EUROPEAN MINK: SETTING OF GOAL FOR CONSERVATION AND THE ESTONIAN CASE STUDY

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INTRODUCTION

The European mink, *Mustela lutreola* (Linnaeus, 1761), is one of the most endangered carnivores in today's Europe. All prioritisation lists, both local and international, have acknowledged its critical status: IUCN Red Data List 2000 regards it as an endangered species; in IUCN Action Plan for Small Carnivores (Schreiber et al. 1989) it is listed as a priority species for Europe and on the global scale; in Bern Convention on the Conservation of European Wildlife and Natural Habitats it is included in Annex II as a species in need of strict protection; in the EU Habitats Directive it is listed in Annex II (Member States are required to establish Special Areas of Conservation) and in Annex IV (Member States are required to establish a system for strict protection). The European mink is also protected by law in all of its range countries, except Russia (where it is still a game animal on the federal level, though being protected in most of the regions by local regulations).

DECLINE OF THE EUROPEAN MINK AND THE PRESENT STATUS

The historical process of the decline of the species has been studied both on the European and local scale (Maran 1994, Maran & Henttonen 1995, Maran et al. 1998a and a number of references therein, Tumanov 1986, Sidorovich 2000, Lodé et al. 2001). The earliest data on its decline come from Germany. According to old records the species was extinct in a number of regions already in the middle of the 19th century. In about the same period it disappeared from Switzerland and probably also from Austria. Subsequently, the remaining populations in southwestern France and eastern provinces of Spain formed an isolated enclave in Western Europe by the beginning of the 20th century. However, since the records on the presence of the European mink in France and Spain are very recent, it might well be that the species is in fact a recent immigrant in these countries.

Between the 1930s and 1950s, the last specimens were recorded in Poland, Hungary and Czech and Slovak Republics. In Finland, Estonia, Latvia and Lithuania the European mink declined into extinction by the end of the 20th century. The data

for Ukraine, Moldova and Georgia are very scanty but the available reports suggest that it became extinct in these countries during the 20th century. In Russia a decline was noticed in the middle of the 20th century. By late 1990s, the European mink was replaced by the American mink, *Mustela vison* Schreber, 1777, in extensive areas of Russia. Recent reports (V. Katsachovsky pers. comm. 2001, V. Sidorovich pers. comm. 2001) reveal a massive decline of the native European mink in all central regions of Russia and its full replacement with the alien American mink in most regions and districts. Surprisingly, in some European regions of Russia (namely Vologda and Arkhangelsk Regions) the situation is slightly better than thought earlier. However, even there the American mink is widely present and a swift decline of the original species in the nearest future can be predicted (Saveljev & Skumatov 2001).

The available data on the existence of the European mink in Danube delta in Romania have been controversial for a long time. However, recent pilot studies (Gotea & Kranz 1999) have confirmed the presence of the species there. A detailed field survey on its actual status is still underway (A. Kranz pers. comm. 2001). Unfortunately, recent data on presence of American mink in Danube delta (Dr. Radu Suciu pers. comm. 2002) leave little hope for the survival of the European mink in this area and make its conservation fairly complicated.

Causes of extinction

Factors behind the decline have been analysed in a number of studies (Shröpfer & Paliocha 1989, Maran & Henttonen 1995, Sidorovich 1997, Sidorovich & Maran 1997, Maran et al. 1998a, Maran et al. 1998b, Sidorovich et al. 1998, Davidson et al. 2000a, Sidorovich 2000, Lodé et al. 2001 and various others). A number of hypotheses have been pushed forward to explain the extinction and there have also been attempts to test the hypotheses. The main hypotheses include: (1) habitat loss, (2) over-hunting, (3) pollution, (4) impact of marine/continental climate spells, (5) introduced disease, (6) dependence on declining prey, (7) interspecific relations with the American mink, (8) interspecific relations with the Western polecat, *Mustela putorius* Linnaeus, 1758, (9) intraguild predation and aggression. The results of these analyses reveal that the causes of decline have varied between different locations and time periods, but seemingly over-hunting and habitat loss were the key factors during the earlier periods. However, in some places the decline of the species has remained hard to explain (e.g. Finland; Maran & Henttonen 1995). At present, the American mink, affecting through various mechanisms, is the main agent leading the remaining European mink populations into extinction (Maran & Henttonen 1995, Sidorovich 1997, Maran et al. 1998, Sidorovich 2000). It seems that in some

regions the impact of extensive habitat change, trapping and other agents may be so influential that the impact of the American mink has so far gained only a secondary role in the extinction process (Lodé et al. 2001).

Defining the goals for conservation

Considering the highly critical status of the European mink and the spread of the American mink in extensive territories of Europe, it is likely that future the original mink will completely vanish in Europe in the nearest unless well-coordinated and effective conservation measures are taken.

To be successful in the conservation of the species, it is necessary to define the status that can be regarded as the species being on the safe side again. It is equally important to map the possible ways of reaching this target status. One possible way of defining the goal for the European mink conservation in Europe is proposed below. In addition, the conservation efforts made in Estonia, which follow this proposed goal, have been briefly described.

Conservation biology follows largely two mutually supportive paradigms (Caugley 1994): (1) *the declining population paradigm* (focussing on the external agents of decline) and (2) *the small population paradigm* (focussing on the risk of extinction because of too small size of the population). The European mink is in heavy decline and exists at present only in small fragmented populations. Therefore both (1) the causes of extinction together with the "prescription of the antidote" have to be identified (application of paradigm 1) and (2) serious attention has to be paid to its populations being jeopardized with extinction because of their tiny size (application of paradigm 2).

(1) The analysis of the causes of decline has indicated that the main factors behind the extinction have been loss and degradation of habitats, overly intensive hunting and the impact of the alien American mink, while the other agents (e.g. the impact of Western polecat, pollution and road-kills) have a minor significance. Therefore three major agents (often acting in concert) have to be targeted while devising the conservation strategy and goals. Over-hunting and habitat-loss can be addressed by conventional conservation measures (such as prohibition of hunting or designation of protected areas), combined by effective public awareness campaigns. The impact of the spreading American mink is a far more sophisticated issue. Undoubtedly, it would be ideal for the European mink survival if the alien American mink could be removed from the European continent. However, all currently available conservation tools are unlikely to achieve it even if the ever-haunting

financial constraints in conservation and the rising ethical issues could be coped with. Yet, without finding solutions to eliminate the negative impact of the American mink, protection of habitats and regulation of hunting will remain irrelevant conservation actions. This makes the **negative impact of the American mink a priority issue** to be addressed to ensure the European mink's survival.

Once it is agreed that overall removal of the alien American mink from Europe is an unachievable goal in foreseeable future, two options remain:

- *Ex situ component:* maintenance of the European mink's genetic heterozygosity and fitness by means of a captive population *via* an intensive and well-coordinated conservation breeding programme (such as a highly intensive form of the European Endangered Species Programme – EEP under the aegis of European Association of Zoos and Aquaria). This captive stock can also be regarded as a backup in case the *in situ* options entirely fail.
- *In situ component:* to ensure that at least some areas still having an extant European mink population will stay inaccessible for the American mink or, if this is not achievable, to establish new wild populations of the European mink in areas inaccessible for the alien mink. That would mean the creation of island populations for the original species, with the term "island" being used here in its broader meaning: a sufficiently large area of suitable habitats to maintain self-sustainable populations of the European mink, surrounded by barriers making the area inaccessible for the American mink (for instance nature restoration areas within industrial landscapes).

(2) Both of the above-mentioned components are derived from the paradigm of declining populations and lead to the management of small populations. The need to secure the survival of these small populations raises the question of: what must be the size of these island populations and captive populations to secure the survival of the species? Under the small populations' paradigm (Caugley 1994), three types of stochasticity (demographic, environmental, including random catastrophes, and genetic) are usually described as being likely to be detrimental for small populations.

The aim of conservation breeding is usually defined (though somewhat arbitrarily; Soule et al. 1986, Ralls & Ballou 1986) as maintenance of 90% of the original heterozygosity of the species for 200 (or 100) years. Also, the need to divide the captive stock between a number of sites has been emphasised (Foose et al. 1986). This "standard aim" could probably also be used in defining the minimum size for these populations.

For the evaluation of the size of these populations I used the computer model Capacity v.3, created by J. Ballou, and demographic and genetic data from the captive

stock of the European mink EEP Program (Table 1) maintained in SPARKS (www.isis.org) database. The captive breeding data cover early periods in the EEP Program, when breeding in captivity was not entirely effective but every effort was made to gain success, and the recent periods when at least part of the population is intentionally managed to breed only to a certain extent so as not to exceed the available capacity of breeding facilities. Therefore it is obvious that application of this model to data from captive breeding operation will provide very conservative results. However, as no ideal data are available, this assessment still gives us a target size which is likely to grant success. As it appears, in order to maintain 90% of the original heterozygosity with 30–50 founders (in general, 25 founders are considered to be an effective size, Ralls & Ballou 1986) and with N/Ne ratio between 0.3–0.5, we need to maintain a population of **364–693 individuals for a 100-year period** and **770–1,483 individuals for a 200-year period.**

The *demographic stochastisity* tends to lead a population into extinction if the size of the population is less than 30–40 specimens (Ralls & Ballou 1986, Caugley & Sinclair 1994). Therefore, fulfilling the genetic requirements for population size will also cover the needs for survival from the perspective of demographic requirements.

However, environmental stochasticity combined by unlikely but unpredictable catastrophic events has not been addressed so far. One way to reduce the impact of environmental fluctuations is to increase the number of minimum viable island populations in distinct from each other sites. Maintenance of 10 such populations will reduce the probability of extinction 10 times. In addition, a well-managed viable captive population can backup the survival of the established 10 island populations.

On the ground of these considerations I propose for discussion the overall target for European mink conservation in Europe consisting of the following elements[1]:

- **Establishment and maintenance of an all-European captive population consisting of 200 effectively breeding individuals divided between a number of facilities.** This would secure the maintenance of 90% heterozygosity for 100 years and would require the actual overall carrying capacity in captivity between 364–693.

1 This attempt to define the conservation target is made under the assumption that the European mink can be regarded as a single Evolutionary Significant Unit, although recent studies, though they have not been able to detect remarkable genetic differences, suggest separate management of the eastern population and the French/Spanish population (Davidson et al. 2000b). If this recommendation is supported by new studies and evidences and if time and allocated funds allow to put forward far more sophisticated goals, provided definition of target should be applied to both populations.

TABLE 1
Actual carrying requires to maintain 90% of the original heterozygosity for different founder under various N/Ne ratios

No. of effective founders

Table				10	20	30	40	50
Parameters			0.20	90	70	70	70	70
		N/Ne	0.30	63	47	47	47	47
Lambda:	1.31	Ratio	0.40	48	35	35	35	35
Generation length:	2.80		0.50	38	28	28	28	28
Time period:	**10 years**		0.60	32	23	23	23	23

No. of effective founders

Table				10	20	30	40	50
Parameters			0.20	2630	560	465	435	420
		N/Ne	0.30	1753	373	310	290	280
Lambda:	1.31	Ratio	0.40	1315	280	233	218	210
Generation length:	2.80		0.50	1052	224	186	174	168
Time period:	**50 years**		0.60	877	187	155	145	140

No. of effective founders

Table				10	20	30	40	50
Parameters			0.20	7045	1290	1040	950	910
		N/Ne	0.30	4697	860	693	633	607
Lambda:	1.31	Ratio	0.40	3523	645	520	475	455
Generation length:	2.80		0.50	2818	516	416	380	364
Time Period:	**100 years**		0.60	2348	430	347	317	303

No. of effective founders

Table				10	20	30	40	50
Parameters			0.20		2800	2225	2020	1925
		N/Ne	0.30		1867	1483	1347	1283
Lambda:	1.31	Ratio	0.40	8120	1400	1113	1010	963
Generation length:	2.80		0.50	6496	1120	890	808	770
Time period:	**200 years**		0.60	5413	933	742	673	642

- **10 wild (or restored) populations in sites with a sufficient amount of suitable habitats inaccessible for American mink and with protection measures applied to prevent the impact of other possible causes of extinction (hunting prohibited and habitats protected),**
- **the wild populations consisting of, as a minimum, the total of 1,500 individuals participating in breeding** (this will secure the maintenance of 90% of the initial heterozygosity for 200 years),
- **at least 30 – 40 breeding individuals in each site** (a guarantee that these island populations will not vanish due to demographic stochasticity),
- **populations situated as evenly as possible over the historical range of the species** (with 10 island populations the species is not likely to vanish due to environmental stochasticity and unpredictable catastrophic events).

It is noteworthy that the above goal-setting has reached a result very similar to the goals set up for the recovery of the Black-footed ferret, *Mustela nigripes* (Black-footed Ferret Recovery Plan 1978).

Clearly, reaching of this goal is not an easy task and could even be partly impossible due to the fact that reality constraints such as the lack of suitable sites or financial resources have their own role to play. However, I believe that definition of an overall target for the conservation of the European mink will be of assistance in fine-tuning the goal-setting on the local scale and will thus contribute to the survival of the species on the global level. The planning and efforts of the conservation of the European mink in Estonia are contributions to this overall goal.

Estonian case study: 1998-2001

Status of the species in Estonia

The European mink was relatively widespread and abundant in Estonia until 1940. Since then the alien American mink started to invade the country and the inexperience of local hunters and researchers with this alien species makes it impossible to draw any conclusions on the status of the European mink in Estonia until late 1980's, when a special survey on the status of the two species was conducted (Maran 1991). This study revealed that the original mink was still extant in the northern and eastern parts of the country, whereas the south and west were fully occupied by the alien mink. The concurrent invasion of the alien species and extinction of the original mink have continued since then. As the last confirmed record of the European mink in the wild dates back to 1996, the wild populations of the species are regarded to be extinct in Estonia at present.

Objectives of the conservation efforts in Estonia

The efforts of the European mink conservation in Estonia are largely based on the activities of Tallinn Zoo in captive breeding of the species and in the promotion of the species' overall conservation. The objectives for the conservation of the European mink in Estonia are provided in the European mink recovery plan in Estonia (Maran 2000):

- *Ex situ*: (1) construction of a Special Breeding Facility for the European mink with the capacity of 200 animals; (2) establishment of a captive population consisting of 200 individuals; (3) maintenance a favourable genetic and demographic structure of the stock and its behavioural identity; (4) integrated management of the Tallinn captive stock within the European mink EEP Program.
- *In situ*: (1) Establishment of two island populations from captive-born founders:
  - Population of min. 168-233 individuals in Hiiumaa Island (1,000 km^2);
  - Population of min. 168-233 individuals on Saaremaa Island (2,500 km^2);
  - Securing of the survival of these newly established wild populations on both islands through the relevant conservation measures.

Conservation actions

- *Ex situ.* Although the history of maintaining and breeding of the European mink dates back to 1983, better targeted activities started only in early 1990s with the establishment of the European Mink Conservation & Breeding Committee (EMCC). Within 10 years additional 14 new founders were obtained through collaboration with the Central Forest Biosphere Reserve (Tver Region, Russia). The first breeding occurred in 1986 and regular breeding was achieved in mid-1990s. In 1998, the construction of a special breeding facility (ESC) for the European mink at Tallinn Zoo was initiated. The aim of ESC is to accommodate 200 minks. At present the ESC can host 80 minks, which together with the old facility will raise the overall capacity to 125 animals. Extension of the facility is limited mainly by the shortage of funds for new constructions, but even more by too high costs (food, husbandry, etc.) of maintaining a higher number of minks in captivity. Therefore, conservation breeding can be continued on a limited scale, keeping the overall stock in ESC on the level of 125 specimens. In 2001, for instance, breeding was restricted to 53 young only and the overall stock in the facility amounted to 106 (as of 31.12.2001).

Apart from conservation breeding in its own facility, Tallinn Zoo has also coordinated the European mink EEP programme since 1992. Seventeen institutions participate in this programme with an overall stock of 225 specimens (as of 31.12.2002).

- *In situ.* Although minor *in situ* actions date back to early 1980s (mostly surveys of the status and trapping of new founders for the captive stock), more substantial conservation actions started in 1998, following the decision to start the establishment of a special island reserve for the European mink on Estonia's second largest island-Hiiumaa. The island is located 22 km from the mainland. According to a preliminary assessment, the habitats of the island can accommodate 100–200 European minks. Since the island was occupied by a feral population of the American mink originating from a mink farm closed by now, the first action was to remove all these aliens from the island. This objective was achieved with five 2-5 week trapping sessions in 1998-2000. At first local trappers were involved but final success was achieved thanks to an effective contribution from Dr. Vadim Sidorovic with his team (Belarus). All in all, 53 American minks were removed from the island. After careful checking during a three weeks session in spring 2000, it was decided that the island was clear of the American mink[2].

  In 2000 two experimental releases of the European minks were conducted: 9 animals in June and 8 animals in September. Part of the animals passed a pre-release training to increase their chances for survival on the island. We trained the animals in hunting for wild prey, in human avoidance, predator avoidance and use of aquatic habitat.

  All the released animals were radio-tracked. The survival rate was over 33%, with predation being the main cause of mortality. All of the live animals trapped at the beginning of 2001 were in very good shape.

  In 2001 a large-scale release was conducted with 41 mink. Half of them were radio-tracked. The provisional results indicated 6 cases of death caused by other predators: dogs, foxes and birds of prey. The final results of this release are yet to be evaluated.

  All conservation actions were managed by foundation "Lutreola" (successor of EMCC) in close collaboration with WILDCRU at Oxford University and Tallinn Zoo. The project was funded from various sources, with most remarkable contributions from Foundation Darwinian Initiative for Biodiversity (UK) and Tallinn Zoo (Estonia).

2 However, two additional American mink were trapped after the end of eradication actions, but before the release actions.

The future

Since 2001 the project has been funded under the European Union LIFE project entitled: "Recovery of the European mink in Estonia: island and captive populations". The objective of the project is (1) to promote the conservation of the European mink in Hiiumaa island and to continue the reintroduction, (2) to establish another island reserve on Saaremaa island – the largest island in Estonia (2,500 km^2), and (3) to maintain and develop the captive stock and conservation breeding of the European mink in Tallinn Zoo.

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