European Mink (*Mustela lutreola*) – Estonia

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Conservation status	Global: Critically Endangered EU25: Critically Endangered EE: U1 (x)
Protection status	HD Annexes II & IV Bern Convention: Annexes I & II
EU population (2007-12)	EU: 525 - 732 individuals EE: 35–100 individuals
MS with genuine improvement	EE
Other MS	ES, FR, RO

Summary: The species became endangered in the 20th Century, as a result of hunting for the fur trade, habitat loss and invasive alien species. American Mink threaten all remaining populations, but their eradication on Hiiumaa island, Estonia, has enabled a reintroduction programme to establish a wild population. A Darwin Initiative project and a LIFE project were important in initiating the programme and led to the development of the first Species Action Plan for the species in Estonia. This and subsequent plans have been instrumental in organising and delivering the reintroduction and conservation activities. Also fundamental to the project's success was the involvement of local stakeholders and local publicity. Key measures have included improving the facilities at Tallinn Zoo and the genetic diversity of their captive population; developing better techniques for the period before, during and after releases; and, habitat restoration across Hiiumaa.

Background

Status and EU occurrence

The historical range of the European Mink (*Mustela lutreola*)[1] extended from Finland to east of the Ural Mountains, to northern Spain and the Caucasian Mountains (Maran, 2007; Maran et al, 2016). The species has been extirpated from the majority of its range. Within the EU, small populations persist in France and Spain (albeit showing low genetic diversity) and Romania; and it has been reintroduced in Estonia and Germany (ÖSSM, 2015–16; Maran et al, 2016; LPO, 2017). Elsewhere, it has recently been rediscovered in the Danube and Dniester deltas of Ukraine, while the Russian population has declined sharply. This decline in part reflects the presence of American Mink (*Neovison vison*) across the whole Russian range of European Mink, with the possible exception of the extreme northern and southern periphery (Maran et al, 2016).

In the EU, the European Mink occurs in the Boreal, Atlantic, Mediterranean, Black Sea and Steppic biogeographic regions.

The Romanian population is the most viable, with an estimated 1,000–1,500 individuals in the Danube Delta population, and further evidence of its occurrence in the Carpathian mountains (Maran et al, 2016). The Spanish population is around 500 individuals along c. 2,000 km of river habitat, among which the Atlantic bioregion accounted for 44 individuals in 2012, while the Mediterranean bioregion held 426–558 (ETC/BD, 2014; Maran et al, 2016). In Estonia, the population is 35–100 individuals on Hiiumaa Island (ETC/BD, 2014; Maran et al, 2016). This population is augmented by annual releases of captive-bred animals because it is not yet self-sustaining, and was estimated to number 65 individuals in 2016, of which 75% were born in the wild (Maran et al, 2017). The feasibility of a reintroduction programme on Saaremaa Island was tested in 2012 and 2013 (ETC/BD, 2014; Lutreola Foundation, 2012). In France, numbers are very low, with the core population located in the Charante River Basin (Maran et al, 2016; LPO, 2017). In Lower-Saxony, Germany, a reintroduction project began in 2010, achieving its first European Mink raised in the wild in 2015, while another project began in Saarland in 2006 (ÖSSM, 2015–16; Maran et al, 2016; EuroNerz, 2013; Maran et al, 2017).

[1] Habitats Directive Article 17 code 1356

The European Mink conservation status in 2007–2012 was assessed as unfavourable-bad in the Atlantic, Mediterranean, Black Sea and Steppic regions, and unfavourable-inadequate in the Boreal region (see Annex I). As the only Boreal population is found in Estonia, its status in Estonia is also unfavourable-inadequate, with an unknown trend. Estonia assessed all components of the conservation status as unfavourable-inadequate, i.e. range, population, habitat for the species, and future prospects. Nevertheless, the reintroduction programme represents a genuine improvement for the EU Boreal Bioregion because the species' status was extinct in the wild prior to 2000.

Ecological requirements

The European Mink is semi-aquatic, inhabiting densely vegetated banks of rivers, streams and lakes, the latter only in warmer months. Males can survive in smaller streams, but females avoid these probably because they are insufficient to support the rearing of young. It is rarely found more than 100 meters away from fresh water. It hunts amphibians, crustaceans (crayfish), fish, small mammals, insects and birds on land and in the water. They reach sexual maturity in their second calendar year (Maran et al, 2016; Maran et al, 2017).

Pressures and threats

Maran et al (2016) gives three main factors responsible for the decline of the species:

- over-exploitation for the fur trade;
- habitat loss; and
- the impact of introduced American Mink.

The importance of each has varied with time and region. Wetland drainage and the channelisation of rivers for agricultural purposes lead to declines across Europe, particularly in the mid-twentieth century. Accidental trapping, pollution and hybridisation/competition with European Polecats (*M. putorius*) have also impacted the species (Maran et al, 2016; Maran et al, 2017).

American Mink (which have more valuable fur) were introduced in the wild and escaped from fur farms from the 1920s, when the European Mink population was already depleted and fragmented. They are larger, more ecologically flexible and competitively superior to European Mink, and rapidly filled the empty parts of the latter's range, preventing its recovery. American Mink continue to expand their area of occupancy, except where significant efforts to control it are in place. Strong evidence demonstrates that European Mink are extirpated even by low numbers of American Mink through competition, ecological factors and direct aggression (Maran et al, 2016; Maran et al, 2017; Põdra, Gómez and Palazón, 2013).

In the reintroduced population in Estonia, predation by Red Foxes (*Vulpes vulpes*) and dogs, and to a lesser extent raptors account for over 75% of known deaths, usually within the first 1.5 months after release. Predation is therefore considered to be a pressure of medium importance. However, susceptibility to predation is likely to be influenced by more general failures in adapting to the wild (Lutreola Foundation, 2004; Maran, 2007; ETC/BD, 2014; Maran et al, 2017). Accidental trapping and drowning in illegal crayfish nets, and other human disturbance are also pressures, with human killing responsible for 14% of known deaths, but these are ranked as low importance. Similarly, dredging and channelisation activities are low importance pressures (ETC/BD, 2014; Maran et al, 2017; Maran *pers comm*, 2018).

The most important future threats are considered to be:

- accidental netting in streams;
- wrongly directed conservation measures, causing antagonism with local people; and
- reclamation of land from sea, estuary or marsh (ETC/BD, 2014; Maran *pers comm*, 2018).

Drivers of improvements: actors, actions and their implementation approaches

Organisers, partners, supporters and other stakeholders

Foundation Lutreola was established by the City of Tallinn authorities as a non-governmental body to organise the reintroduction and protection of European Mink in Estonia and achieve wider biodiversity goals. They are responsible for the scientific work and *in situ* activities around the reintroduction programme (Maran *pers comm*, 2018).

Tallinn Zoo are responsible for the European Mink captive breeding programme, which became a focus for the conservation of this species in the 1990s and is now the most important in Europe (Darwin Initiative, undated; Maran *pers comm*, 2018).

In early years, the West Estonian Archipelago Biosphere Reserves' Hiiumaa Centre contributed, but the Estonian Environmental Board (EB) has taken on the nature conservation element of their work and is responsible for protected areas in the country (Maran, 2004; Maran *pers comm*, 2018).

The Ministry of the Environment and EB are fundamental to all work on the reintroduction programme. As an endangered species, all work carried out with European Mink has to fulfil elements of the Estonian Species Action Plan. These state institutions approve and publish all Estonian Species Action Plans, which are prepared in collaboration with experts as seen in the 2010–14 plan (Maran and Põdra, 2009; Maran *pers comm*, 2018).

The European Association of Zoos and Aquaria (Endangered European species Programme) and several specific zoos in Europe and further afield have been supportive (Lutreola Foundation, 2004; Maran, 2004).

Hunters, forestry-owners and other public opinion leaders have been convinced of the importance of the programme through dialogue and some have become involved in delivering or allowing conservation actions. Dialogue has also been maintained with the owners of land containing European Mink habitat, primarily streams (Darwin Initiative, undated; Maran, 2004; Maran *pers comm*, 2018).

Contributions / relevance of strategic plans

Early management guidelines for the species were developed during the Darwin Initiative project for European Mink in Estonia (Darwin Initiative, undated).

The first formal management plan was generated as an output from the LIFE project (Maran, 2004).

The Estonian Ministry of the Environment and Environmental Board have published three Action Plans for European Mink (Ministry of the Environment, undated a):

- Euroopa naarits* (approved 2004);
- Euroopa naarits 2010–2014[#] (approved 2011); and
- Euroopa naaritsa Hiiumaa population*.

Species action plans have been published in other European bioregions (for the Danube Delta and Spanish populations).

Maran et al (2017) advocate the development of an adequately-funded EU-wide Species Action Plan for the species.

Measures taken and their effectiveness

Estonia reported that in 2008 to 2012 the following conservation measures were taken for *Mustela lutreola*.

Application of conservation measures for *Mustela lutreola* for 2008–2012 in Estonia

Measure	Type	Ranking	Inside/outside N2k	Broad evaluation
7.4 - Specific single species or species group management measures	Legal Contractual Recurrent	High	Both	Maintain Enhance Long-term
6.4 - Manage landscape features	Administrative Contractual One Off	High	Both	Maintain Enhance Long-term
6.3 - Legal protection of habitats and species	Legal	High	Outside	Maintain
6.1 - Establish protected areas/sites	Legal	High	Inside	Maintain Enhance

Source: Estonia Article 17 report 2013 at https://bd.eionet.europa.eu/article17/reports2012/

The Estonian Five-year Species Action Plan for European Mink (2010–2014) encompassed four main activities (Maran and Põdra, 2009):

- *ex-situ* conservation in Tallinn Zoo, which aims to maintain an adequate level of genetic diversity among the captive population and translocation of mammals to the wild;
- conservation activities in Hiiumaa to establish the wild population and habitat improvement activities on the island;
- conservation activities in Saaremaa aiming to create a free-living population on this island; and
- dissemination of information – raising awareness among local people and publicity.

The work of the Lutreola Foundation and Tallinn Zoo, boosted by a UK Darwin Initiative project from 1998–2001 and a LIFE project from 2001–2004 has produced improvements in the conservation breeding facilities at the zoo – now the best in Europe for this species – and increased the captive population (Darwin Initiative, undated; Maran, 2004).

American Mink were removed from Hiiumaa as one of the Darwin Initiative project actions (Darwin Initiative, undated). This was an essential prerequisite for success.

The ongoing programme of captive breeding and release of 565 European Mink on Hiiumaa from 2000–2015 has resulted in a population that may be described as 'established', but perhaps not yet self-sustaining. Achieving a viable population has proved a longer term project than stakeholders initially anticipated, which reflects experiences with other endangered mammal reintroductions (Maran et al, 2017). However, releases were stopped in 2017, and subject to the monitoring results in 2018, it is possible that the reintroduction will move to a third phase, which is to address gaps in the genetic diversity of the wild population that can be filled by strategic releases from the captive population (Maran *pers comm*, 2018).

Habitats have been improved on Hiiumaa to support the European Mink population, notably the (re)construction of ponds where amphibians thrive, providing sources of prey and thereby reducing food shortages for the mink (Remm, Lõhmus and Maran, 2014).

Preparatory work for possible release on Saaremaa Island has been carried out, including surveys of American Mink (a rare vagrant here) and of habitat/prey availability. In 2012–13 pilot releases of radio-tracked captive-bred European Mink were conducted. All died within a month, leaving the future of conservation actions on Saaremaa in doubt (Lutreola Foundation, 2004; ETC/BD, 2014; Lutreola Foundation, 2012). However, as a larger island, the extinction risk of a population here would be lower, particularly in combination with Hiiumaa. Therefore it remains a short-term aspiration to restart reintroductions on Saaremaa (Maran *pers comm*, 2018).

Overall, the actions to maintain the genetic diversity of the *ex-situ* population and to develop techniques for releasing captive-bred individuals have become effective. Captive-bred individuals were found to be less able to handle live prey, so this has been provided in captivity in an effort to help prepare mink for release. Post-release predation remains a problem, and attempts to use domestic dogs to train mink to avoid predators while still in captivity were dropped. Behavioural issues with males in courtship situations are a major problem and further work is required to develop ways to increase breeding success among the Hiiumaa population, before it can be considered self-sustaining (Maran, 2004; ETC/BD, 2014; Maran et al, 2017).

Local engagement in advance of each stage of the project has been critical to success (Maran *pers comm*, 2018). For example, the reason for eradicating American Mink was explained to local hunters who initially opposed the proposal, but were brought on board and involved in the eradication work itself (Darwin Initiative, undated). The project team has maintained an ongoing dialogue with local stakeholders and regularly attracts publicity through the mainstream local media, website and social media to project activities. Convincing local opinion-leaders has been an important element of this work, such as forestry-owners who have traditionally opposed conservation policies, but in this instance publicly supported the reintroduction programme. The key issue for landowners is the restriction of activities they are allowed to carry out in streams across their land, but this is resolved through one-to-one contact. It is seen as important in gaining local trust, that the key fieldworker was from Hiiumaa itself. Likewise, a fieldworker from Saaremaa has been identified who it is hoped will become responsible for any future programme on that island. Dissemination activities have been tested with questionnaires in Hiiumaa, revealing that 97% of survey respondents were aware of the project (Maran, 2004; Maran *pers comm*, 2018).

Alongside the publicity, a compensation process was established for losses caused by European Mink. The scheme was designed to include costs beyond the direct price of replacing domestic animals, primarily loss of revenue from eggs for poultry-owners (Maran, 2004; Põdra and Maran, 2003), however it has proved bureaucratic and cases are rare, so the scheme will remain little-used unless it can be streamlined (Maran *pers comm*, 2018).

Funding sources (current and long-term) and costs (one-off and ongoing)

Compensation for the predation of domestic animals by European Mink on Hiiumaa comes from Estonian public funding.

The Estonian Five-Year Species Action Plan (2010–2014) has a projected budget of €1.23 million (Maran and Põdra, 2009). However, the sums actually spent under this budget were typically €20–30,000 per year. This level of funding from the Estonian Environmental Board /Environmental Investment Centre remains in place

subject to a project tendering process, as well as annual payments of around €5,000 from the Estonian Environment Agency for monitoring work. It may be possible to increase the sums available through tendering if the ENVIRONMENTAL BOARD approves more expensive priorities in future Species Action Plans, for example, reintroduction to Saaremaa (Maran *pers comm*, 2018).

The LIFE project had a budget of €373,454 for the period September 2001–December 2004. Half of these funds were from the European Commission, while the remaining funding was from Zoos Help Foundation (the Netherlands), Helsinki Zoo, Rotterdam Zoo and several other zoos and institutions (Lutreola Foundation, 2004). These zoos and institutions continue to provide small but regular amounts of funding to the programme, which is important to the Lutreola Foundation (Maran *pers comm*, 2018).

A UK Darwin Initiative project provided £161,215 (approx. €240,200–268,700) for the period April 1998–March 2001 to prepare the release site and *ex-situ* population for the reintroduction programme, working with national authorities, to release and monitor a founder population and to develop long-term management guidelines (Darwin Initiative, undated).

Captive-breeding work at Tallinn Zoo is funded through the zoo's own income (Maran *pers comm*, 2018).

Future actions:

The Estonian Prioritised Action Framework (PAF) for the Natura 2000 network (Ministry of Environment, 2013) highlights the following conservation priorities for the 2014 to 2020 period:

- Improve the status of freshwater turloughs from U2 to U1, including minimising agricultural pollution
- Compensating farmers for damage caused by the species
- Ex situ species protection actions – reintroduction in Saaremaa
- Restoration of habitats in Hiiumaa, including:
    - riverine habitat
    - turloughs (temporary lakes on karst limestone formations)
- Studies on population genetics

Reintroduction of the species to Saaremaa would greatly enhance the species' viability. This would need to be included in the Species Action Plan and would require attempts to solve the issues experienced with the 2012 releases there (Maran *pers comm*, 2018).

River restoration is planned through the management plan for the West-Estonian River Basin District (Ministry of the Environment, undated b). The use of projects to create riffles and meanders in drainage channels would benefit European Mink, and has been shown to be a low-maintenance, cost-effective tool for improving water quality, in many circumstances (Ayres et al, 2014; Maran *pers comm*, 2018).

Further expansions in the European Boreal bioregion would require significant control of American Mink. The European Environment Agency (2012) notes that developing a sound regulation of the license system and a drastic improvement of the fencing system around fur farms would be needed in order to reduce the risks of further release and possible spread of the species from the farms.

Achievements

Impacts on the target species

The reintroduction of the species into the wild has been achieved, although further work is needed in order to improve the viability of the population – partly because of the poor breeding success rates.

Other impacts (e.g. other habitats and species, ecosystem services, economic and social)

Removal of American Mink may have led to increases in the populations of non-target species. In Finland and the UK, benefits have been demonstrated to wildfowl (especially the rarest species) and European Water Voles (*Arvicola amphibius*), respectively. On Hiiumaa, the benefits to birds and small mammals may be more limited partly because American Mink are replaced with European Mink, and partly because another species that anecdotally seems to have benefitted is the Stoat (*Mustela ermina*), both predators. However, American Mink range more widely than European, so it is possible that Water Voles may have benefitted on Hiiumaa (Maran *pers comm*, 2018).

Artificial ponds and other habitat restoration in hydrologically impoverished forests on Hiiumaa have benefited amphibians and aquatic macro-invertebrates, including species of conservation concern (Remm, Lõhmus and Maran, 2014).

There have been economic benefits through tourism. A small number of well-developed nature tourism companies exist in Estonia and have taken tourists to see signs of European Mink. Several Finnish wildlife groups have made Hiiumaa the subject of excursions with members. In both cases, project staff have presented information to the visitors (Maran *pers comm*, 2018).

Conclusions and lessons learnt

The key targeted conservation measures that led to the improvements

- Elimination of American Mink from an island separated from the mainland sea (22 km)
- Increases in the size of the captive population at Tallinn Zoo and improvements in the facilities for this programme (e.g. naturalistic enclosures)
- Use of on-site enclosures in Hiiumaa and 'naturalistic enclosures' at Tallinn Zoo for pregnant females to raise kits to the natural dispersal age (2–3 months) for release into the wild
- Supporting recent releases (e.g. with shelters) and training of mink prior to release to improve their survival skills (e.g. feeding behaviour) – though the effectiveness of this needs to be tested here; evidence comes from other research
- Supporting strategies for habitat restoration, notably the creation of artificial ponds in which amphibian prey thrive

Conservation measures that have not been sufficiently effective

- Release of pregnant females directly into the wild (kits died)
- Release of kits hand-reared in captivity until the natural dispersal age (erratic behaviour)

Factors that supported the conservation measures

- Long-term development of a Species Action Plan for European Mink in Estonia, starting with management guidelines, through to the Management Plan generated during the LIFE Project, and finally National Plans published by the Ministry of the Environment/Environmental Board
- Actions to raise the awareness of and maintain a dialogue with local people in advance of each of the key stages of the project
- The local origin of the key fieldworker, who is from Hiiumaa

Factors that constrained conservation measures

- Predation by Red Foxes, domestic dogs and raptors, probably Ural Owls (*Strix uralensis*) and/or Northern Goshawks (*Accipiter gentilis*).
- The primary challenge for achieving a viable population is low mating success. Only 11% of captive born males successfully bred during their lifetime. Analysis showed that lack of interest in the female or aggression towards her to be prevalent behaviours likely to be causing this problem
- Expansion of the reintroduction beyond islands free of American Mink would be challenging because of that species' presence
- The introduction of a law, which gave the State the first right of refusal when land of conservation value is put up for sale, was erroneously linked to the European Mink reintroduction by the Estonian media. This caused considerable local antagonism for a year or two.
- Limited available time – conservation measures of this type require more time than was thought at the start – at least ten years.
- Further transfers into the Tallinn Zoo population will be needed to broaden their genetic diversity.

Quick wins that could be applied elsewhere for the species

- There are no quick wins. This project is an example of long-term, coordinated action delivering results. A key lesson learnt is that mammal reintroduction takes a long time.

Examples of good practice, which could be applied to other species

- The gradual development of an evidenced-based Species Action Plan/Management Plan, initially generated through project work, and then incorporated into government action for biodiversity has contributed to the longevity and coherence of conservation action for this species. Implementation of

these plans has been a driver of success in the case of the European Mink in Estonia's Boreal Bioregion. This assessment accords with an analysis by Barov and Derhé (2011) which indicates that well-resourced and coordinated implementation efforts can deliver species recovery, especially with the involvement of LIFE funding.

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Authorship

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Annex 1. *Mustela lutreola* conservation status at Member State and biogeographical levels

Favourable	FV	Unknown	XX	Unfavourable - inadequate	U1	Unfavourable - bad	U2

Qualifier (+) improving (-) deteriorating (=) stable (x) unknown (n/a) not reported

	2001-06			2007-12		
	Overall	**Range**	**Population**	**Habitat for the species**	**Future**	**Overall**
ES (ATL)	XX	FV	U2	U2	U2	U2 (-)
FR (ATL)	U2	U2	U2	U1	U2	U2 (-)
EU overall (ATL)	U2	U2	U2	U2	U2	U2
RO (BLS)	n/a	FV	XX	FV	XX	XX
EU overall (BLS)	XX	FV	U2	FV	XX	U2
EE (BOR)	U2	U1	U1	U1	U1	U1 (x)
EU overall (BOR)	U2	U1	U1	U1	U1	U1
ES (MED)	XX	FV	U1	U2	U2	U2 (-)
EU overall (MED)	XX	FV	U1	U2	U2	U2
RO (STE)	n/a	FV	XX	FV	XX	XX
EU overall (STE)	XX	FV	U2	FV	XX	U2

Source: Member State Article 17 reports as compiled by ETC-BD on EIONET https://bd.eionet.europa.eu/article17/reports2012/

Annex 2. LIFE Nature Projects that aimed to help conserve *Mustela lutreola* in Estonia

Project Title	Project N°	MS
Recovery of *Mustela lutreola* in Estonia: captive and island populations	LIFE2000NAT/EE/7081	EE

Source: LIFE Programme database, projects with species = 'Mustela lutreola' or '*Mustela*' listed as a key word/free text