Aspects of the biology, ecology and captive breeding of stoats

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1. Background

Surprisingly few serious papers on mustelids were published in the former Soviet Union (FSU) countries after 1991. Disestablishment of the All Union Institute of Hunting Industry and Fur-Mammal Breeding followed the collapse of the Soviet Union. Its regional divisions and laboratories, such as one in Almaty, Kazakhstan, and another one in Tashkent, Uzbekistan, were closed as well as many pelt farms. Their scientific collections and libraries disappeared and are probably kept privately by their former workers. Economic changes in FSU affected commercial hunting negatively. For example, the stoat harvest in Yakutia (one of main regions of fur production) during 10 years of Gorbachev's "perestroika" dropped dramatically from annual 65.5 thousand skins to 38.0 thousand skins. The weight of the stoat fur harvest (in money equivalent) fell by half. Stoat has fifth position (5.4%) in its fur harvest after sable, arctic fox, muskrat, and squirrel. Degradation of the hunting industry is an on-going process. Papers of the early 90s are mostly of local importance, such as: "Small mammals as food resource for carnivores of Ust-Lena game reserve"; "Resources of stoats in Yakutia"; "Death of non-commercial and non-target mammals in traps" (*in*: Ecological and Economic Aspects of the Game Use and Conservation in Siberia. Abstracts of the Conf. Shushenskoe. 1990).

The Central Library of the Kazakh Academy of Sciences and libraries of the academic and other institutes of biological studies stopped their subscriptions for the Russian Journal of Abstracts in 1993/94 due to lack of funds.

Note: In this review, some terms used have been recently introduced by researchers and are probably unique for the Russian zoological literature, so their translation may be inadequate and need further clarification.

2. Captive breeding of mustelids

2.1 PROCEDURES USED FOR SUCCESSFUL BREEDING

Stoats in Russia and other countries of FSU proved to be the least suitable for captive breeding because of their zoopsychological peculiarities. They never make good pets and are always bad-tempered and aggressive to people; they are not tolerant enough to each other, etc. Among several main types of behaviour - aggressive, apprehensive, timid-malicious, calm - the first one is definitely prevailing and the most stable between generations. In the series of species suitable for captive breeding, stoats have the very last position: furo - Altai weasel - ferret - Siberian weasel - sable - otter - American mink - black ferret - weasel - stoat). Some pelt farmers reported that all these behavioural

peculiarities along with poor quality of the pelt (due to permanent stress, in their opinion) makes captive breeding of stoats unreasonable. It is definitely not as cost-effective as commercial hunting in FSU countries. Thus pelt farmers were focused mostly on minks, ferrets, sables and their various hybrids. However, stoat kits raised by ferrets (all species) or Altai weasels are more tolerant and often follow their owners (imprinted) with the group of their milk brothers and sisters (J. Ternovsky, Role of defensive behaviour in breeding of mustelids, PhD thesis, Novosibirsk, 1984)

Nevertheless, Dr Dmitryi Ternovsky and his wife Dr Julia Ternovsky, two researches from Novosibirsk, Siberia *(Dmitryi Vladimirovicb and Julia Grigorievna Ternovsky, Russia, 630072, Novosibirsk, Academgorodok, ul. Zolotodolinskaya 1, kv. 7)* successfully bred stoats in their research centre. Their experience in breeding has been included in detail in Chapter 2 of their book "Ecologia of kunicieobraznykh" (Ecology of Mustelids), Novosibirsk, 1994.

Traditionally all the pelt farmers used only external signs (indications) to recognise mustelid females' readiness for breeding (full oestrus). The main indicator is the size of female external genitalia (vulva). In all the mustelids in full oestrus, the vulva is enlarged from 5-8 times (American mink) to 20-30 times (European mink), and its orifice is reddened, moist and elevated.

Additional signs of "sexual desire" (Russian term) are some easily visible patterns in behaviour of both males and females. Courtship (sexual ritual) in periods of intense sexual activity is very diverse and normally includes:

- specific voice signals - "cooing" (stoat as well as polecats, Siberian weasel, minks, Altai weasel, weasel);
- while "creeping" (crawling), marking of objects of their environment by intensive urination and scent of anal glands;
- mutual sniffing around; licking of anus and external genitalia of the partner;
- distinctive poses such as jumps, tail raising, trample down and periodical sitting accompanied by stereotypical biting and holding of the skin at occiput (back of the head) and neck. The last behavioral pattern is common in males and very excitable receptive females as well.

Judging by appearance and behaviour is very subjective, according to the Ternovskys. For the objective recognition of oestrus they suggest their own method of microscopic examination of vaginal smears (Ternovsky & Ternovsky 1988). All the mustelid species have no differences in "oestrus cells" - "cornificated oestrus shells" (nuclearless cells). They have easily visible distinctions from other cells, which are common during di-, pro-, and meta-oestrus periods (Ternovsky, D. 1977). Males and females are not put together before the result of cellular composition of the vaginal smear confirms readiness for fecundation (full oestrus).

Advantages of the method are: saving of time, early recognition of pregnancy, it makes it easier to get recurring (repeated) litters, and efficient use of male sires.

With help of this method, experimental populations of stoats, weasels and Altai weasels were established for the first time in Russia. Over 2000 vaginal smear examinations were completed in stoats, and 97 stoat litters were produced in captivity from parents of all ages.

Microscopic examination of the smear:

(a) di-oestrus (repose) - prevalence of small leukocytes in the smear, rare nuclear cells;

(b) pro-oestrus - sharp decrease in number of leukocytes, cells with nuclei still remain, so called "cornificated oestrus shells" (nuclearless cells, shells) appear;

(c) oestrus (full oestrus) - only nuclearless oestrus cells (shells) which look like broken piece of ice;

(d) meta-oestrus (the end of oestrus) - presence of leukocytes, cells with nuclei and small number of "cornificated oestrus shells".

The scientists suggested also a formula for the average mustelid fecundity. Average fecundity $F_{av} = M_{av\ l} : M_{av\ nb}$, where $M_{av\ l}$ is an average mass of a newborn litter, $M_{av\ nb}$ is an average mass of one newborn kit. $M_{av\ l}$ 0.1 female mass. For stoat, a specific coefficient 0.17 (instead of 0.1) may be used.

Pregnancy becomes visible 10-20 days before delivery (enlarged belly). Usually at this stage of pregnancy, the female starts to pluck hairs around her nipples. By the end of winter some dark hairs appear on both sides of the nose - indication of coming moult. Delivery will take place in 22-25 days after that indication.

It is possible to touch or take kits at the day of birth. Hands should have a smell of the nest to avoid trouble. Before return of the litter, the female should be given a live mouse.

Ferrets raise stoat kits very well. Early separation of kits from their mother provokes oestrus. Females separated from their litters at the very beginning of the lactation period reach their next full oestrus in 6-16 days.

2.2 AGE IDENTIFICATION

Some tips for age identification in captive stoats.

AGE (DAYS)	COLOUR AND OTHER INDICATIONS
3-6	Body-pink or raspberry-pink is the prevailing colour.
8-15	Mane up to 6 mm on the upper part of the body. Vibrissas up to 6 mm.
18-22	The mane is well developed. Darkening of the tail tip. Milk teeth erupt.
23-27	Dark spots on the tip of the snout. Mane up to 8 mm. Vibrissas up to 13 mm.
28-34	Opening of acoustic duct
30-42	Eye opening. Usually takes 1-7 days: as a slot from inward angle of the eye to the outward one.
30-37	Disappearance of clutch (coupling, huddle) reflex.
33-40	Distinctive "chick-chick-chick" calls when they are alarmed/anxious.
By 40	Activation of anal glands.
30-40	Dorsal side from dark violet (purple) to tobacco-brown. Ventral side is pinkish. Vibrissas 8-12 mm. Black tail tip is up to 7 mm long. Hairs on the back are of the same level - up to 8 mm. Some individuals have "mask" on the snout.
42-60	Juvenile down and "mask" disappear.
50-60	Sexual dimorphisms in length of the body, foot and palm.
60-75	Adult colour.
58-72	Intensive prey chasing, killing and eating behaviour.
90+	Exclusively meat food.
2.5-4 months	Dispersal of litters

2.3 ROLE OF THE MALE

During the first 5-10 days after delivery, the female keeps the male away from the nest. Later, in her absence, the male visits the nest and sometimes has coitus with female kits. In one of five experiments, the male killed male kits of the litter and had coitus with baby females, all of which were pregnant at 41 days of age.

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Content: Breeding (preparations for mating, mating, pregnancy, raising of young); Selection (pedigree); Feeding (food consumption and diet for ferret, mink and sable); Diseases (diagnostics, clinical examination, non-contagious diseases, infectious diseases).

Il'ina, S.D. 1975. Zverovodstvo. M. Kolos. // Ильина С.Д. Звероводство. М. Колос. 1975. // Il'ina, S.D. 1975. *Fur Mammal Breeding.* Moscow, Kolos.

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Content: Selection (pedigree); Breeding; Preparations for mating season and mating; Raising of young animals; Keeping in captivity; Feeding; Treatment and handling; Veterinarian practices; Diseases (infectious viral, infectious bacterial, invasive, helminthoses, arakhnoenthomoses).

* Title transliteration // Russian title // Title translation

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3. Review of biology of stoats

3.1 BREEDING

Some other aspects of stoat biology may be of interest for captive breeding, for instance, early pubescence in stoats. It is well known that females of some rodent species with short life expectancy (1-3 years) start to breed very early. Successful breeding begins when young animals can see and move easily, when they are self-sustainable and do not depend on their mother. The stoat has quite a long life expectancy (7-10 years) which is not typical for such a small animal. It has some reproductive peculiarities, which are not common among mammals.

Information on stoat pubescence and seasonal cycle is very controversial in the literature. Suppositions and speculations were mostly made by analogies with other carnivores. Some contemporary authors (Danilov, Tumanov 1976 // П.И. Данилов, И.Л. Туманов, 1976*) thought that stoats reached pubescence the year after they were born. Other authors supposed that stoats have early pubescence (not more than 5 months) (Deanesly 1935, 1943*; Tikhvinsky 1937 // Тихвинский, 1937*; Grigoriev 1938 // Григорьев 1938*; Watzka 1940*; Lavrov 1944 // Лавров 1944*; Wright 1963*; Heran 1982*). Muller* (1970) assumed stoat pubescence at age 5 weeks.

Data on the stoat breeding season are also controversial. For a long time it was an axiom that mating takes place in late winter-early spring. N. Grigoriev (Н.Д. Григорьев 1938) wrote: "...stoat as well as sable and marten has oestrus in summer or autumn". Yu. Baevsky Ю.Б. Баевский 1968*) wrote that the stoat has variations in the period of oestrus in the western part of its range, while in Siberia this period is stable. S. Schvarz (С.С. Шварц, 1963*) and K. Kopein (К.И. Копеин, 1965*) reported about spring and summer mating periods in Subarctic regions (proved by finding live sperm in male stoat testicles).

D.V. Ternovsky for the first time found that stoat females from the early part of their life (during the suckling period) were reproductively mature and had a normally developed reproductive system, which was far more developed than other organs such as senses, teeth, etc. The uterus is sinuous and compact

* Well known publications, not included in the list of references.

enough to be located within a small abdominal cavity. It is of normal (elongated) U-shape during further development of a kit.

Typical oestrus cells (shells) were registered in vaginal smears taken from 8- to 12-day old females. Their number increased every day. It should be mentioned that this has also been recorded in other mustelids at early stages of postnatal development, as well as a short-term increase in size of the vulva. However, all these signs in other mustelids disappear quite soon. In stoats, first oestrus takes place at the age of 15 days and lasts for a few months continuously (proved by daily examination of vaginal smears). During this period, mature males may impregnate young females at any time. Successful coitus with young females is typical for stoats. In Dr Ternovsky's experimental populations, 58 young females became impregnated at 17-134 days old. All of them gave birth the following year. Tables included in the book support all these data. Photos of different stages of such unusual behaviour presented in D. Ternovsky's paper "Gornostai" (Okhota I okhotnichye khoziaistvo. 3-1996, P. 7.).

The youngest female was only 17 days old at copulation. She had a body length of 112 mm, and was blind, deaf, toothless, helpless and almost immobile. She sucked only mother's milk. Her weight was only 18 g (13% of body weight of her mother and 6% of that of the copulating male), but 337 days after copulation she gave birth to 13 kits and raised them successfully.

While the female is absent the adult male visits a litter and sniffs the genitalia of female kits. If he finds a female kit in oestrus, he grabs the back of her head and copulates immediately. The duration of successful coitus is usually not more than one minute. After the first coitus, a female kit sometimes aspires to repeat coitus. At this time for the first time in her life she emits specific "marital" cooing calls, which are typical of adults. A high polygamous potential of mature males has been revealed in experiments. One four-year old male copulated with seven 34-day old females several times within a two-day period; within avery short period of time (55 min) he had coitus 32 times. As a result live sperm was found in vaginal smears of all the females.

Many wildlife biologists believe that it is probable that in the wild there are no aggregations of stoats of different sexes or groups of males chasing females in oestrus.

Long-term observations of stoats in captivity show that sexual ritual is very intensive. When an adult female in oestrus is put to the male's cage, he starts chasing immediately. The animals run very fast. During this chasing one can hear distinctive "cooing". Courtship is very brief. In 2-5 min a male grabs the female's neck. The very beginning of coitus is accompanied by squawk (like a prolonged "tsiik" or "tsiirrk"). This call is common for coitus time exclusively. Coitus with adult females and big yearlings takes on average about 15 min (2-59 min). Short-time frequent copulations are also quite common (8 coitus from 2 to 5 min each during 1 hour; 3 coitus of 5, 9, and 10 min during 50 min). Usually the female was isolated after the first coitus if she had live sperm (confirmation by vaginal smear) for identification of changes in her sexual system and confirmation of pregnancy.

The age of maturity (age at puberty) of stoat males is still unknown. In the experimental population, males started successful mating at 10-14 months old.

Suppositions about their early maturation have not been substantiated. Some data were obtained in an experiment where a female shared a voliere with four males of the same litter born 2 May 91. Full oestrus had been registered 17 June 91, and di-oestrus on 1 Aug 91. The female was isolated on 6 Aug 91, and gave birth to 10 kits on 18 May 92. Live sperm was found in the testicles (which were within the body cavity) of a 3-month old male (18 Aug), but no sperm in a 6.5-month old male (2 Oct). In other experiments, four more females lived with males of the same age for 5 months, and examination of their reproductive system showed no pregnancy.

On the other hand, adult males are able to copulate successfully even if they are very old. Thus one good sire that had lived in a voliere for 7 years had coitus in the last year of his life, and a young female gave birth to a healthy litter next year. After the death of this male, live sperm were recorded in his testicles.

Adult females have a high individual variability in season and duration of oestrus: early spring, spring, summer, early autumn (Ternovsky, 1972, 1977). In experimental conditions successful mating took place from 1 April to 4 September. Such a high variability of the sexual cycle of females (especially adult ones) determines the structure of the breeding population. Over the vast areal of stoats in the wild, the mating season is usually prolonged for half a year. Adult males, adult females (including females on the last stages of lactation and having just completed lactation), young females, yearlings and baby females participate in breeding. This adaptive ability leads to success of the species.

The biological literature presents many points of view on the character of pregnancy in mustelids. The prevailing hypothesis is that there are two types of pregnancy: real (without delayed implantation); and with delayed implantation. Generally this biological peculiarity is not very well described, which is why introduction of new species into zooculture and captive breeding of rare mustelids progresses slowly.

Efficient practical breeding of any species depends on a knowledge of the details of pregnancy. After confirmation of oestrus by vaginal smear examination, a female is put to a male. Another vaginal smear should be taken after coitus. If sperm are present in the smear, the female should be isolated. Normally one coitus is enough, although repeated coitus is possible during the same day. It is assumed that pregnancy starts on the next day and ends with birth of the litter.

In experiments, 97 litters were produced, the period of pregnancy lasting from 224 to 393 days (average 314 ±3.15 days, n=96), with young females (17-134 days of age): 224-371 days (average 317±3.64 days, n=58) and adult females: 239-393 days (average 298,5±4.99 days, n=38). This difference in duration of pregnancy between young and adult females is statistically reliable (reliability coefficient 0.99). The duration of pregnancy is determined by the time of mating, not by the time of birth, and the mating season in stoats is three times longer than birth season (Ternovsky, 1974, 1977, 1983).

The reproductive organs were examined to confirm pregnancy in 45 females (31 young, 14 adult) after coitus at different stages during a 320-day period. Only fresh material was examined. The detached uterus was sprayed with water, placed on glass and examined in transmitted light. By 38-40 days of pregnancy embryos were visible even with the naked eye. It was possible to

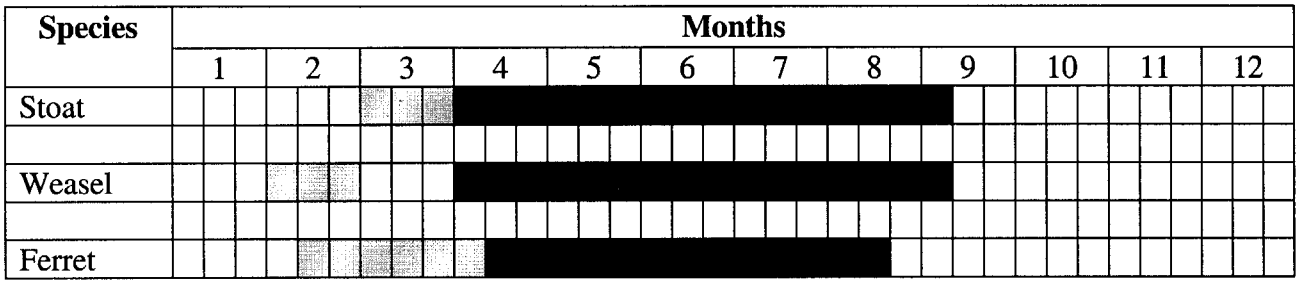

FIGURE 1. MATING PERIOD IN SOME MUSTELIDS.

Dark shading, Ternovsky's data; light shading, other authors' data.

TABLE 1. FEMALE PRODUCTIVITY IN SOME MUSTELIDS.

SPECIES	NUMBER OF LITTERS	MALES	FEMALES	TOTAL	LIMITS	M±m
Weasel	3	9	9	18	6	6.0±0.00
Stoat	97	331	345	676	1-14	7.0±0.36
Ferret	14	37	45	82	1-11	5.8±0.82

count their number and distribution in the left and right horns of the uterus. This simple and reliable method may be used in laboratory and field conditions as well. It is more simple and less time-consuming (also needs less qualified personnel) than the well-known method of washing out the embryos with water, suggested as an "express method" by I. Tumanov (1988)*. Of course it also has a lot of advantages in comparison with the time-consuming microscopic examination of the sliced uterus (3-5 thousand sections should be examined but number of embryos could be counted only 2 months before birth).

Average number of embryos: 9.70 ± 0.63 n=45. Skewness is common for the embryo location, the right horn of the uterus being more productive (5.8 t 0.46 embryos) than the left horn (4.3 ± 3.8 embryos).

3.2 HUNTING BEHAVIOUR

Another interesting aspect of stoat biology is its hunting behaviour. The stoat's hunting reflex seems to be highly exaggerated. It is not an easy task for a stoat to kill a grey rat *(Rattus norvegicus),* but it is easier to kill a water rat *(Arvicola terrestris).* A stoat can scarcely kill a hare *(Lepus timidus),* as it took considerable effort for two minks, which are larger than stoats, to kill one in an enclosure. The same applied to capercaillie (wood grouse) *(Tetrao urogallus).* The daily food requirement for stoat is from 9.6% to 75% of its body weight, and 1 rat (160-190 g) a day is sufficient. The largest food requirement is for 3-month old stoats (100 g of food for a male and 70 g for a female).

Stoats are able to store their prey, but they seldom use their supply (2 of 8 cases). Very often a stoat kills just one rodent and, if it is enough, brings it to the shelter, where it may remain for a long time.

Observations in Ternovsky's experimental populations showed the following results.

- 10-day experiment: 31 of 42 mice offered were killed (23 mice in 5-day period).
- 2-week experiment: 66 of 69 mice offered were killed in the first week, 16 of 27 mice offered were killed in the second week.
- 2-month experiment: total 144 mice killed, with 99 of 107 mice offered being killed during the 13-day period of active hunting. Interval between active hunting periods was up to 32 days. During the next 14-day period the stoat killed 45 of 60 mice offered. Next interval-up to 60 days (stoat eats mice killed on previous days).

A decline in hunting activity during the period of observation was obvious. Hunting activity had certain cycles in periods of plenty with the exception of that of pregnant females. A pregnant female was able to kill up to 37 of 45 mice offered in the 4-day period before delivery (actually, in three days).

Stoats very often visit repeatedly rodent burrows where their hunting has been successful. Experienced trappers use this pattern of stoat behaviour to their advantage.

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4. Diseases and parasites

4.1 MAIN SOURCES OF INFORMATION

Almost all Russian experience in diseases of mustelids is based on data from numerous (in the past) fur farms. Stoats were never bred in captivity in commercial numbers, and therefore information on stoat diseases and parasites is very limited. There is information on stoats and other mustelids as carriers (vectors) of particularly dangerous infections (plague, tularemia, etc.) available from the Proceedings of the Plague Control Institute of Central Asia, but I think it would not be applicable for New Zealand.

TABLE 2. DISEASES OF MUSTELIDS.

DISEASE	AGENT	SPECIES AFFECTED	NOTES	PROGNOSIS WITH PROPER TREATMENT
Salmonellosis	*S.onteridis, S. cholera-suis, S. typhimirium*	Young minks, sables, ferrets	Secondary infection while affected by plague of carnivores, Aleutian disease, stress	Favourable
Colibacteriosis	*Escherichia coli*	Mink and ferret kittens	Secondary infection	Favourable
Botulismus	*Clostridium botulinum*	Minks, ferrets	Polcy (paralysis)	Treatment ineffective
Pasteurellosis	*Pasteurella multocida*	Young minks and sables	Lasts 1-3 days	High mortality
Streptococcosis	*Various serotypes*	Minks, ferrets	Septic form, articular form	Articular - favourable Septic - unfavourable
Pyodermia neonatorum		New-born minks	Abscess of occiput and perineum	1-2 day old kittens - lethal; over 4 days - favourable
Brucellosis	*Brucella abortis, B. melitensis, B. suis*	Adult minks	In utero contagion. Minks may be carriers of brucellas more than one year	
Tularemia	*Francisella fularensis*	Minks		Lethal
Pseudomonosis	*Pseudomonas aeruginosa*	Male minks		Treatment mostly ineffective
Klebsiellosis	*Klebsiella*	Minks, ferrets	Abscess or sepsis	Lethal
Listeriosis	*Listeria monocytogenes*	Minks, ferrets, sables	Lesion of central nervous system, abortions	
Pestis*	Fam. Paramyxoviridae	Minks, ferrets, weasels		
Morbus Aujeszky (pseudo-rabies)*	Fam. Herpesoviridae	Minks, ferrets		Lethal
Encephalopatia	Agent - virus of sheep's skreily strain	Minks, martens, albino-ferrets	Loss of coordination	Lethal
Enteritis virosa lutreolarum (viral enteritis)	Fam. Parvaviridae	Some mustelids		Lethality up to 75%
Morbis aleutica lutreolarum*				
Proritis, Automutilatia, Autoagressis		Some mustelids	Caused by stress, parasites and limited movement. Sick females kill their litters or remain single	
Molineasis	*Molineus patens*	Minks, ferrets, stoat, martens, sable	Nematodes 6-10 mm	Low mortality
Crenomatosis	Fam. Crenosomatidae *C. petrovi* in martens	Mustelids	Nematodes 3.5-7 mm	Lethal in case of secondary infection
Capillariosis	Nematodes: *Capillaria putorii, C. mucronata*	Sable, martens, ferrets, stoat, weasel, Siberian weasel		
Thominesosis	*Thomminex aerophilus*	Martens, minks		Lethal for young in case of broncho-pneumonia
Trichinellosis*	*Trichinella spiralis*	Stoat, martens		Lethal. Treatment ineffective
Dioctophymosis	*Dioctophyme renale, D.skrfabini*	Ferrets, martens, minks		High mortality
Diphylobotriosos	Cestodes: *Dipbylobotrium latum*	Minks, otter		
Mesocestoidoses	*Mesocestoides lineatus, M. petrowi, M. kirbyi*	Sables, minks	Anaemia	Lethal
Alveococcosis*	*A. multilocularis*			
Opisthorchosis	Trematodes: *O. falineus*	Minks, sables		
Metorchosis	*Metorcbis albidus*	Ferrets		
Pseudamphisto-matosis	*Pseudampistomum truncatum*	Minks, ferrets		Unfavourable
Nanophyetosis	*Nanophyetus salmincola*	Minks, sables	Diarrhoea	
Alariosis	Strigeidae: *Alaria alata*	Sables, minks, martens, weasels, stoats		Lethal for kittens
Coccidiosis	*Eimeria vison, E. furonis, E. mustelae*	All mustelids		Very often lethal for kits
Toxoplasmosis	*Toxoplasma gondii*	Weasels	Dyspepsia, disorder of coordination, cramps (fits), disorder of heart activity	High mortality among young

* - No details for well known diseases

4.2 REFERENCES ON DISEASES OF MUSTELIDS

Astrakhantsev, V.I. 1973. Bolezni pushnykh zverei. M. Kolos. // Астраханцев В.И. Болезни пушных зверей. M. Konoc. 1973. // Astrakhantsev, V .I. 1973. *Diseases of fur mammals.* Moscow, Kolos.

Berestov, V A Red. 1985. Nauchnye osnovy zverovodstva. L. Nauka. // Научные основы звероводствaю Под ред. В.А. Берестова. Л., Наука. 1985. // Berestov, VA. (ed.) 1985. *Scientific basics offur mammal breeding.* Leningrad, Nauka.

The very best summary of diseases of mustelids based mostly on vast experience of captive breeding of some mustelids (sable, minks, ferrets and various hybrids) in Russia and data from the wild nature (see the table below).

Danilov, E.P; Maiorov, A.I.; Chizhov, VA.; and others. 1984. Bolezni pushnykh zverei. Izd. 3., pererab. i clop. Pod red. E.P. Danilova. M. Kolos. // Данилов Е.П., Майоров А.И., Чижов В.А. и др. Болезни пушных зверей. Изд. 3, перераб. и доп. Под ред. Е.П. Данилова. М. Колос. 1984. // Danilov, E.P ; Maiorov, A.I.; Chizhov, V.A.; and others. 1984. *Diseases of fur mammals.* 3rd edition, revised and amended. Moscow, Kolos.

Kucheruk, V V Red. 1989. Medicinskaya teriologia: gryzuny, khishnyye, rukokrylye. M. Nauka. // Медицинская териология: грызуны, хищные, рукокрылые. Ред. В.В. Кучерук. M. Hayica/ 1989. // Kucheruk, VV (ed.) 1989. *Medical teriology: rodents, carnivores, bats.* Moscow, Nauka. 1989.

Pankov, VA. 1963. Chuma pushnykh zverei. M. // Панков В.А. Чума пушных зверей. M. 1963. // Pankov, VA. 1963. *Plague offur mammals.* Moscow.

Distribution; etiology; cultivation of the virus; resistance of the virus; receptivity (susceptibility) of different animals; epizootology; clinical characteristics (in minks and sable); complications; diagnosis; varied (comparative) diagnosis (coccidiosis, pasteurellosis and Aleutian disease in minks); immunity; treatment; prophylaxy.

Rementsova, M.M.; Postricheva, OV; Rybalko, S.I. 1983. Antropozoonozy v zverovodcheskikh khozyaistvakh. Alma-Ata. Nauka. // Ременцова М.М., Постричева О.В., Рыбалко С.И. Антропозоонозы в звероводческих хозяйствах. Алма-Ата. Hayica. 1983. // Rementsova, M.M.; Postricheva, O.V; Rybalko, S.I. 1983. *Anthropozoonoses in fur farms.* Alma-Ata, Nauka.

Brucellosis; infectious epididimitis caused by *Brucella ovis;* TB; Q-fever *(Coxiella burnetti),* and as a result, abortions, pneumonia, catarrh, rhinitis; toxoplasmosis *(Toxoplasma gondii);* leptospirosis *(Leptospira,* serological groups: *gryppotyphosa, pomona, tarassovi, hebdomadis, australis, canicola, javanica, bataviae, pyrogenes, ballum, cynopteri, autumnalis);* chlamydiosis (Chlamydioaceae).

5. Russian research likely to be of use in New Zealand

5.1 TRAPS FOR MUSTELIDS

Okhota I okhotnichie khoziaistvo *(Hunting and Hunting Industry* journal)

All the papers mentioned below contain brief characteristics of new traps (some of them in comparison with old ones) and producers' addresses.

1. Lovushka dlia kunikh (Trap for mustelids). 1977-11.
2. Novyi kapkan DKA i ego ispytaniya. V. Agafonov (Agafonov's new trap DKA and its field trials). 1990-10. P.22.
3. Gumannye kapkany (Humane traps for mustelids). 1994-1. P. 18-19.
4. Yashichnaya lovushka dlia gornostaya (Box trap for stoat) 1994-2. P.18-19. Description, drawings, technology of production and use of very simple, cheap and efficient trap suitable for winter conditions. Advantages: good to use in areas with deep snow cover, captive animal is protected against crows, magpies and mice inside, may serve as killing (strangling) and live trap as well.
5. Kapkan Makarova. Russian Patent 1648312, ISI TK 191 (Makarov's killing trap for stoat, mink, ferret, marten, sable. The trap grasps neck, chest or body. Kills quickly). 1995-5. P. 10.
6. Ubivayushie kapkany (lebedinaya sheya, hair trap, udushayushyi, novis, okhotnik). Killing traps (several new strangling traps). 1996-2. P.47

An overview of traps widely used and recommended for commercial trapping is given in:

Gerasimov, Yu.A. 1990. Okhotnichi samolovy i samolovnyi promysel. M. Agropromizdat. // Герасимов Ю.А. Охотничьи самоловы и самоловный промысел. М. Агропромиздат. 1990 // Gerasimov, Yu.A. 1990. Traps and Trapping. Moscow, Agropromizdat.

The book contains a lot of information on traps, their design, production (industrial and homemade), use in different conditions, advantages and disadvantages of different types. Some of them, including traditional Siberian ones, may be of interest.

- universal trap "Ural-1" with torsion spring suitable for mustelids;
- wooden hand-held traps (burrow traps - "cherkans", falling trap - "proskok" for stoat);
- live trap with diaphragm door;
- folding live trap with shutter doors;
- live traps with shutter doors ЭШД-4 and ЖШД-3;
- ice-cylinder for stoat;
- stationary live traps ("sleeve" for stoat).

Copies of pages with figures are available.

Another chapter contains information on methods of trapping, preparation work, and tactics for successful trapping.

5.2 POISONS

Poisons were never used in Kazakhstan for eradication of mustelids. All our experience is based on numerous rodent eradication programmes elaborated mostly by Anti-Plague and other Anti-Epidemic Services. Some poisons were used for eradication of wolves and other canines. No evidence of poisoned mustelids was collected during the above-mentioned operations, even when in some experiments stoats, marbled polecats and ferrets were offered dead poisoned rodents. Lethal and sublethal exposures for mustelids are still unknown.

TABLE 3. POISONS USED FOR OTHER SPECIES BUT NOT SPECIFICALLY FOR MUSTELIDS.

POISON	OBJECTS	USED BY
Strychnine Cyanide	Rodents, wolves, jackals, feral dogs and cats	Anti-Plague Service, Wildlife Conservation, Game management
Thallous sulphate TI_2SO_4 Zn phosphide Zn_3P_2 Krysid Carbonic barium ($BaCO_3$)	Rodents	Anti-Plague Service and other anti-epidemic services
Cyanplave Bromine (Bromide?) methyl	Rodents in burrows	Anti-Plague Service and other anti-epidemic services
Granozane Cyclophosfane	Affects generative system of rodents	Anti-Plague Service and other anti-epidemic services
Difenacoum Zoocoumarin	Rodents	Anti-Plague Service and other anti-epidemic services
Gliftor Difenacoum Zoocoumarin Klerat (Talon) Ratindan Ratak Redentin Zn phosphide Shtorm (fluocoumafen) Ethylphenacin Bactorodencid	Rodents	Plant Protection Service
Toxan lanirat	All mammals	Field trials. Made in Poland, extremely toxic needs removal of corpses.
Nefraps	Rodents	New. Patent 1993

5.3 UNIVERSAL ODOROUS BAIT

A promising universal odorous bait is described in:

Korytin, S. 1993. Universal odorous bait. Okhota I okhotnichie khoziaistvo. 1993-7. P. 12-13 // Корытин С. Универсальная пахучая приманка. Охота и охотничье хозяйствою 1993-7 С. 12-13 // Korytin, S. 1993. Universal odorous bait. *Hunting and Hunting Industry*. 1993-7. P. 12-13.

Fill glass jar (up to a half level) with doubly minced meat or fish mince. Close it tight. Leave just a small hole for gases. Put the jar in a warm place t°=+35°C (not more than 60°): meat mince - for 3-4 months; fish mince - for 1-2 months. Use a plastic pipe to extract gases. The bait is ready when it turns grey inside as well as outside. After that keep the bait in a fridge.

Mince made of lizard, snake or frog meat is the best attractant for stoats. Meat of big carnivores is absolutely unfit.

Very good results are given by a mixture of mince and animal fat (goose fat, tallow, etc.): 1000 g mince + 400 g butter + 100 g fish oil.

The author recommends to put this bait into plastic-lined pits or wooden boxes dug into the ground, and to place the traps around. Odorous bait may be spread on some objects around traps. A small bottle of the bait may be hidden close to the trap. Use objects odorised by the bait to drag along the stoat's track and put small pieces of meat or bread in some places. Anchor the trap beside visible objects (hummocks, snags, etc.).