

Why is the European mink (*Mustela lutreola*) disappearing? — A review of the process and hypotheses

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The historical range of *Mustela lutreola* extended from Finland to east of Ural Mountains, to northern Spain and Caucasian Mountains. The species went extinct in some parts of Central Europe already a hundred years ago. During this century, populations have declined almost everywhere. Several hypotheses have been put forward to explain the disappearance of the species. These include climatic change, competition with the American mink *M. vison*, destruction of the habitat, disease transmitted by the introduced American mink, crash of the favored food item, crayfish *Astacus astacus*, hybridization with the European polecat *M. putorius*, etc. It is very clear, however, that none of the hypothesized factors alone could explain the events in various place at different times. The early declines in Central Europe and later in Finland took place before the spread of the American mink. On the other hand, the present decline of *M. lutreola* in Estonia seems to coincide well with the spread of *M. vison*. The early declines in Central Europe could have been caused by destruction of the natural river ecosystems, especially river banks. Still, in Finland the major disappearance happened well before the major environmental change of natural small river ecosystems due to modern forestry. Even if the detailed explanations seem to vary, there is an underlying theme: environmental change. The European mink seems to be a much more specialized species than the American mink. Before the arrival of *M. vison*, the change in the preferred habitat, small sandy brooks, or the crash of the food source, could have been the underlying cause. With the arrival of the American mink, the European one loses even without the environmental change.

1. Introduction

The European mink (*Mustela lutreola* Linnaeus 1761), is a small semi-aquatic carnivore resem-

bling the polecat (*M. putorius*) or the American mink (*M. vison*). In spite of resemblance to the American mink, *M. lutreola* is not closely related to it. Similar appearance is due to convergent

evolution to the semi-aquatic way of life (Grafodatskij et al. 1976, see also Youngman 1982). The original range of the European mink covered most of the continental Europe, except Sweden, Norway, Denmark, western Spain, Portugal, Italy and Belgium. For the Netherlands, only historical records (2300–2100 B.C.) exist (Van Bree 1961a, b).

Starting last century — as far as we know — the numbers and range of the European mink began to shrink with an accelerating rate (Novikov 1939, Youngman 1982, Tumanov & Zverjev 1986, Ternovskij & Ternovskaja 1988, Schreiber et al. 1989, Saint-Girons 1991, Maran 1994). At present the status of the species is critical, and it is surviving in less than 1/5 of its original range. The most recent estimate of the total population size does not exceed 30 000 (Maran 1993). The European mink is included as a vulnerable species in the IUCN's Red Data Book.

In this paper we 1) review the the pattern of decline and the present situation in European countries, 2) discuss the hypotheses put forward to explain the decline, and finally 3) comparing these ideas with the known courses of the decline in various regions we present a synthesis of the past and present factors.

2. Review of the decline

The oldest data on the decline come from Germany. Novikov (1939) reviews the older German literature and concludes that in many regions the European mink was extinct already in the middle of the last century. There is no evidence of the European mink in Germany during this century (Novikov 1939, Youngman 1982). A similar pattern has been observed in Switzerland without records in this century (Gautschi 1983). From Austria some data exist from the last decades of the last century, but not since then (Novikov 1939).

The next stage of decline concerns countries like Poland, Hungary, Czech and Slovak Republics, possibly also Bulgaria, where the main decline had probably taken place until the beginning of this century. In these countries the last specimens date back to 1930's–1950's (Romanowski 1990, Szunyoghy 1974, Barta 1956, Schreiber et al. 1989).

In Finland, Estonia, Latvia, Lithuania and Belarus populations of the European mink have declined into extinction this century, or are on the verge of extinction now. In Finland the major decline took place in the 1920's–1950's, and it was believed that the last specimen was found in the late 1970's (Henttonen 1992). Surprisingly, however, one individual was caught and some other unconfirmed observations were made in 1992. In Latvia, the European mink was considered to be extinct for years, but in 1992 one specimen was caught in northern Latvia (Maran 1994). In Lithuania the last specimens have been caught in 1978 and 1979 (Bluzma 1990).

In Estonia and Belarus the rate of decline has been very rapid during the last decade. At present, small fragmented populations exist in the north-east of both countries. The rough estimate of the population size in both countries is 100–150 individuals (Maran 1993, Sidorovich 1992).

For the Ukraine, Moldova, Romania and Georgia the data are very scanty. According to Tumanov (1992), the decline in the Ukraine started in late 1950's. Turjanin (1986) reports that recently only some small isolated populations inhabited the upper courses of the rivers in the Ukrainian Carpathians. Muntjanu (cited in Maran 1994) states that in Moldova in the 1930's the numbers started to decline very quickly, and in 1980's the last populations survived in the lower course of the River Prut along the Romanian border. The European mink has earlier been very common and widely distributed in Romania (Novikov 1939). Around 1960, 8000–10 000 European minks were still caught annually (Rösler 1991). Present data are very conflicting, but as far as we can judge on the basis of personal contacts (D. Murariu, O. Ionescu), a small population still survives in the Danube Delta. For Georgia, Novikov (1939) states that the European mink was common and widely spread along the rivers flowing to the Black Sea in the north-western part of the country. If the species still exists, it must be very rare (Kudatkin, pers. comm. 1991).

In the European part of Russia, the European mink was common and wide-spread in the early decades of the century (Novikov 1939). The general decline in Russia was first realized in the 1950's, and in the 1970's a lot of attention was

paid to it (Ternovskij & Tumanov 1973, Ternovskij 1975, Tumanov & Ternovskij 1975, Danilov & Tumanov 1976a). Tumanov and Zverjev (1986) published a survey of the status of the species in Soviet Union, which revealed a drastic change in all regions except Tver where the density of the species was the highest, 4–6 individuals per 10 km of river bank. Maran (1992) made a review based on a questionnaire to protected areas in the former range of the European mink in Soviet Union. The results indicated that from 33 areas with information, 16 reported extinction, 13 reported decline or very critical situation, and only 4 had stable populations. The situation is getting worse with time. A very recent report (Sidorovich & Kozulin 1994) shows that the species is also declining in some parts of the Tver region that is usually considered to be the core area of the range. According to the most recent data by Katchnanovskij (pers. comm. 1994), the European mink exists in no more than one third of its previous range in Tver region, and the American mink has recently invaded to the region. Furthermore, the remaining stock has fragmented into two isolated populations.

In France and Spain there is an isolated range of the species extending from Brittany to northern Spain (Blas Aritio 1970, Chanudet & Saint-Girons 1981, Braun 1990, Camby 1990, Palomares 1991, Ruiz-Olmo & Palazon 1991). The French experts have estimated the population size at 2000 individuals, and in Spain the estimate is about 1000 (Maran 1993). The decrease in the distribution and numbers of the mink has been observed also in France. The most recent data (Maizeret, pers. comm. 1994) suggest that the European mink has disappeared from the northern half of its previous range. The situation of the European mink in Spain is quite intriguing since the first records are from 1951, and the most recent data suggest the spread of the species southwards (Ruiz-Olmo & Palazon 1990). According to Youngman (1982), the species has spread from France in the 1940's, but it is also possible that the presence of the species has not been known earlier.

388 European minks (mostly captive bred) were introduced on two of the Kurile Islands in Russian Far East in 1981–89 (Ternovskij et al. 1986, Shvarts & Vaisfeld 1993). The population

on the island of the main introduction has not grown; in fact, Shvarts & Vaisfeld (1993) report that the present number is remarkably lower than originally released.

3. Hypotheses for the decline

Due to the drastic decline almost everywhere in Europe a number of ideas has been put forward. These ideas can roughly grouped into those emphasizing the human influence, relation to other carnivore species, climatic change, etc. In the following we will briefly review the essential points in various hypotheses.

Habitat loss. The first reports that habitat losses are causing the decline date back to last century (Claudius 1866, Löwis 1899). For example, Claudius (1866) tells that the mink population declined in ten years due the expanded land drainage, and Löwis (1899) predicted the quick extinction of the mink due to land drainage and improvement in the area of present Lithuania. In Central Europe most of the original small rivers have been channelled, and the original river ecosystems have disappeared. Major land improvement has been carried out more recently in several other countries like Estonia, Finland, Russia, Moldova and the Ukraine. Drainage of small rivers will definitely influence the European mink because of its is high specialization to this ecosystem unlike the American mink (Novikov 1939, Novikov 1970, Danilov & Tumanov 1976b).

According to Rukovskij (1982) extensive clearcutting in Russia could affect the water balance in the area and consequently impair the habitat availability for the European mink.

Overhunting. The European mink has earlier been hunted excessively. Novikov (1939) points out that in some district, e.g. around the former Leningrad, the hunting was temporarily forbidden to let the population recover. In the early decades of this century, the annual bag in Soviet Union was 40–60 000, with an record of 75 000 individuals (Novikov 1939), which is more than the estimate for the entire species nowadays. The species is still a legal game animal in Russia (Rozhnov 1992), although there are intentions to include it into the Red Data Book. According to

Siivonen (1972), the Finnish annual bags reached up to 3000 specimens in the 1920's. Rösler (1991) reported that still around 1960 the annual catch was up to 10 000 minks in Romania.

The muskrat (*Ondatra zibethica*) was introduced to Europe in the 1920's and became soon a popular hunting object. Siivonen (1972) asks if the intensified hunting of the muskrat could have had an impact on the decline of the populations of the European mink, too.

Pollution. Pollution has every now and then been suggested to cause the mink decline (Schröpfer & Paliocha 1989), but there is not any research confirming this.

Marine/continental climate spells. Voipio (1946) considered the European mink a continental species because the core of its distribution was in eastern Europe. The warm period in the 1930's was marine, and was thought to be unfavorable for the mink in Finland.

A crayfish specialist? The possible dependence of the European mink on the crayfish (*Astacus astacus*) was already mentioned by Pallas (1811–31) (as cited by Novikov (1939)) who explained the absence of the mink on eastern side of the Ural mountains with the lack of crayfish there. Without being aware of the idea of Pallas, Henttonen (1992) connected the rapid decline of the European mink in Finland in the 1920–40's with the invasion of the crayfish plague (fungal disease *Aphanomyces astaci*) which dramatically started to destroy crayfish populations in 1910's. Henttonen (1992) also suggested that the failure of the species to spread west to Scandinavia was due to the gap in the distribution of the crayfish. The original northern limit of the crayfish was in Central Finland at 62°N. In Sweden the northern limit was at 61°N. In Finland, the distribution of the mink extended north of that of the crayfish, but still there was a long way around the northern tip of Gulf of Bothnia (the northernmost part of the Baltic at 66°N) to Central Sweden.

Introduced diseases. Henttonen & Tolonen (1983) and Henttonen (1992) speculated on the idea that the introduced American mink could have transmitted a disease, not too virulent to itself, but fatal to the original species. The disease could have spread much faster than the American mink did. The comparable case could be the

myxomatosis as an indigenous disease in lagomorphs in South America and as an introduced one in rabbits in Europe.

Interspecific relation with the American mink. The American mink was introduced for fur farming or released in many parts of Europe in the 1920's–1930's, but the modern intensive fur farming did not start until in the 1950's. Consequently, in addition to the animals deliberately released, minks escaping from farms initiated the feral populations. At present, the American mink is common in most European countries (Stubbe 1993). Even if both mink species are semi-aquatic animals, the American mink is not such a strict specialist as the European one. The difference between the species in the body size is 20–40%, the American mink being larger (Danilov & Tumanov 1976b, Sidorovich 1992).

The impact of the American mink has been explained in two ways. First, the idea that the competition between the species leads to the exclusion of the European mink, is widely recognized (Popov 1949, 1964, Danilov & Tumanov 1976b, Maran 1991, 1994, Ryabov et al. 1991, Sidorovich 1992). Second, on the basis of crossing experiments with these two species, Ternovskij (1977) found that hybrid embryos will be resorbed. Consequently he suggested that because the male American minks are stronger than the European ones, and because the breeding season of the American species starts earlier, the American males will copulate with the European females thus preventing their reproduction. The chromosome number of the European mink is 38, and that of the American mink is 30 (Grafodatskij et al. 1976).

Interspecific relation with the polecat. Granqvist (1981) studied museum material of the European mink and polecat, and found specimens he regarded as hybrids. Connecting this discovery with the warm climatic period in northern Europe in the early decades of this century when the polecat greatly expanded its range to northern Europe, he suggested that, due to hybridization between the species, the European mink was gradually absorbed by the polecat. The existence of wild hybrids between these two species is well-known in Russian literature (Ognev 1931, Novikov 1939, Heptner et al. 1967, Tumanov & Zverjev 1986). Tumanov & Zverjev (1986) re-

ported that in a material of 500–600 pelts of the species, 3–5 suspected hybrids were found. The chromosome number of the polecat is 40. Ternovskij (pers. comm. to Maran, 1991) has informed that the hybrids can be backcrossed with the polecat.

Schöpfer & Paliocha (1989) mentioned that due to the landscape change favoring the habitats of the polecat, the competition between the two species has apparently intensified resulting in exclusion of the European mink.

Intraguild predation. The disappearance of large predators like wolf and lynx has caused a release in the numbers of several medium-sized predators; for example red fox has increased in many regions, although the increase has been attributed also to other factors like modern forestry (Henttonen 1989). It is known that red fox preys on mustelids like pine martens (Lindström 1995). If the regional red fox increases had preceded *lutreola* declines, it might be possible to hypothesize that predation by red fox has been involved.

4. Competing hypotheses or multiple causes of the decline?

We believe that the basic reason for the considerable number of hypotheses is that local examples have been extrapolated elsewhere. We also emphasize that often the actual decline has not been studied, and the explanations are retrospective speculations.

The decline of the European mink in the central Europe at the end of last century cannot have been caused by the American mink or pollution. Neither can we accuse the climatic change or overhunting; the latter was considerably less intensive in Germany than in Russia (Novikov 1939). However, the large-scale land-improvement and dredging of rivers most certainly reduced the amount of suitable habitats. It probably resulted in the decrease of the population as well as in fragmentation of it.

The causes of the rapid extinction of the mink during the first half of the present century in several eastern European countries like Poland, Hungary, former Czechoslovakia, is difficult to understand. It can only partly be connected with

the change of river ecosystems, as these countries at least until recently had a lot of optimal habitats for the European mink. However, the extensive development in agriculture could have contributed to the fragmentation of populations thus increasing the probability of stochastic extinctions.

In Finland as well as in several locations in the former Soviet Union neither the habitat loss nor the American mink could have been the cause of decline. The American mink spread over Finland in the 1950's–1970's, and the very extensive drainage for forestry purposes did not start until in the 1950's when the European mink population had already experienced the major decline. According to Siivonen (1972) hunting in 1920's was intensive and the start of the active muskrat trapping in the 1930's could also have affected the mink population. The species has been totally protected since 1945 but no signs of recovery were observed. A firm explanation is hard to give, and the ideas on the role of crayfish crash or introduced diseases are speculative. However, the possible recovery of the European mink population since late 1960's has certainly been prevented by high density of the American mink.

The idea of intraguild predation is hard to assess for many regions, but it seems not to hold at least for Finland. Due to hunting and high value of the pelt, the red fox population was very low for most of the early part of the century (Henttonen 1989) when the major decline of the European mink occurred.

In Moldova, in the Ukraine and in several regions of Russia the decline of the European mink was also recorded long before the invasion of the American mink. Even nowadays there are large areas in Russia without the American mink, yet the European mink is declining there. In these areas, however, the habitat loss, e.g. drainage of river estuaries, intensive agriculture and forestry of former virgin land, and hunting pressure could have been significant factors (Tumanov & Zverjev 1986, Tumanov 1992).

During the 1970's and 1980's the decline of the European mink and the invasion of the American mink have coincided in Belarus (Sidorovich 1990, 1992) and in Estonia (Maran 1991, 1994). It seems that these two countries

are the only examples of detailed studies on the impact of invading American minks on the original European mink. Sidorovich (1992, 1993) concluded that the competitive dominance of the American mink is the key-factor causing the decline of the original species. The American mink forces the European one to withdraw into suboptimal habitats resulting in fragmentation of the reduced population. This seems to happen presently also in the Tver Region.

In Estonia the American mink invaded the southern part of the country in the 1960's and 1970's, and there are no records of the original species there since the mid 1980's. The early decline here could have been caused by habitat loss, but the northern part remained relatively untouched. The density of the European mink was high in the northern part until the late 1980's, when the American mink spread there. Subsequently, there has been a drastic decline of the European species in five years (Maran 1991, 1994). Maran (1990) and Sidorovich (1992) have predicted that the European mink will be extinct in 5–10 years in Estonia, and in 10–15 years in Belarus, respectively.

Factors not affecting viable populations might contribute to the decline of fragmented low-density populations. It is likely that the premating behaviour of the animals are distorted due to the scarcity of potential mates. This may favor the efforts to breed with the congeneric species and thus accelerate the decline. Similar phenomenon has been reported to occur between wolves (*Canis lupus*) and feral domestic dogs where the wolf density is low (Ryabov 1985).

There are several reports on the narrow ecological niche and high dependence on the running-water of the European mink (Novikov 1939, Novikov 1970, Tumanov & Zverjev 1986). The activity of mink has seldom been recorded farther than 150 meters from the river-bank (Danilov & Tumanov 1976a, b). Furthermore, the European mink occupies new areas very slowly indicating poor dispersal capacity from one water course to another (Novikov 1939, Danilov and Tumanov 1976b).

The European mink seems to be sensitive to environmental change and disturbance. The factors initiating the decline have differed depending on time and region. The underlying causes

earlier seem to have been the habitat loss and excessive hunting, but nowadays the continuous spread of the American mink does not give very much hope for the original European species.

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