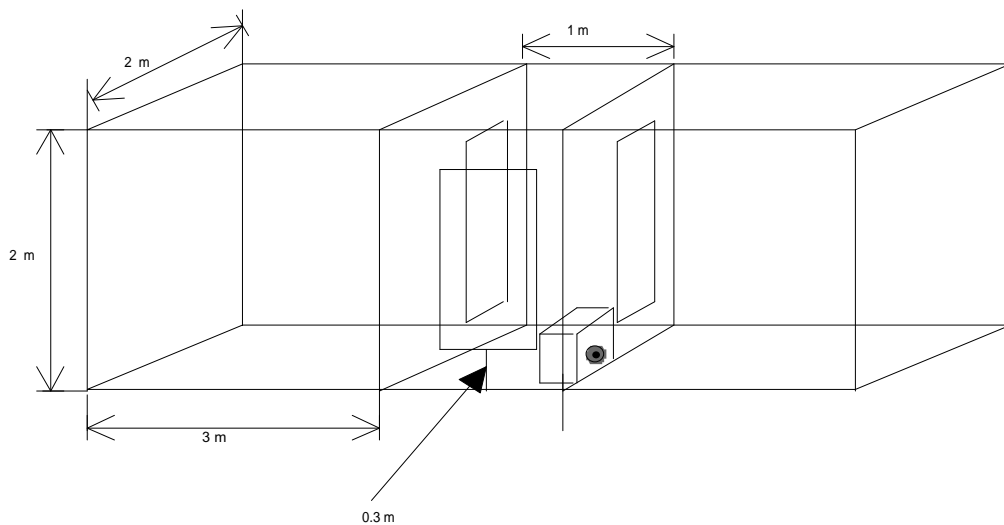


Figure 3. Two-enclosure module for breeding facility

WATER/LAND RATIO

The ratio of land to water should not be more than 4:1 (preferably 8:1).

OUTDOOR POOL

Depth of pool should not be less than 0.3m. Water should be renewed constantly or filtered.

It would be better to have the water in pool throughout the year, but freezing must then be taken into account (e.g. keeping the water running will help to prevent ice-formation).

LAND PART (OUTDOOR ENCLOSURE)

A suitable substrate is smooth small pea-gravel. The bottom of ground should be covered with mesh to prevent mink digging themselves out. Cage furniture should include sand areas, rough stones, tree trunks & stumps and stones used for fur-rubbing (especially after swimming) and scent-marking.

Hollow tree trunks & stumps or pipes provide suitable denning sites for seclusion, resting and shelter. However, it is necessary for the keeper to be able to view these areas adequately.

FENCING

The enclosures must be fenced on all sides with mesh (10 x 10mm) including the floor and roof. The height of enclosure should be approximately 1.8 -2m to allow easy access for the keeper. The door to the enclosure as well as the door to service corridor, must open inwards, and should be 'stepped' with a threshold no less than 0.3m from the ground to prevent the accidental escape of an animal while opening the door.

In regions with heavy snow-coverage in winter, roof damage may occur if left unattended, especially to the mesh-panels, due to the weight burden from the collection of snow.

3. Nest Box Requirements

Nest boxes should be situated in the outdoor enclosure. It is recommended to use the standard sleeping-boxes (Figure 4). The nest box and enclosure should be connected with sliding shift door. The nest box(s) should consist of two compartments. As a rule the animal uses one of the compartments as sleeping box and the other as a latrine. A connecting door between each of the two compartments helps in the manipulation of the animal. In all doors the slider tracks should stop short at the edge of the entrance holes to the boxes to make cleaning easier.

The nestbox should be light and portable. This facilitates the nestbox being moved with the animal to another enclosure or facility.

Ventilation holes (0.7cm) drilled all around the top and bottom sides of the boxes may be advisable, especially in warm climates.

MEASUREMENTS

The overall dimensions should be 27 x 28-30 x 70-80cm. The diameter of the entrance holes should be c.6-10 cm. The box should be built of plywood or deal. Both compartments should have separate roofs. Ideally the box should be situated at the farthest distance away from the water. In regions with extreme winter conditions the use of thermostatically controlled floor heating or the additional insertion of a smaller sleeping box (c. 25 x 20 x 31 per compartment) may be appropriate.

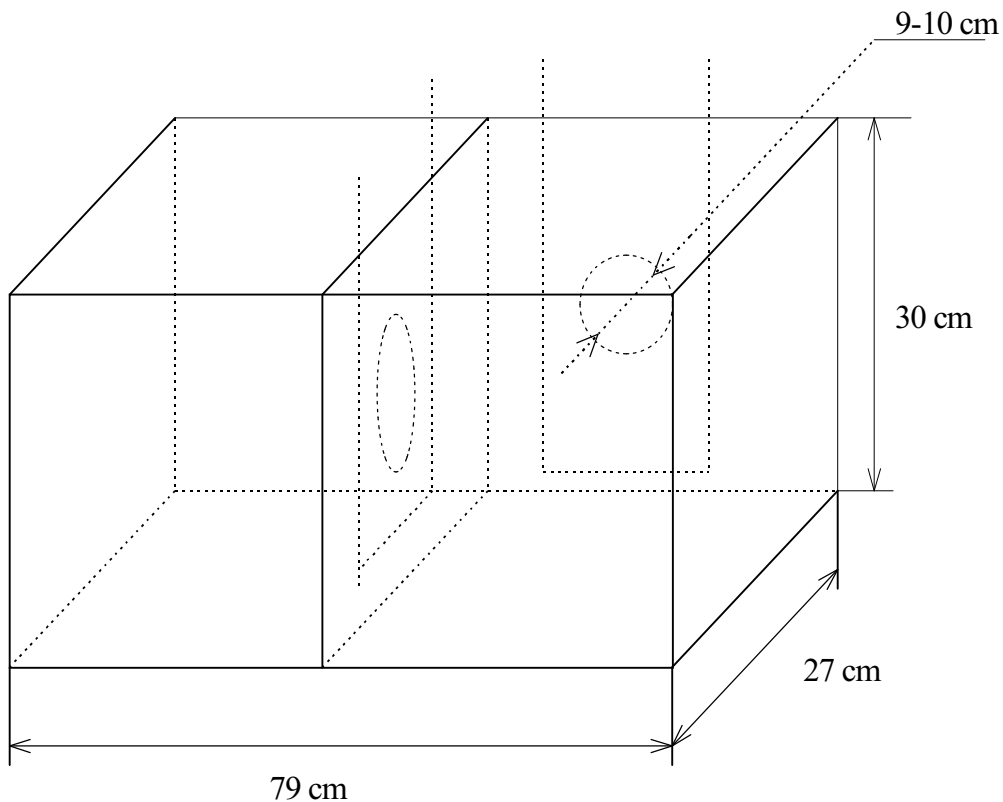


Figure 4. Nestbox

BEDDING

Dry sphagnum moss, hay or leaves(dry) could be used for bedding. Woodshavings is a good bedding material for use in the latrine. During the winter period unlimited bedding material should be offered to the animal(s).

4. Breeding Box Requirements

All facilities should provide sufficient hiding places especially during the breeding season. However, it may be necessary to offer additional 'denning sites' in the form of breeding boxes. Males particularly favour these boxes, especially during the breeding season when they are frequently used as a place for copulation to occur.

5. Environmental Enrichment

Environmental enrichment is an important consideration in the design of the enclosure to encourage the normal behavioural repertoire of the mink. Though essentially static, it is therefore of equal importance to provide additional “behavioural” enrichment in the form of “movable” objects, such as floating objects in the pool. The positioning of different types of pipes and other tunnel-like objects would provide interest where mink like to move and hide themselves. Further re-positioning or renewal of movable objects is also desirable as it stimulates additional interest.

Foraging behaviour can be encouraged by hiding food that will also increase the overall daily activity. Live food in the form of invertebrates (locusts, crickets) and fish in the pool will stimulate hunting behaviour. However, the European mink are very conservative in relation to new food items and it might be very difficult at first for the mink to accept new food.

6. Dietary Requirements

Due to the mainly crepuscular and nocturnal nature of the European mink, with a peak daily activity period occurring during these periods, it is better to feed mink in the late afternoon. If fed too early the food may be spoiled. A complete balanced captive diet has yet to be developed, nevertheless, the captive diet developed for the Black-footed ferret can provide a good starting point (Appendix 5).

A suitable captive diet comprises of around 33% fish (freshwater cyprinids & salmonids, or seawater species, such as, cod, haddock and whiting; but not oily fish like herring or mackerel) and the remainder comprising of day-old chicks, mice and occasionally amphibians and invertebrates (crayfish). Where legally permissible live food is recommended with appropriate supervision, or alternatively, freshly killed food can be offered.

A recommended feeding regime is as follows: ground meat (50%) and Mazuri Carnivore Feline Meat F (50%) for three days; fish diet for two days; mice & day-old chicks for two days - all presented on alternative days. The amount of daily food ration is dependant on individual consumption though it must be increased during the breeding season (see Breeding Protocol).

Vitamin/mineral food supplements may be of benefit, especially where fresh food is not always available. Commercially prepared supplements are available or preparations can be added to the food ration (see appendix 5)

7. Restraint

TRAPPING-BOX

Two types of trapping-boxes are recommended:

- a) Constructed of wire-mesh (weldmesh) with a trap door. This design is perhaps best for transfer of mink from the nestbox for removal and/or examination. The measurements of the box should be slightly less than

that provided for the compartment next to the sleeping chamber of the nestbox. Place the trapbox against the 'end' compartment (latrine) with sufficient cover (i.e. towel or sack) to darken the interior, then by lifting off the roof of the sleeping area the mink will almost always seek refuge in the darkened compartment containing the trapbox.

- b) Constructed of wood for better protection, warmth and seclusion (see Figure 1 and 5). This design of trapbox is best deployed in the event of an accidental escape of an animal from its enclosure. As mink usually choose to run along the edge of a 'wall' it will try and seek refuge in a dark tunnel-like place from which to hide, even without bait.

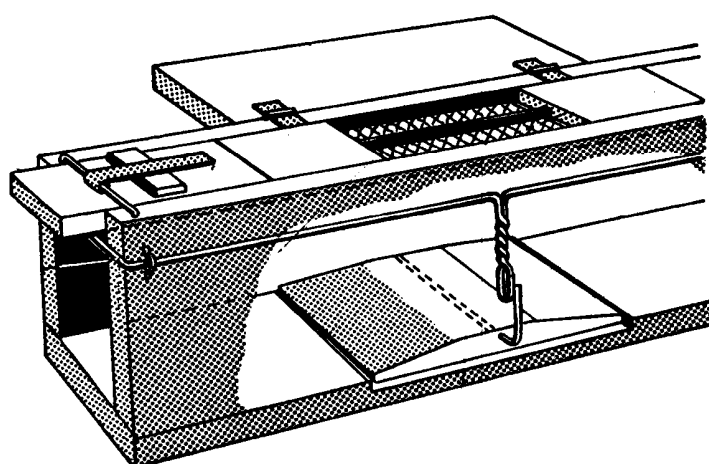


Figure 5. Construction of live trap (Behnke, 1982)

8. Daily Husbandry Routine

It is important that a daily routine is established and maintained in the facility. A husbandry protocol must be established by each facility (based on the European mink Guidelines) and posted in the area.

Individual records must be maintained on each European mink kept in the facility, with the exception of kits whose records will be incorporated initially with the mother until they reach independence and are separated from her; whereupon they will be issued with their own individual records.

All European mink have to be individually checked at least twice daily, in the morning and afternoon. The only exception being females with kits during their first 7-14 days after parturition.

Nest boxes should be cleaned in the morning. All soiled bedding material (shavings, wood chips etc.) should be replaced daily with fresh material. A scraper is used to remove faecal material from the sides of the latrine side of the nest box. Use of disinfectants and water for cleaning on a daily basis is discouraged as mink prefer their own scent.

Fresh food and water should be presented in late afternoon.

E. European Mink Captive Breeding Protocol

1. Female European Mink - Detection of Oestrus

The walls of vagina are lined with epithelial cells and at the onset of oestrus will cause these cells to become cornified. Non-cornified cells, which are quite small, round and with a distinct nucleus, are found when anoestrous vaginal flushes are taken and examined. A few cornified cells are found in pro-oestrus flushes. The onset of oestrus is characterised by a 90% vaginal cornification. Cornified cells are large, flaky cells without nucleus (Figure 6; see also Appendix 1: Reproduction).

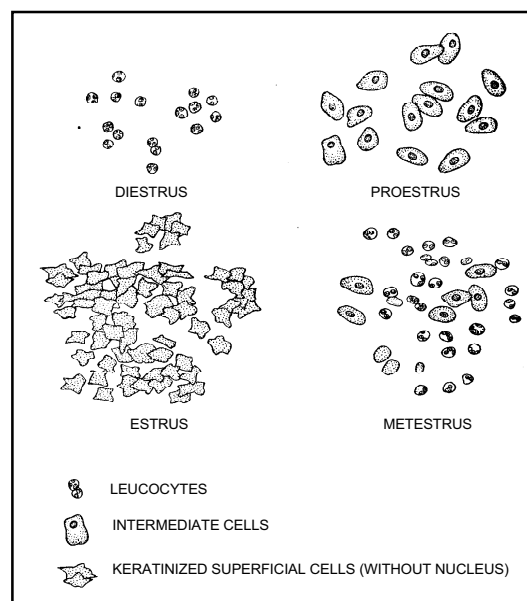


Figure 6. the cells in vaginal lavage of the oestrus cycle

From March 1st, females will be subjected to weekly flushes during anoestrus and early pro-oestrus periods. When the quantity of cornified cells are greater than 50%, then vaginal flushes must be conducted on every third day. When 90% cornifications is achieved the female must then be placed with an appropriate male for breeding.

Measurements of vulva swelling and evaluation of vulva appearance will be conducted concurrently with vaginal flushes. It helps to predict a proper time for pairing, especially while having only a few breeding pairs of mink, or when the use of vaginal smears may seem to be too complicated a method to use.

Detection of heat can be indicated by the size of the vulva, when in full heat the vulva is swollen. In comparison, the size of the anoestrus vulva is minute, measuring a maximum 2 mm to 4 mm, but usually much smaller. When the female begins to come into heat, the vulva enlarges over a period of three to four

weeks. Its maximum size may reach 10mmx10mm or more. The colour of the vulva also changes during heat from pale white during the anoestrus to pro-oestrus period and to a pink-reddish coloration during oestrus. The size and coloration of vulva can be easily examined and measured through the handling cage.

The vulva measurements should be at least 10mm x 10 mm and pinkish in colour before the introduction of the female to the male for breeding.

Behavioural changes exhibited by the female may also provide a good indicator of heat, where the oestrous female becomes more active and less timid.

2. Male European Mink - Detection of Fertility

Starting from February 1st, the testes should be measured on a weekly basis. The testes may grow up to 18mm x 16mm. If the size of the testes remain relatively small by the beginning of April, it usually indicates a male of poor breeding quality.

Nevertheless, large testes are not always indicative of a good breeding male, as very often males with relatively normal size testes are of equal breeding potential.

3. Breeding Protocol

a) ANIMAL WEIGHTS

The weights of adult animals are variable within the sexes and change throughout the annual cycle. Males are considerably heavier than females, with males also exhibiting a greater seasonal weight change. The following recommendations are based on the black-footed ferret breeding protocol and therefore should be taken as general guide and its application may also be dependent on individual variation.

Adult females older than one year of age, should lose 15% of their January weight prior to breeding. Their weight should then be maintained or slightly increased (2 - 3%) during gestation. Weights should be taken at a minimum of twice weekly to monitor weight loss during February and March.

Adult males, older than one year of age, should lose 10% of their January weight prior to breeding. Their weights should then be maintained during the breeding season by increasing the weight/volume of food ration provided.

Juvenile males and females should lose about 10% of their February 15th weights prior to March 15th.

b) PAIRING OF ANIMALS

Pairing will begin once females are determined to be in oestrus (based on the vaginal smear samples or on vulva appearance).

Whenever possible, pairings will be based primarily upon genetic considerations determined through the recommendations provided by the species co-ordinator of

the breeding programme. If genetically preferred pairs are incompatible or non-productive, emphasis will still remain on gaining reproductive success using other pairings that result in successful mating with the lowest possible inbreeding coefficient of potential offspring.

Handling and moving the animals should be carried out by the mink keeper or with other staff with whom the mink are familiar with.

Oestrous females will be paired with successive males until successful copulation is achieved. If the male is aggressive or the female is not receptive to the male, the animals should be separated. However, if the temperament and behaviour of the pair(s) is extremely conducive then receptive animals can be left overnight and separated during daylight hours. If copulation occurs it is desirable to take a vaginal smear to check for the presence of sperm. Each receptive female should be placed with the same male on three successful nights. Thereafter no further introductions to the male will be necessary or should be attempted.

Experience at Tallinn Zoo, but also at other breeding facilities in Russia (for example, at Novosibirsk) show that usually males are the main reason of unsuccessful breeding. They either do not show any interest or exhibit such overt aggression that they have to be separated before inflicting serious injury to the female.

A single male will be allowed to inseminate no more than one female per night. The males should be rested one or two nights between introductions to different females.

If the pair is found to be incompatible they will be separated and the female returned to her cage. A second introduction can be tried the following night and if this fails no further introductions to this male should be attempted.

4. Whelping Management

The breeding enclosure must be isolated from visitors during the breeding period. Having only the keeper(s) with which the mink are familiar, to be allowed to care for pregnant or whelping females.

Exchange of keeper(s) during pregnancy or whelping is highly inadvisable, as it may result in the failure of successful breeding.

Pregnant females should have the choice of at least two nest boxes. Food must be provided without restrictions to the female with kits.

The European mink is a mono-oestrus species that typically have only a single litter each year. If the female resorbs her embryos or loses her first litter within a few days of birth, a second oestrus may occur and then a second breeding attempt may be made.

This pattern of reproduction may prove advantageous, at some stage, as a management tool to increase population size, where a second litter may be

produced by removing live young shortly after birth and placing them with foster mothers. Such a propagation technique however must first have the approval of the species co-ordinator.

5. Cross Fostering of Kits

In the case of very large litters(5-6 young) or very small litters(1 young)then cross-fostering may be necessary. Weak or stunted kits should be selected for cross-fostering.

Cross-fostering can be attempted when the kit(s) are one month of age, prior to opening of the eyes and onset of hearing. The foster female to whom the kits are to be introduced should be locked out of the nest box and the foster kit(s) should then be placed into the nest with other kits. It helps to scent the newcomers by rubbing the introduced kit(s) with the existing bedding material removed from the nest. The operation should be done quickly to reduce the stress of the female being kept apart from her young.

The introduced youngster(s) can be temporarily marked for identification by dyeing or cutting away some of the fur.

6. Hand Rearing of Kits

Hand-rearing of kits is not desirable or encouraged. Whenever possible, cross-fostering is the preferred choice. Abandoned or orphaned kits reared by foster mothers are exposed to social interactions that are often absent or impossible to reproduce in animals reared in isolation.

7. Kit Care

NEW KITS

Newly-born kits should not be disturbed for 7-14 days after birth. Any form of disturbance may result in the loss of young, especially by inexperienced primiparous females.

NESTBOX CLEANING

The female should be locked outside of the nestbox before cleaning commences. Everything must be cleaned as quickly and quietly as possible. If separation of the female causes aggression or trauma to the kits, then cleaning should be minimal or stopped.

The box should be cleaned once a day in the morning, but when the kits start to move around and eat solids, cleaning may also take place twice a day.

SEPARATION OF YOUNG

The young should be kept with the mother as long as possible. Normally litter-mates start to act aggressively towards each other by late -summer and this is the best time for separation. This can be done gradually starting with the most dominant and aggressive kits.

F. Medical Care

Restraint(*immobilisation*)

Whenever possible manual restraint of mink should be avoided. A handling cage can be used for all procedures such as examination, vaccination, anaesthetising, sample collection or for weighing. Measurements of the handling cage should be 12cm x 12cm x 30cm and include a sliding-door. The mink can be encouraged to enter the handling cage (located towards the latrine compartment) by carefully lifting the lid to the sleeping compartment from which it will leave. A towel placed over the handling cage makes it more inviting to enter. It may be useful to place sheet of glass under the lid to prevent any accidental escape when the sleeping compartment lid is open.

Only **in extreme cases** should mink be manually restrained. When this is necessary the mink must first be caught in the handling cage. A darkened bag is then placed over the 'mouth' of the handling box from which the mink usually will run into. The animal should then be handled carefully with gloves through the sack. After use the sack should be washed.

This procedure will help reduce the amount of stress caused by manual restraint.

For **immobilisation**, the preferred injectable anaesthetic agent is a combination of 10% Xylazin(Rompun) and 5% Ketamine Hydrochloride (Ketalar, Ketaset, Ketaject, Vetalar) (1:1); having a wide safety margin it has been used successfully at Tallinn Zoo. In practice a dose rate of 0.2 -0.5ml per animal (dependant on body size), by intramuscular injection is usually sufficient. It is better to administer small doses at first, with additional doses added until the desired response is attained. Relaxation is good, usually within 5 -10 minutes (in some cases after one minute) and a duration between 10 to 30 minutes.

European mink are more sensitive than the European polecat, *Mustela putorius*, or American mink, *Mustela vison*, to overdoses of anaesthetic agent. Respiration of the animals may stop and artificial respiration may be needed to save the animal.

The use of Ketamine Hydrochloride as a sole anaesthetic agent is NOT RECOMMENDED having been known to bring on seizures and abnormal breathing.

It is recommended that for prolonged anaesthesia gaseous agents be used, with Isoflurane being the agent of choice and Halothane a suitable alternative.

Whenever an animal is sedated for whatever reason, the opportunity should be taken to carry out a full veterinary examination, blood collection for genetic and/or physiological data, weight and other morphological measurements etc.

Vaccination

In comparison to the American mink there is limited information on the susceptibility of European mink to viral infection or the routine use of vaccines to build up an immunity.

In common with other mustelids, the European mink is thought to be prone to a number of viral diseases, in particular, canine distemper, rabies, leptospirosis and toxoplasmosis. The American mink is the only known mustelid species reported to be susceptible to feline panleukopenia (though it has been suspected in skunks and otters).

The European polecat (*Mustela putorius*), closely related to the European mink, are susceptible to pseudorabies (Aujeszky's disease), that affects the nervous system and is characterised by pruritus and self-mutilation.

Farm-ranched mink are routinely vaccinated against canine distemper, rabies, feline panleukopenia and botulism.

At Tallinn Zoo, all adult European mink have been vaccinated with BIOCOP - P (United Vaccines, USA) and a month later with DIST EMINK (United Vaccines, USA)

NB! No live vaccines or any kind of modified live vaccines should be used for vaccination as it can prove fatal to mustelids.

(In North America, live vaccines have been used on European mink at San Diego Zoo and on Black-footed Ferrets at the Sybille Conservation Research Centre - where it resulted in the rapid death of vaccinated animals)

Endoparasites control

Wild European mink have been reported to have high levels of helminth infestation with over 17 species of parasitic worms (trematodes, cestodes, nematodes, acanthocephala) recorded in one study area. Furthermore, parasite-related diseases are infrequently encountered in mustelids generally, suggesting that such a parasite burden can be tolerable in healthy individuals.

Endoparasites have not caused any specific problems in captive European mink.

At Tallinn Zoo faecal samples are collected at least three times per year:

- March - before the breeding season
- July or August - after the breeding season
- October-November - prior to the winter period

At Tallinn Zoo the following endoparasites have been found from faecal sampling and during *post mortem* examinations:

1. *Eimeria* sp.
2. *Isospora* sp.
3. *Taenia* sp. (*T. sibirica*??)

4. *Contracaecum sp.*
5. *Capillaria mucronata*
6. *Capillaria putorii* (Rud, 1819)

The most commonly encountered endoparasite has been *Capillaria murconata*. The use of "Ivomec" has been used successfully against helminths and sulfonamids against coccidians.

Ectoparasites

In common with other mustelid, external parasites of European mink include mites, fleas, lice and ticks. Treatment with a suitable, typically -applied, "anti-parasite" spray or powder, is usually sufficient. In severe cases of untreated animals, skin inflammation and severe irritation (pruritus) can lead to biting and scratching of the skin; or even severe hair loss.

Pathological & Physiological Data

There appears to be little available pathological and physiological information on the European mink; especially in comparison to that amassed on the American mink.

It is important that detailed clinical reports are provided. All EMCC participants are urgently requested to send post-mortem reports to the species co-ordinator and are urged to use the standardised post-mortem report found in the appendices (appendix 6); unless a more detailed autopsy report is available. In addition, where possible, tissue collection for taxonomic, genetic and pathological research is also important

Also, valuable physiological data (respiratory rate; heart rate; rectal temperature; haematological parameters etc.) can be obtained during routine veterinary examination.

Identification

Various methods of permanent and unique identification have been used in the form of ear tags, tattoos and microchip transponders. The best method for identification of European mink is the use of microchips.

G. Transportation

Animals should always be transported separately. Crates should be made of solid plywood resistant to biting. Where possible it is preferred to use for transport ation the nest-box of the animal. Good ventilation through wire-netting is very important as there is a **risk of overheating**. During the long-distance transportation the animals should be provided adequate food and water. Transportation during hot weather should be avoided whenever possible.

Literary sources used in preparation of the protocol

- Behnke, H. 1982: Jagd und Fang des Raubwildes: Anleitung zur gerechten Bejagung. Hamburg, Berlin: Parey. 106 pp.
- Carvalho, C.F., Howard J., Collins, L., Wemmer, C., Bush, M., Wildt, D., 1991: Captive breeding of Black-footed ferrets (*Mustela nigripes*) and comparative reproductive efficiency in 1-year old versus 2-year old animals. J. Zoo. Wildl. Med. 22: 96-106.
- Devison, D. 1992: Metro Toronto Zoo Black-Footed Ferret Captive Propagation Protocol. Metro Toronto Zoo. 15 pp. Manuscript.
- Maran, T. 1994: Studbook for the European mink, *Mustela lutreola* Linnaeus 1761. Vol. 1. EMCC & Tallinn Zoo, 50 pp. Manuscript
- Ternovskij, D. 1977: Biology of mustelids (Mustelidae). - Nauka. Publ. Novosibirsk. (In Russian)
- Vogt, P. 199? : Husbandry Guidelines for *Lutra lutra* (EEP). Manuscript

I. Appendices

Appendix 1

Reproduction.¹

Unlike the majority of mustelids, the European mink does not display delayed implantation. Mating takes place in late March, April and in early May, but according to the breeding results at Tallinn Zoo the peak of the heat falls in the second and third week of April (Figure 2). The gestation lasts 40-43 days and parturition usually occurs at the beginning of June.

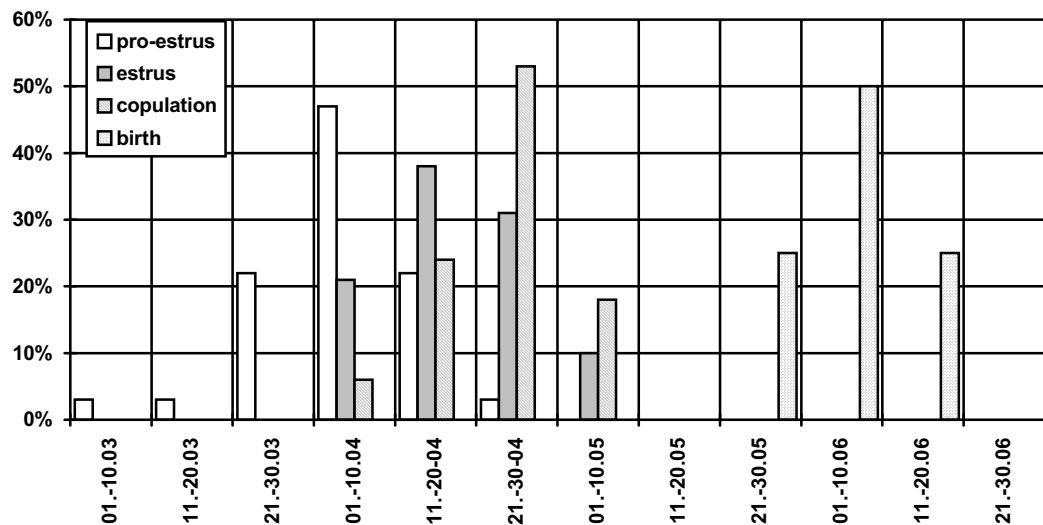


Figure 2. Pro-oestrus, oestrus, occurrence of copulation and time of parturition in the European minks kept at Tallinn Zoo

The heat of the female is easily detectable by the size of vulva. The anoestrus vulva is minute, measuring 2 mm to 4 mm maximum, usually much smaller. When the female begins to come into heat, the vulva enlarges over a period of three to four weeks. Its maximum size may be 10 mm to 10 mm or even more. The colour of the vulva also changes slightly from pale white during the anoestrus to pro-oestrus period, to pink-reddish during oestrus. The size and colouration of vulva can be easily measured and checked through the handling cage.

Changes in the behaviour may also be a useful indicator of oestrus. The oestrus female becomes more active and less timid.

More detailed detection of heat can be achieved by histological investigation of vaginal smears. Samples can be obtained through vaginal flushing and collected in a small pipette while the animal is held in a handling cage. A small amount of sterile

¹ From: Maran, T. 1994: Studbook for the European mink, *Mustela lutreola* Linnaeus 1761. Vol. 1. EMCC&Tallinn Zoo, Tallinn, 50 pp.

water is aspirated into the tip of the pipette. The tip of the pipette is then inserted approximately 10 mm into the vagina, the sterile water is injected and immediately aspirated back into the syringe. The sample is placed on a slide, and can be stained before examination under the microscope for cornified cells (Hamilton & Gould, 1940, Travis et.al., 1978, Doboszynska, 1976).

In case of early death of the litter, the potential polyestricity exhibited by European mink, may still provide the chance to provide further offspring. Six to nine days after the death of the young it is possible for the female to come into oestrus a second time and for copulation to take place again (Moshonkin, 1977).

The reproductive physiology of the European mink is often confused with that of the American mink, *Mustela vison*. The latter displays delayed implantation and its gestation period may be up to 93 days (Ternovskij, 1977).

The size of the litter varies from 1 to 7. There is a slight difference in the mean litter size recorded at Tallinn Zoo (2.5), St.Peterburg Zoo (3.6) and that reported by Ternovskij (3.5;1977).

Since 1960, 113(48.56.9) European minks have been held in captivity, of which 35% (16.18.5) are wild caught and 64%(30.38.4) captive bred (1% animals of unknown origin). Dr. D.V. Ternovskij has kept and bred European mink with the utmost success in captivity, but unfortunately no data has been made available for the studbook. Altogether 68(29.35.4) kits have been bred in 25 litters since 1960. At Tallinn Zoo there has been remarkable imbalance in the sex ratio of in litter(25% of males, 67% of females, 8% of unknown sex); at St. Petersburg the ratio has been more or less equal - 52% of males, 43% of females and 5% of unknown sex. Of all these litters, 32% of the birth were of single kit, 20% two kits, 20% three kits, 8% four kits, 4% five kits, 12% (???) six kits and 4% seven kits (Fig. 3). This does not reflect accurately the actual variance in the litter size, as normally the nest-box can be checked only a week after parturition. Early disturbance of the mother may result in the killing of young.

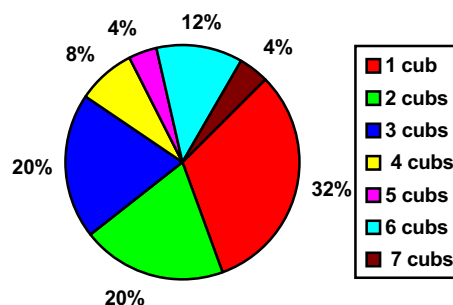


Figure 3. Variation in litter size.

The mean litter size in 25 litters is 3.6 kits per litter. This is in accordance with the figures given in the literature (Ternovskij, 1977)

Appendix 2

Morphological parameters(Ternovskij, 1977)

	FEMALE				MALE			
	n	mean	±		n	mean	±	
Weight of the animals ²	9	540.3	5.8	gr	17	814.6	30.4	gr
Weight of liver	5	29.2	3.10	gr	8	39.9	1.03	gr
Weight of heart	5	5.0	0.30	gr	8	6.0	0.21	gr
Weight of lungs	5	7.5	1.10	gr	8	10.5	0.50	gr
Weight of brain	5	7.9	0.40	gr	8	9.0	0.40	gr
Weight of pancreas	5	2.6	0.60	gr	8	2.4	0.219	gr
Weight of left kidney	5	2.5	0.10	gr	8	3.4	0.13	gr

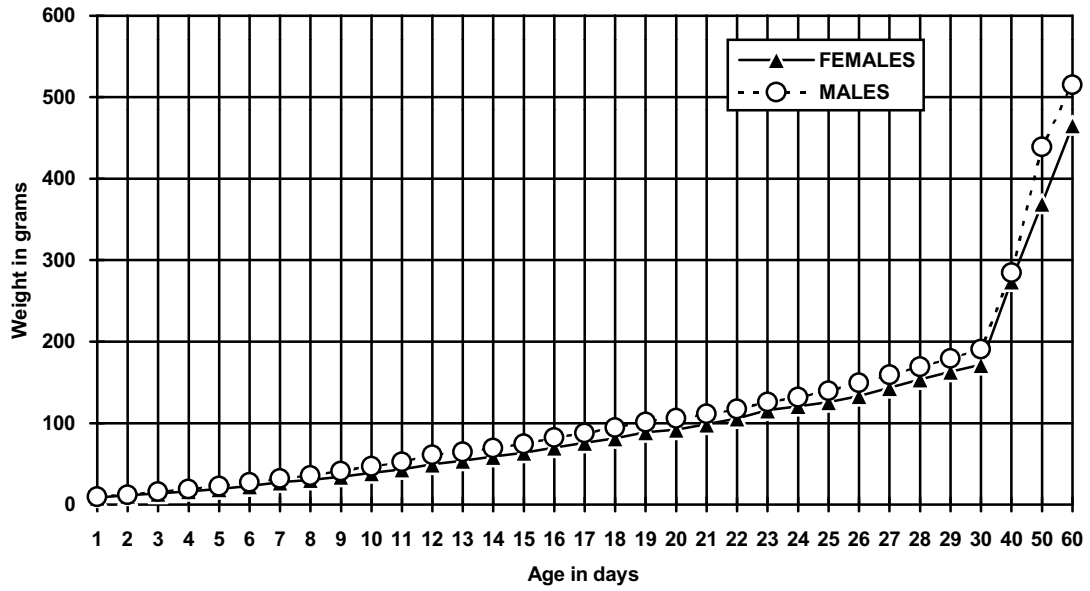
² Weights from: Danilov, P.I. & Tumanov, I.L. 1976: The ecology of the European and American mink in the Northwestern U.S.S.R. -In: Ecology of birds and mammals in the Northwestern of U.S.S.R.. Akad. Nauk. Karelski Filial. Inst. Biol., Petrozavodsk, p. 118-143.

Appendix 3

Change in weight during the post-embryonic development of the young(Ternovskij, 1977):

Age in days	Female			Male		
	n	mean	±	n	mean	±
1	8	8.8	0.24	8	10.0	0.22
2	8	11.3	0.27	8	11.9	0.55
3	8	13.6	0.43	7	15.7	0.31
4	8	16.1	0.51	7	18.6	0.37
5	8	19.2	0.91	7	22.7	0.41
6	8	22.7	1.00	7	27.2	0.39
7	8	27.4	1.14	7	31.5	0.52
8	8	30.4	1.47	7	35.7	0.53
9	8	34.2	1.17	7	41.2	0.52
10	8	38.9	1.60	7	46.6	0.80
11	8	43.3	1.85	7	52.2	1.12
12	8	49.5	2.30	7	60.6	2.01
13	8	53.9	2.21	7	64.8	1.71
14	8	58.7	2.27	7	69.2	1.71
15	8	63.6	2.55	7	74.9	2.00
16	8	70.0	2.50	7	81.8	2.39
17	8	75.7	2.62	7	87.6	2.63
18	8	81.3	2.85	7	94.4	2.98
19	8	89.0	2.86	7	101.6	3.36
20	8	91.8	3.60	7	106.2	3.57
21	8	98.5	4.30	7	111.1	3.88
22	8	105.6	5.15	7	117.0	4.20
23	8	115.8	4.27	7	126.1	4.70
24	8	120.7	4.43	7	131.4	4.43
25	8	125.8	4.71	7	139.6	5.80
26	8	133.2	5.86	7	149.2	7.00
27	8	143.3	6.15	7	159.2	7.96
28	8	153.5	6.47	7	169.2	8.94
29	8	162.9	6.38	7	179.1	9.97
30	8	171.7	6.69	7	190.6	10.53
40	8	274.0	8.10	7	284.4	13.42
50	8	369.5	21.06	7	438.3	21.04
60	7	465.1	14.24	6	515.3	45.15

DEVELOPMENT OF YOUNG EUROPEAN MINKS
(by Ternovsky, 1977)



Appendix 4

Development of fur coat.

3-7 days. The new-born young have no proper fur and are covered with a fine natal down. The colour of the dorsal side of body is dark violet; and the ventral side varies from pinkish-violet to greyish violet. The markings around the mouth is barely noticeable. The growth of the mane appears on the neck which reaches a length of 5mm; on the back the fur is 3mm; and on the stomach and chest 2 mm.

10-16 days General body coloration is similar to the previous development period but with the white area around the mouth becoming more distinguishable.

19-27 days. A more uniform body colouration is developing with the dorsal side of the body a dark grey or dark violet and the ventral side approaches a dark violet.

29-40 days Mane disappears. The juvenile fur darkens towards the pelage colouration of an adult mink. The appearance is similar to the young of the European polecat (*Mustela putorius*) until the appearance of the guard hair, after which the kits resemble the young of the American mink.

The eyes begin to open at 30-36 days of age. At 35-40 days the young are visually capable of following moving objects. However, the reaction to moving objects diminishes at 53-54 days of age.

45-80 days The fur of young resembles more and more the appearance of adult animal.

At 90 days old the juveniles are indistinguishable from adults.

Appendix 5

Feeding Rations of the Black-Footed Ferret.**Diet of the BBF at CRC of the National Zoological Park (Carvalho et. al. 1991)**

	gr	
Commercial mink chow	1,275	62.3%
Ground rabbit meat and bones	675	32.9%
Blood meal	50	2.4%
Bioliver	50	2.4%
Total	2,050	100.0%
Per one animal in a day	68.33	
Each adult ferret received 60 -90 g every day		

Diet at Laramie for *Mustela eversmanni* (Kwiatkowski 1989 in lit):

Liver	17%
Fish	20%
Bovine stomach	10%
Chicken	25%
Commercial mink growth ration	25%

Black-Footed Ferret diet at Laramie (Kwiatkowski 1989 in lit):

5 days a week	
Commercial mink ration	60%
Grounded prairie dogs + liver(dry 6%)	40%

2 days a week hamsters or small rodents

Black-footed Ferret diet at Toronto Zoo (Devison,1992)

Mink chow	60%
Ground rabbit with blood-meal,bioliver and vitamin E	40%

Ad. females lose 15% of their January weight prior breeding

The weight should be maintained or slightly increased(2-3%)
February - March daily ration
50gr/animal

Ad. males should lose 10% of their January weights prior to breeding.
Daily ration in February, March
62gr/animal

Juv. males & females should lose 10% of their February 15th weight prior to March 15th.

**Obligatory to add to the ration
(Kwiatkowski 1989 in lit):**

Vitamin E 100 IU/kg of ration
Zinc 50mg/kg of ration
Liver 20%(=6% of bioliver)

Weights of BFF and the European mink (Walker ,1991)

	female		male	
Black-Footed Ferret	809		1021	
European mink	440	54%	739	72%

Appendix 6

European mink (*Mustela lutreola*) post mortem report

Studbook No: _____ **ISIS No:** _____ **Local ID:** _____

CaseNo: _____ **Zoo:** _____ **Age:** _____ **Weight:** _____

Date of Birth ___/___/___ **Date of Arrival** ___/___/___

Date of Death ___/___/___ **Date of PM Report** ___/___/___

CarcassCondition:

Fresh / Refrigerated / Frozen / Decomposed / Other _____

Physical Condition:

Normal / Fat* / Emaciated / Other _____

- Fat*: grade on kidneys:-
- 1) completely covered with fat
 - 2) some kidney showing
 - 3) fat at poles
 - 4) little or no fat

Comment if obese: _____

Gross Post Mortem:

skin /appendages		digestive		urinary	
sensory		liver		endocrine	
muscular		respiratory		reproductive	
skeletal		cardio-vascular		nervous	
adipose		lympho-ret			

Please write:

A - if abnormal ; B - if normal; NE - if not examined

Gross Post Mortem Description:

Parasitology:

Arthropods: Y/N Protozoa: Y/N Helminths: Y/N

Results and comments:

Microbiology:

Bacteria: Y/N Fungi: Y/N Virus: Y/N Other: Y/N

Results and Comments (please give bacteria code A,B,C etc and indicate organ of origin):

Antibiogram

	Bacteria Code				
	A	B	C	D	E
Chloramphenicol					
Kanamycin					
Streptomycin					
Sulphonamide					
Oxytetracyclin					
Trimetoprim + S					
Gentamycin					
Ampicillin					
Neomycin					
Colistine					
Spectinomycin					
Flumequine					
Others(specify):					

Code: + = sensitive; ± = some inhibition; - = resistant

Haematology:

Blood Smear: Y/N EDTA: Y/N Heparin: Y/N Marrow: Y/N

Results and Comments:

Histology: please indicate which were studied

oesophagus		kidney		lung	
stomach		adrenal		skin	
intestines		cerebrum		eye	
pancreas		cerebellum		lymph nodes	
liver		spinal cord		<i>Others(specify):-</i>	
thymus		pituitary			
thyroid		heart			
parathyroid		muscles			
spleen		urinary/bladder			
testes/ovaries		aorta			

Results and comments:

Probable Cause of Death:

Final Conclusion about Cause of Death:

Veterinarian _____ **Signature** _____
 (NB PLEASE ATTACH FULL CLINICAL HISTORY IN ADDITION TO THE PM REPORT)

Appendix 7

Tissue collection for pathological research

In addition to specimens submitted for diagnostic pathology, the following tissues should be preserved in 10% buffered formalin at a ratio of 1 part tissue to 10 parts formalin. Sections should be no thicker than 1cm. All lesions should also be included. Tissues should be accurately labelled and stored at the collection of origin.

During post mortem examination much taxonomic information can be lost by careless technique. In order to avoid such problems, please make sure all skin incisions are as straight and neat as possible. Do not remove any more skin than is required for diagnostic purposes. Ensure that no skin is attached to the sets or skeletal muscle if samples of these tissues are removed. If it is necessary to remove the brain for examination, please make a straight saggital skin incision from the crown down the nape of the neck, allowing the skin to be peeled neatly away from the cranium.

Tissue	Area	Taken
Adrenal	Entire gland with transverse cut	YES NO
Brain	Sliced longitudinally along midline	YES NO
Heart	Longitudinal section of atrium, venticle and valves from each side	YES NO
Intestines	Duodenum, jejenum, ileum, ceacum, colon; open along long axis	YES NO
Kidney	Section of cortex, medulla and pelvis from each kidney	YES NO
Liver	2 sections from two lobes with capsule and gall bladder	YES NO
Lung	Sections from several lobes including bronchus	YES NO
Lymph nodes	Cervical, anterior medisatinal, bronchial, mesentric and lumbar with a tansverse cut	YES NO
Pancreas	Samples from two areas	YES NO
Peripheral nerve	3cm section of sciatic nerve	YES NO
Skeletal muscle	Cross section of thigh muscle	YES NO
Skin	3cm length of full thickness of abdominal skin	YES NO
Spleen	Cross section including capsule	YES NO
Spinal cord	Sections from cervical, thoracic and lumbar cord	YES NO
Stomach	Cardia, antrum and pylorus	YES NO

Appendix 8

Reproductive parameters

Reproductive pattern	Male		Female	
	mean	range	mean	range
Age at first copulation				
Age at first conception				
Oestrus			4.5days	3-6days
Gestation period			41.5days	40-43days
Mating period			April	March April May
Birth period			June	
Litter size			3.6	1-7
Birth interval				
Reproductive life-span				
Life-time production of kits				