Management Plan

of the European Mink *Mustela lutreola*

in Hiiumaa (2004–2008)

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INTRODUCTION

This management plan was drawn up in conformity with the requirements set out in the Management Plan for the European Mink (2000–2004) and in EU LIFE project "Recovery of the European mink in Eestis: captive and island populations". The aim of the plan is to describe and prioritise the risk factors that could hinder the formation of a European mink population in Hiiumaa and, taking into account these factors and on the basis of both the existing information and the outcome of additional studies, to provide an in-depth analysis of further conservation needs of the European mink population to be established in Hiiumaa. The action plan for the protection of the European mink covers the years 2004–2008.

As reintroduction of the European mink in Hiiumaa was already underway at the time of drawing up this plan, also the activities already implemented are introduced for the sake of integrity.

The Management Plan consists of three parts. The first part provides an overview of the geography of Hiiumaa, of the habitats and food resources available there. The quality of habitats is addressed in great detail, incl. the biota of water courses, availability of shelter, access to water in winter, etc. Species ecology and global state of the European mink is discussed and an overview given of minks already released in Hiiumaa and of their survival rate, home ranges a. o. ecological aspects. The second part deals with conservation management of the species. It gives an overview of possible risk factors that might inhibit the formation of a viable mink population. On the basis of the risk factors and the present state of minks in Hiiumaa, management objectives and actions are provided. The third part presents a plan and budget for implementing the management activities.

The management plan is significantly comprehensive and the budget for management activities is relatively big for one species. It must be taken into account that, as the European mink is a semi-aquatic carnivore, its well-being depends on the quality of water courses in Hiiumaa. The European mink is a so-called umbrella species: improvement and conservation of its habitat conditions will guarantee the survival of the entire aquatic life. Also, the specific geography of Hiiumaa makes the island almost the only region in the world where the European mink could survive in the wild.

The following studies were ordered for the preparation of the management plan:

1. "Comparative assessment of the state of fish fauna in the water courses of Hiiumaa" – by Mart Kangur (2003) (in Estonian);
2. "State and development possibilities of the crayfish population in Hiiumaa" – by nature conservation society Lutra, responsible person Nikolai Laanetu (2002) (in Estonian);
3. "Theoretical considerations in restoring the amphibian spawning ponds on Hiiumaa" – by Amphi Consult (Lars Briggs, 2003);
4. "Legal basis of conservation management of the European mink" – by Uudo Timm (2003) (in Estonian);
5. "Historical review of drainage" – by MTU Koduajaloo Keskus, responsible person Vello Kaskor.

The studies are available at the Administration of Hiiumaa Protected Areas (in Kardla) and in Foundation Lutreola (Tallinn).

SUMMARY

The European mink *(Mustela lutreola)* is a semi-aquatic small carnivore belonging to the Mustelid family. Its historical range covered almost the entire European mainland. The European mink is an endemic European species although the historical range of the species reached slightly across the Ural Mountains. Only a few rapidly declining populations of the species have preserved to date. If the current factors remain in effect, the European mink is likely to become extinct within a few decades. In Estonia, the species began to disappear after World War II and the latest confirmed finding dates from 1996.

The causes of extinction of the species have differed between regions and between different periods of time. While at earlier times the decline was mainly caused by over-hunting and destruction of habitats, the main reason today is aggression by a widely spreading alien species – the American mink. The three factors intensify one another.

In Estonia the European mink is a protected species of category I. It is listed in annexes II and IV of the EU Habitats Directive and in Appendix II of the Bern Convention. The International Red Data Book (2003) regards the European mink as an endangered species. The species is likely to face rapid extinction unless active species conservation measures are taken. One of the possibilities to ensure survival of the species is establishment of island populations.

Hiiumaa has proved suitable for establishing an island population of the European mink due to its size, natural conditions and geographic location. The American mink population that formerly inhabited the island, having formed on the basis of fur farm escapees, was removed in 1998–2000. Re-introduction of European minks into the wild in Hiiumaa started in the year 2000. In 2000-2003, the total of 172 animals from the Endangered Species Centre of Tallinn Zoo have been released on the island.

In the period of establishing the European mink population in Hiiumaa, the main risk factor has been the high mortality of animals during the adaptation period (mostly due to falling victim to other carnivores). In future, once a self-sustaining population has formed, it can be endangered mostly by the following factors: (1) re-formation of a population of the American mink (re-establishment of a mink farm or formation of a new population on the basis of invaders from the mainland), (2) scarcity of habitats and small size of population (demographic and genetic risks), (3) big and abrupt variation of environmental conditions. The most important factors related to habitats are (1) limited food resources (uneven distribution and great fluctuation of the abundance of amphibians, poor condition of fish and crayfish) and (2) scarcity of shelters. Habitats have been damaged by large-scale drainage works, which has resulted in deterioration of the ecological condition of inland water bodies.

The primary protection objective is the formation and maintenance of a viable population of the European mink. Taking into account the species ecology of the European mink and the described risk factors, several sub-objectives have been derived: strengthening of the forming population, securing of a sufficient quantity of habitats, reduction of the impact of carnivores, prevention of possible impact of the American mink, maintenance of positive public attitude, securing of effective and long-term management of the established population.

Management activities to achieve these objectives are divided into three categories. The highest priority is given to strengthening of the forming population, restoration of habitats and preservation of their natural quality, organisation of monitoring of American mink and prohibition of establishment of farms, organisation of consistent monitoring of the European mink, designation of core habitats and establishment of protection regime therein (incl. designation of Natura 2000 sites). Also the creation of a job for a species conservation expert to ensure long-term management of the mink population, and establishment of the Coordination Committee for European Mink Protection, are of high priority

The total cost of the activities is EEK 4 314 200, of which EEK 3 924 200 is the cost of

activities of higher priority. A significant part of the total expenditures will be spent on captive breeding of European minks and improvement of habitats in Hiiumaa in 2004–2008 a. Uncovered costs are expected to be funded mainly from foreign aid (possibly the EU LIFE programme), but also with funds from the Environmental Investment Centre and the State Budget.

1 GENERAL PART

1.1 General description of the island.

1.1.1 Geography

Hiiumaa is an island in the Baltic Sea with an area of 1019 km² and a coastline of 326 km. The nearest distance from the mainland is 22 km, from other bigger islands (Vormsi and Saaremaa) – 9 km and 5 km, respectively. The extreme points have the following coordinates:

north	59°50`	22°35`
south	58°41`	22°34`
east	58°45`	23°10`
west	58°56`	22°20`

As of 2001, the island had a population of 11 335 (11.1 inhabitants/km²). The settlement structure consists of three small towns and 182 villages (www.hiiumaa.ee).

Forest covers 69% of the island. There are 11 protected landscapes and 4 nature protection areas in Hiiumaa, covering 11.7% of the total area of the island. Zones with a strict protection regime (special management zone and strict nature reserve) cover 8.7% (www.hiiumaa.ee) and mires appr. 7% of the island's area (Marvet, 1974). The biggest mires are Pihla (3050 ha) and Ongu or Tihu (1200 ha) (Valk, 1988).

1.1.2 Fauna

The fauna of Hiiumaa includes 196 species of breeding birds (Leito & Leito, 1995), 33 mammal species (Jeeser, 1974, Ernits jt, 1984; Klein, 1992; Maran, 2000a; Masing, 2001) 5 amphibian and 4 reptile species (Kiili, 1996). The inland water bodies of Hiiumaa host 14 fish species, also crayfish occurs in relatively low numbers (Jarvekulg, 2001; Laanetu, 1998; Kangur, 2003).

In addition to the European Mink, the mammal fauna of the island includes at least 8 carnivore species – weasel (*Mustela nivalis*), stoat (*Mustela erminea*), pine marten (*Martes martes*), otter (*Lutra lutra*), raccoon dog (*Nyctereutes procyonoides*), red fox (*Vulpes vulpes*), lynx (*Felis lynx*) and wolf (*Canis lupus*). Earlier there occurred also polecat (*Mustela putorius*) and American mink (*Mustela vison*) on the island (Klein, 1992; Maran, 2000a). The fauna of semi-aquatic mammals includes, besides the European mink and otter, also beaver (*Castor fiber*) (Maran, 2000a), northern water vole (*Arvicola terrestris*) and water shrew (*Neomys fodiens*) (Ernits a.o., 1984; Klein, 1992). At least 8 species of small rodents have been recorded in Hiiumaa – house mouse (*Mus musculus*), yellow-necked mouse (*Apodemus flavicollis*), bank vole (*Clethrionomys glareolus*), common vole (*Microtus arvalis*) and field vole (*Microtus agrestis*), northern water vole (*Arvicola terrestris*), brown (Norway) rat (*Rattus norvegicus*) and red squirrel (*Sciurus vulgaris*). Two species of insectivorous small mammals have been recorded – common shrew (*Sorex araneus*) and water shrew (*Neomys fodiens*) (Ernits a.o., 1984; Klein, 1992). An overview of mammal species of Hiiumaa is given in Annex 1.

Of the possible competitors and predators of the European mink among the local bird fauna (big birds of prey), at least 9 bird species are recorded (Leito & Leito, 1995). Eagles and the eagle owl occur in low numbers – in 2001 there were 7–8 breeding pairs of white-tailed eagle (*Haliaetus albicilla*) in Hiiumaa, one pair of golden eagle (*Aquila chrysaetos*), one or two pairs of eagle owl (*Bubo bubo*) (data of Hiiumaa Environmental Department). The most common birds of prey are Ural owl (*Strix uralensis*), common buzzard (*Buteo buteo*), northern goshawk (*Accipiter gentilis*), northern harrier (*Circus cyaneus*), Montagu's harrier (*Circus pygargus*) and marsh harrier (*Circus aeruginosus*) (Leito & Leito, 1995).

Amphibians are represented in Hiiumaa by five species. Common frog (*Rana temporaria*), moor frog (*Rana arvalis*) and common toad (*Bufo bufo*) are relatively common (Podra, unpublished). Also natterjack toad (*Bufo calamita*) (Leito, 1995, Kiili, 1996, R. Rannap pers. comm., 2002) and common newt (*Triturus vulgaris*) (Kiili, 1996) have been recorded. Reptiles are represented by common viper (*Vipera berus*), grass snake (*Natrix natrix*), slow worm (*Anguis fragilis*) and common lizard (*Lacerta vivipara*) (Kiili, 1996; Podra, unpublished).

The following fish species are recorded in the inland water bodies of Hiiumaa: pike (*Esox lucius*), perch (*Perca fluviatilis*), ruffe (*Gymnocephalus cernus*), sea trout (*Salmo trutta*), burbot (*Lota lota*), eel (*Anguilla anguilla*), three-spined spickleback (*Gasterosteus aculeatus*), nine-spined spickleback (*Pungitius pungitius*), roach (*Rutilus rutilus*), dace (*Leuciscus leuciscus*), ide (*Leuciscus idus*), sunbleak (*Leucaspius delineatus*), carp (*Carassius carassius*) and tench (*Tinca tinca*), of Cyclostomata – lamprey (*Lamperta fluviatilis*) (Laanetu, 1998, Jarvekulg, 2001, Kangur, 2003). Populations of crayfish (*Astacus astacus*) exist in four water courses (Laanetu, 2002; Podra, unpublished).

1.1.3 Inland water bodies as habitats

Habitats suitable for the European mink are found on 40 bigger ditches, streams or rivers of Hiiumaa. The total length of these water courses is 326 km and drainage area – 792.6 km (Arukaevu, 1986). In addition, there are appr. 100 km of bigger drainage ditches in Hiiumaa (measured from a topographic map 1 : 50 000). A big part of the water courses of Hiiumaa have been dredged and only a few lower course stretches have preserved in their natural state (appr. 57 km in total, as measured from a map). There are no clear watersheds, the rivers are relatively small and water-scarce. The discharges measured in summer and spring of 1969–1976 remained below 6.7 l/s (Kangur, 2003). Only 10 water courses are longer than 10 km, with the longest of these (21 km) being the river Luguse (Arukaevu, 1986). In the years of draught, the upper courses of some rivers and some smaller water courses dry up completely.

According to L. Veering (1974), Hiiumaa has 13 lakes with a total area of 189.7 ha. However, some smaller lakes are not included in this number and the actual number is somewhat bigger. The total length of shoreline is appr. 25 km, measured from a map of 1 : 10 000 (EELIS – Information System on Estonia's Nature). Many lakes have disappeared or are disappearing because their water level has been lowered by drainage. Lakes are located mainly near the coast and constitute former inlets. Only the three Tihu lakes are located in the central part of the island. An overview of the bigger ditches, streams, rivers and lakes of Hiiumaa is presented in Figure 1.

The water courses and lakes of Hiiumaa are strongly influenced by drainage. The first major drainage works were carried out in the middle of the 19th century, when the water level of lake Undama was lowered and the same area was thoroughly ditched. In the period 1923–1940, drainage societies established 24 main ditches with the total length of over 160 km. Also forest drainage was actively dealt with at the time. After World War II, the existing main ditches have been dredged several times and new recipients (142.5 km in total) have been made. In 1966–1992, the total of 13402.4 ha was drained, having an effect on recipients (Annex 2). In 1971–1991, forest drainage was carried out in 10396.3 hectares (Kaskor, 2003).

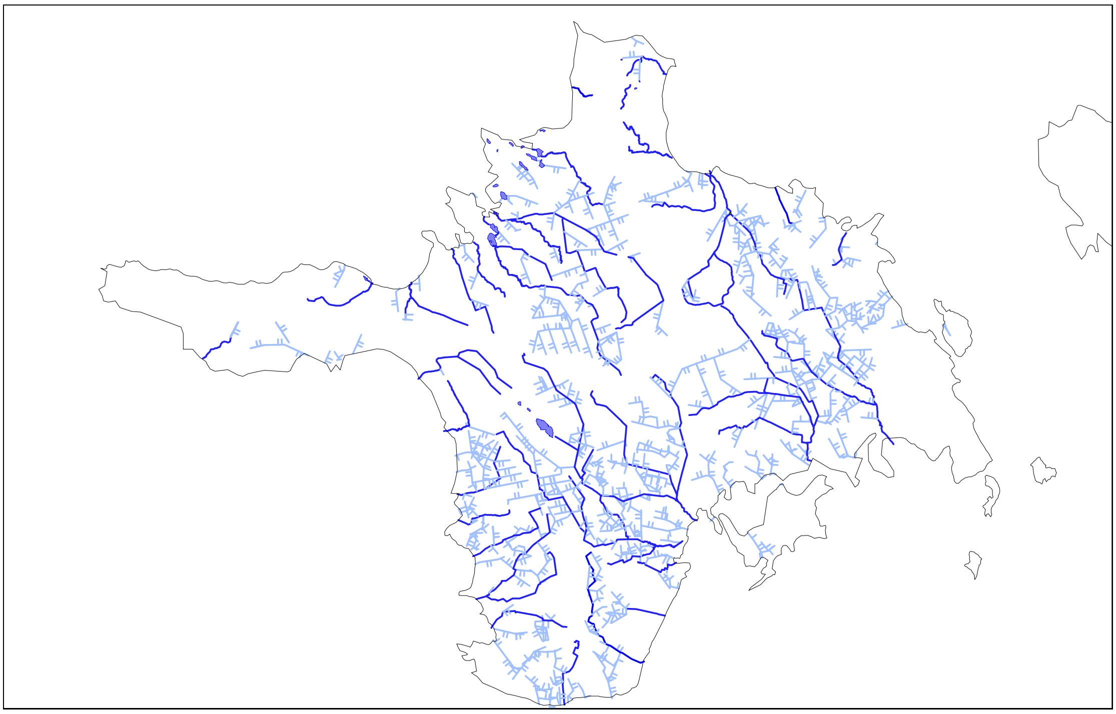


Figure 1. Inland water bodies of Hiiumaa

1.2 Species ecology of the European mink

1.2.1 Morphology

The European mink has a smooth and glossy brownish-black coat. Lower and upper lips are white (the American mink has white on its chin but rarely on the upper lip), sometimes there are white patches also on the chest and abdomen, very rarely feet are white, too. Tail blunt-tipped. Distinguished from polecat by evenly dark colour and absence of face mask. Feet slightly webbed. Sexual dimorphism in size: males are bigger and heavier than females. Head-body length 13–16 cm in males, 31–35 cm in females. Tail-length 13–16 cm in males, 12–14 cm in females. Hind-foot length 5–6 cm. Condylo-basal length 53–65 mm. Weight: males 650–1100 g, females 448–600 g. Dental formula 3/3, 1/1, 3/3, 1/2 = 34.

1.2.2 Systematics

The European mink belongs to the Mustelid family (*Mustelidae*), weasel genus (*Mustela*). This genus includes 16 species (Wilson & Reeder, 1993), of which 5 occur in Estonia. In evolutional terms, the closest species are western polecat (*Mustela putorius)*, steppe polecat (*Mustela eversmanni*) and Siberian weasel (*Mustela sibirica*) (Youngman, 1982).

Intra-specific systematics of the European mink is still somewhat unclear. G. A. Novikov (1939) analysed the earlier approaches to intra-specific systematics of the species and, on the basis of museum collections of the former Soviet Union, identified 6 sub-species (Table 1). According to his analyses, Estonia should be part of the range of the subspecies *Mustela lutreola borealis* V. G. Heptner et al. (1967) analysed largely the same materials and drew up a somewhat different list of subspecies, incl. slightly different range borders (according to this analysis, the subspecies occurring in Estonia is *M. l. novikovi*). However, the authors consider it likely that the distinguished subspecies do not exist in reality. The most recent study comes to the same conclusion. Ph. M. Youngman (1982) states that the different forms identified as subspecies by earlier authors are associated with clinal variability of characteristics within a continuous range and thus there exist no subspecies.

As it is essential in today's nature conservation that global protection goals of species are formulated as precisely as possible (Maran, 2003, in print), there has arisen the important question of whether the European mink as a species can be regarded as one evolutionary significant unit or several intra-specific units (regardless of whether they are named subspecies or something else) the preservation of each of which is equally important. There is no final answer to this question yet but the studies carried out to date give us reason to claim that there are no considerable differences between the French and Spanish populations. The studies carried out so far have not been able to establish a difference between the West-European (French/Spanish) and East-European populations either, other than the nearly complete lack of genetic diversity in the West-European population, which probably indicates that the population has passed several "bottlenecks". However, the authors suggest that the West-European and East-European populations should be regarded as two separate evolutionary significant units (ESU) from species conservation point of view until more thorough studies are completed.

Table 1.

Described subspecies of the European mink (*Mustela lutreola*)

Subspecies
Mustela lutreola lutreola
Mustela lutreola borealis
Mustela lutreola caucasica
Mustela lutreola cylipena
Mustela lutreola hungarica
Mustela lutreola biedermani

1.2.3 Breeding

The oestrum of the European mink lasts from late March to early May. Gestation lasts for 42 days. The young are born between mid-May and the second half of June. In rare cases, another litter may be born in late July if the first breeding fails. Average litter size is 4 (1–8). Although captive-bred European minks can live for nearly 10 years, their breeding is limited by the significantly short reproductive age of females (3–4 years). This allows them to participate in the regeneration of the population only in three or four breeding seasons (Maran, unpublished).

1.2.4 Diet

The diet of the European mink consists mainly of amphibians, fish and small mammals, but also invertebrates (e.g. crayfish) and birds (Table 2). The share of different food components depends on habitat, season, abundance and availability of prey, and individual preferences (Danilov & Tumanov, 1976; Maran et al., 1998, Sidorovich et al., 1998). In most cases, amphibians prevail in the European mink's diet and other food components are less important (except for a study conducted on a trout river in North Estonia, where the diet of the species included a lot of fish).

Table 2.

Diet of the European mink (*Mustela lutreola*) according to different authors.

Prey item	Sidorovich et al., 1998	Danilov & Tumanov, 1976	Maran et al., 1998
Small mammals	14.5%	30.3%	12.0%
Birds		12.4%	6.0%
Amphibians	56.5%	46.3%	29.9%
Fish	26.6%	29.2%	70.1%
Crustaceans (crayfish)	10.9%	17.1%	18.8%
Insects		34.2%	13.2%
Birds/reptiles	3.5%		
Molluscs			1.3%
Vegetable components		6.4%	

In climate conditions similar to those in Estonia, seasonal dynamics and inter-habitat and individual differences in the European mink's diet have been studied in Belarus, seasonal dynamics to some extent also in Russia.

Seasonal dynamics. From spring to autumn, the European mink's diet consisted mainly of amphibians (up to 73.5% by biomass, depending on the season), to a smaller extent of small mammals (up to 24.3%), fish (up to 16.4%) and crayfish (up to 9.2%). In summer the share of amphibians decreased (45.2%) and that of fish and, to some extent, crayfish increased to 35.2% and 12.5%, respectively (Sidorovich et al., 1998). P. I. Danilov & I. L. Tumanov (1976) note that in winter the share of amphibians was smaller than in winter, while the share of small mammals was bigger in winter.

Diet in different habitats. Amphibians (*Rana* sp.) form the biggest part of European mink diet on streams (56.8% by biomass), on fast-flowing small rivers (60.4%) and on main drainage ditches (81.2%). Relatively small quantities of fish (9.4–15.8%) and crayfish (0–10%) were eaten in these habitats – these water courses are less suitable as fish and crayfish habitats. On slow-flowing small rivers and, in particular, on lakes, the share of amphibians is smaller (36.2% and 14,5 %, respectively), in these habitats the animals eat more fish (15.8% and 31.6%) and crayfish (22.2% and 31.5%). The share of small mammals was highest on streams – 28.3%, in other habitats it remained between 5.7% and 14.1% (Sidorovich et al., 1997).

According to a study on **individual differences** in the diet of the European mink (9 specimens), specialisation was observed in at least four specimens: three specialised in eating amphibians (61.6–87.6% by biomass) and one in eating crayfish (61.1%). In the remaining five animals specialisation was not observed but in the diet of three of them the share of amphibians was relatively high – 21.5–54.6%. (Sidorovich et al, 2001).

The home ranges of the so-called "frog specialists" (and also those "generalists" who fed largely on amphibians) were located mainly on streams or small fast-flowing rivers. "Crayfish specialists" lived mostly on the banks of slow-flowing rivers or lakes. This division confirms the results of the study on the diet of the European mink in different habitats, according to which amphibians are the main prey items primarily on streams and fast-flowing rivers. "Frog specialists" showed no significant seasonal changes in their diet, while in the diet of "crayfish specialists" (and one "generalist") the share of amphibians increased in spring and in autumn, which coincides with the results of seasonal dynamics (Sidorovich et al, 2001).

In summary – the most important food items of the European mink are amphibians, particularly on smaller water bodies and in cold seasons. Fish and crayfish prevail in its diet on lakes and slow-flowing rivers, where they are more abundant. A study conducted in Estonia shows that on trout rivers even fish may prevail in the European mink's diet. The share of fish and crayfish is higher in summer, when the water level of rivers is low and minks inhabit also the banks of lakes. Small mammals are more abundant in the mink's diet in autumn and in winter, and mainly on small streams poor in fish and crayfish.

1.2.5 Habitats

The European mink inhabits different water courses together with an up to 200 metres wide riparian zone (Danilov & Tumanov, 1976). Its preferred habitats are small forest rivers and streams with rapids that do not freeze in winter, but also stretches of bigger rivers near the mouths of small rivers or streams (Danilov & Tumanov, 1976, Sidorovich, 1997a).

According to studies conducted in Belarus (Sidorovich, 1997a), the occurrence of the European mink on water bodies correlates with such features as current velocity and discharge, sinuosity of river bed, height of bank and presence of forest vegetation, occurrence of beaver settlements, quantity of shelters, etc. In the most difficult period – in winter – minks are found mainly in beaver settlements, in areas of rapids, near the mouths of other rivers, etc. Such places are also the main hibernation places of one of its most important prey items, the common frog. The home ranges of minks who inhabited the banks of lakes in summer were located mostly near the mouths of watercourses.

The population density depends largely on habitat type. The best overview of population density by different types of water body is presented in a study conducted in Belarus (Sidorovich, 1997a) (Table 3).

Table 3.

Population density of the European mink (*Mustela lutreola*) in different habitats

Habitat type	Density (ind./10 km of bank)
Big rivers (>100 km)	2–6 (average 3.6)
Small fast-flowing rivers	6–10 (average 8.6)
Small slow-flowing rivers	2–6 (average 4.3)
Streams (2–10 km)	< 4 (average 2.5)
Streams (<2 km)	A half inhabited by one individual
Lakes (summer)	0–6 (average 3.1)
Main ditches	< 2
Old main ditches, in forest	1–3

The highest population density occurs on small fast-flowing rivers, followed by big rivers and small slow-flowing rivers. European minks are less common on lakes (in summer) and on small streams and main ditches. They are not found on lakes in winter due to the lack of access to water. Access to water is difficult in winter also on slow-flowing rivers and main drainage ditches (Sidorovich, 1997a).

According to Belarussian studies (Sidorovich, 1997a), male and female individuals prefer different types of water body. On streams (up to 10 km), mostly males are found, while females are mostly found on small rivers and lakes and never on streams. It is likely that small streams do not provide enough food resources for raising a litter, as the main prey item there are amphibians, which are less important in the European mink's diet in summer. Lakes and rivers are richer in fish and crayfish, which constitute important additional food resources (next to frogs) for the European mink in summer, when females raise their young (see p. 12).

1.2.6 Competitors

The competitors of the European mink are other carnivores and bigger birds of prey. The most important competitors are other semi-aquatic carnivores, such as otter, polecat and American mink.

The **otter** (*Lutra lutra*) uses similar habitats as those of the European mink, i.e. water courses and (in summer) lakes but its optimum habitats are bigger rivers (Sidorovich, 1997a) – different from the European mink, whose optimum habitats are small rivers or streams (Table 3). Compared to the European mink, otters eat more fish and crayfish, which are more abundant in bigger rivers (Sidorovich & Pikulik, 1997, Jedrzejewska et al. 2001; Podra, unpublished), while the diet of the European mink contains more rodents and amphibians (see p. 12). Amphibians are most important in otter's diet on main drainage ditches (Sidorovich & Pikulik, 1997) and on small fast-flowing rivers (Jedrzejewska et al. 2001) but these are not optimum habitats for the otter. Summarising the above, the European mink and the otter have somewhat different preferences for habitat and prey and competition between the two species therefore cannot be very strong (both are native species in our region and have evolutionally co-adapted to the local semi-aquatic conditions). The European mink, being a smaller carnivore, is probably able to find shelter more easily and has better access to water in winter.

For the **polecat** (*Mustela putorius*), optimum habitats are riparian areas, especially river floodplains (Sidorovich, 1997a). Compared to the European mink, the polecat eats more rodents, less amphibians and rarely (only in summer) fish and crayfish (Sidorovich et al., 1997). Amphibians are more important in polecat's diet in spring. According to Belarussian studies, no aggression has been observed between polecats and European minks in case they use the same habitats (Macdonald et al, 2002) but hybrids have been found, especially in the period when the European mink reached the verge of extinction (Maran et al., 1998).

The **American mink** (*Mustela vison*) originates from North America and was introduced in Europe in 1920ies–1930ies (Maran & Henttonen, 1995). Compared to the previous two species, it inhabits similar habitats and has essentially the same diet. The American mink eats slightly more rodents and fish and less amphibians than the European mink. Its preferable habitats are small rivers (in particular, slow-flowing rivers with a broad floodplain), less frequently streams, in summer it can often be encountered on lakes (Sidorovich, 1997a). Being a larger and more aggressive carnivore, the American mink competes the European mink out of its habitats, causing the decline of the kin species. During the invasion of the American mink, European minks (mainly males) have survived longer on small streams, which are insignificant habitats for the American mink. However, the food resources available there do not allow female European minks to raise their young. Litters have been encountered only on rivers and lakes, which are richer in food (Sidorovich, 1997b, 2000; Macdonald et al., 2002). Therefore the invasion of the American mink causes the European mink to disappear from the area in just a few years.

Other carnivores (stoat, weasel and raccoon dog) or big birds of prey can be regarded as food and habitat competitors for the European mink to some extent but they are less important competitors. There have been a few cases where European mink has been killed by a fox, lynx, dog or golden eagle (see p. 15).

1.2.7 Mortality

Being a small animal, the European mink has a short life span and is characterised by a high mortality of both the young and adults. The existing data suggest that an average litter of a captive-bred European mink consists of 4 young (Maran, unpublished). According to a study conducted in Russia, the average size of a wild-born litter was 4.7 and by the time of dispersal it had decreased to 3.5 (Danilov & Tumanov, 1976). Thus, these data suggest that the mortality rate of the young from birth to maturation is 25.5%. In Belarus (Sidorovich, 1997b), 4 embryos were found on an average in one European mink, the average size of up to two-week-old litters was 3.8 and month-old and older litters consisted of the average of 2.3 young. Thus, the mortality of young between the age of up to two weeks and over one month was 36.8%. Consequently, the moratlity of kits younger than one month was 36,8%. It has been suggested that females prevail in litters but among the adults of a population the sex ratio is almost equal. Higher mortality of females has been explained by the exhaustive effect of pregnancy and raising of young – the fat-accumulation period in autumn remains too short and the animals are unable to survive the winter (Danilov & Tumanov, 1976). However, the data on captive-bred animals do not confirm the prevalence of females in litters (Maran, unpublished).

According to a study carried out in Russia, Leningrad region, animals under the age of one year form 36.6% of a population, 1-2-year-olds – 30.8%, 3-year-olds – 17,2% and those older than 3 years – 15.4%. In Pskov region, up to 1-year-old specimens formed 29% of the population. Average life span of females was 2.6 and that of males – 3.7 years (Danilov & Tumanov, 1976). Also the data of V. E. Sidorovich (1997b) suggest that the average life span of females is shorter than that of males.

No special studies have been conducted on winter mortality of the European mink. Thus there are no specific data. The observations in Hiiumaa indicated that the average winter mortality from November/December to March was 20.1%. In three winters (2000/2001, 2001/2002 and 2002/2003) there lived 19 specimens in Hiiumaa in November-December (4♀, 13♂, 2?) and 15 of these survived by March (2♀, 13♂) (Podra & Maran, unpublished). Mortality was higher among females. It is likely that an increase in intra-specific competition will increase also winter mortality. The number of animals was considerably higher in summer than in late autumn but, as the population is under restoration, comparison between summer and winter mortality does not show the natural dynamics of population in this case (mortality is very high during the first post-release weeks and months).

The most important potential causes of death in Hiiumaa are likely to be other carnivores, hunting (with dogs) and fishing gear placed in rivers. Incidents of deliberate killing (near houses) or road kills cannot be fully excluded either.

Observations in Hiiumaa suggest that the European mink is endangered mostly by foxes and dogs but smaller females can fall victim also to the Ural owl or buzzard (see p. 34). Dogs may kill European minks mostly in human settlements, stray dogs also in woods. A study by A. K. Tishechkin and V. E. Sidorovich (1997) indicated that small carnivores, such as polecat, European and American mink, have been found in the diet of wolf, lynx, red fox, eagle owl and golden eagle.

In the course of hunting, European minks can get killed by dogs or through random shooting without determining the game species. Fishing gear poses a danger mostly in spring (on trout rivers in autumn and on burbot streams in winter) when they are placed to catch the fish that come to spawn in the rivers. A mink (also otter or beaver) that dives after a fish may easily drown in a net.

Deliberate killing may occur in cases where the European mink comes to human settlements and causes damage there (e.g. by killing chicken). Road kills are likely to be infrequent due to low traffic (see p. 39).

The causes of death established in Hiiumaa to date are presented on p. 34.

1.3 Description of the habitat conditions of the European mink in Hiiumaa

1.3.1 Potential capacity of habitats

The rivers and streams of Hiiumaa are largely dredged and straightened for the purpose of land improvement or forest drainage. Natural stretches have preserved to some extent mostly in lower courses, while middle and upper courses are mainly canalised. Of natural river beds, which are the best habitats for the European mink in Hiiumaa, appr. 33 km (17%) have preserved (mainly in lower courses). Smaller streams flow in their natural beds for the total of 24 km, the remaining water bodies are straightened rivers, streams and main ditches (appr. 269 km or 83%) (measured in the EELIS computer programme).

A study conducted in Hiiumaa in 2000 yielded that the average size of the European mink home range was 3–4.2 km; home ranges were located in optimum habitats (Podra, 2002). As the study covered a long period (both summer and autumn) and was conducted in the conditions of nearly lacking intra-specific competition for habitats, it can be expected that, once the population is established, the home ranges (in the same conditions) will be smaller. This result is relatively similar to that of a Belarussian study which yielded that the average population density of the European mink in similar habitats – streams of 2–10 km and bigger main ditches – was 2.5 and 2 specimens per 10 km of bank, respectively. Population density was higher on small rivers: 4.3 ind./10 km on slow-flowing rivers and 8.6 ind./10 km on fast-flowing rivers (Sidorovich, 1997b).

The results of the studies in Hiiumaa allow for theoretical estimation of the capacity of habitats in Hiiumaa. Considering the established average size of home ranges in summer 2000 and the total length of bigger watercourses, **80–109 specimens** could live on the bigger water bodies of Hiiumaa in summer. In summer the European mink may live also on bigger forest drainage ditches, where its population density remains below 2 specimens per 10 km of bank, or on lakes – 3.1 specimens per 10 km (Sidorovich, 1997a). There are appr. 100 km of bigger drainage ditches in Hiiumaa (measured from topographic map 1 : 50 000) and appr. 25 km of lake bank (measured in computer programme EELIS). Thus the total potential population size in summer can be estimated at **88–159 specimens**.

However, the real population size may differ from the estimate for the following reasons:

- the study was conducted in Hiiumaa during a long period (summer-autumn). Therefore the animals moved between different home ranges and the capacity may be over-estimated;
- the study was conducted in the conditions of almost complete lack of intra-specific habitat competition and animals could have used a bigger home range than indispensable.
- the European minks studied in Hiiumaa did not inhabit the different habitat types proportionally and generalisation of the result for all water bodies of the island may cause a relatively big deviation.

Next to getting an idea of summer abundance, it is even more important to ascertain the potential winter abundance, which is the year's lowest and thus of critical importance. The results of a study carried out in Belarus, in habitat types similar to the water courses of Hiiumaa, can serve as a basis (Sidorovich, 1997a). On the basis of these results, the potential size of the Hiiumaa European mink population in winter can be estimated at **50–92 specimens at the minimum** (Table 4).

Table 4.

Potential size of the population of the European mink (*Mustela lutreola*) in different fluvial habitats in (based on the results of a Belarussian study).

Type of water body	Average density in Belarus	Total length of bank	Abundance of European mink in the respective habitat type in Hiiumaa
Natural river, fast-flowing	8,6 ind./10 km	33	14–28
Natural river, slow-flowing	4,3 ind./10 km		
Natural stream	2.5 jnd./10 km	24	9–10
Dredged river or bigger main ditch	1–2 ind./10 km	269	27–54
Total		326	50–92

This is a very conservative estimate because the nature of habitat types in Hiiumaa differs from that in Belarus. For instance, the best crayfish rivers in Hiiumaa (Laanetu, 2002) largely belong to the type of main ditches. Thus the population density of European minks on main ditches should prove higher than 1 ind./10 km and the total size of population will therefore be closer to 92 than to 50. However, such very good habitats that could support a high population density are relatively scarce in Hiiumaa. The majority of the water courses suitable for the European mink (dredged stretches of rivers and streams, main ditches) have a more modest capacity. As the water courses have small drainage areas, they face a great danger of drying up in extreme years, or freezing to the bottom or suffering from the lack of oxygen in winter.

1.3.2 Food resources

1.3.2.1 Amphibians

There are 5 amphibian species recorded in Hiiumaa – common frog (*Rana temporaria*), moor frog (*Rana arvalis*), common toad (*Bufo bufo*), natterjack toad (*Bufo calamita*) and common newt (*Triturus vulgaris*) (see p. 9). The so-called brown frogs – the common and moor frog – have an important role in the European mink's diet. The former seems to be more abundant near watercourses. In 2000–2003, 53 spawning sites of frogs located in the vicinity of water courses were studied (Figure 2). The occurrence of common frog was established in 32 of these sites and the occurrence of moor frog in 14 places. Common toad was less frequent.

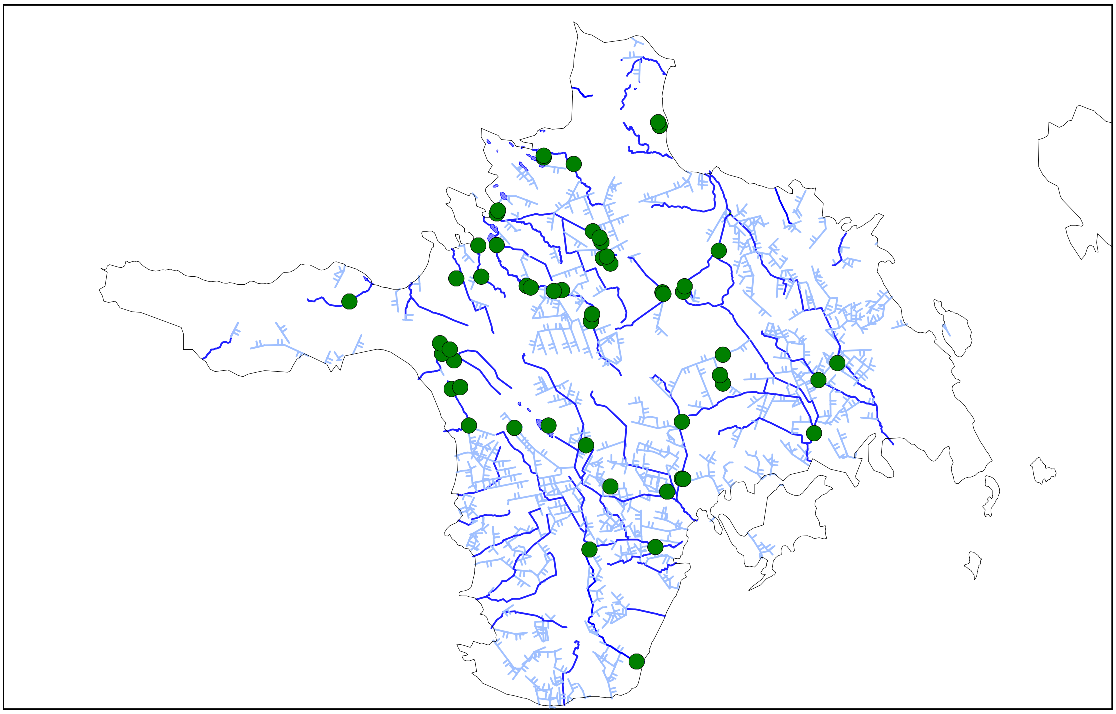


Figure 2. Spawning sites of frogs found in Hiiumaa in 2000–2003.

V. E. Sidorovich estimated the population density of the common and moor frog in different habitats of Hiiumaa in August of 1999. The highest density was observed in wet forests, on the banks of water courses and in dry forest types dominated by spruce, while the lowest density was observed on the seashore, in dry pine forests and in grasslands (Macdonald et al., 2002). The results by habitat types were as follows:

banks of water courses 0,37±0,10 ind./10m²

seacoast 0 ind./10m²;

dry forest types dominated by pine 0,02±0,01 ind./10m²;

dry forest types dominated by spruce 0,33±0,11 ind/10m²;
wet forests 0,61±0,34 ind./10m²;
dry grasslands 0,07±0,05 ind./10m²;

Estimated on the basis of these data and personal experiences (locations of spawning sites, visual observations), amphibians are more abundant on rivers and streams flowing entirely or partly through forest expanses (moister habitat types), such as Ongu stream, Armioja, Pihla and Kidaste streams, rivers Nuutri and Luguse. Frogs are relatively abundant also on wooded stretches of Jausa stream, river Vaemla and river Suuremoisa and in the middle and upper course of river Vanajogi (the lower course runs mostly in dry pine forest).

1.3.2.2 Fish fauna

In order to get a good overview of the fish fauna of the watercourses of Hiiumaa, an additional study was conducted in the summer of 2002 under the leadership of Mart Kangur within the framework of preparing the management plan. Catches were sampled from 16 rivers (Figure 3, Annex 3), species and size composition and age structure of fish fauna was determined, catch sites were described and the state and perspective of fish fauna was analysed.

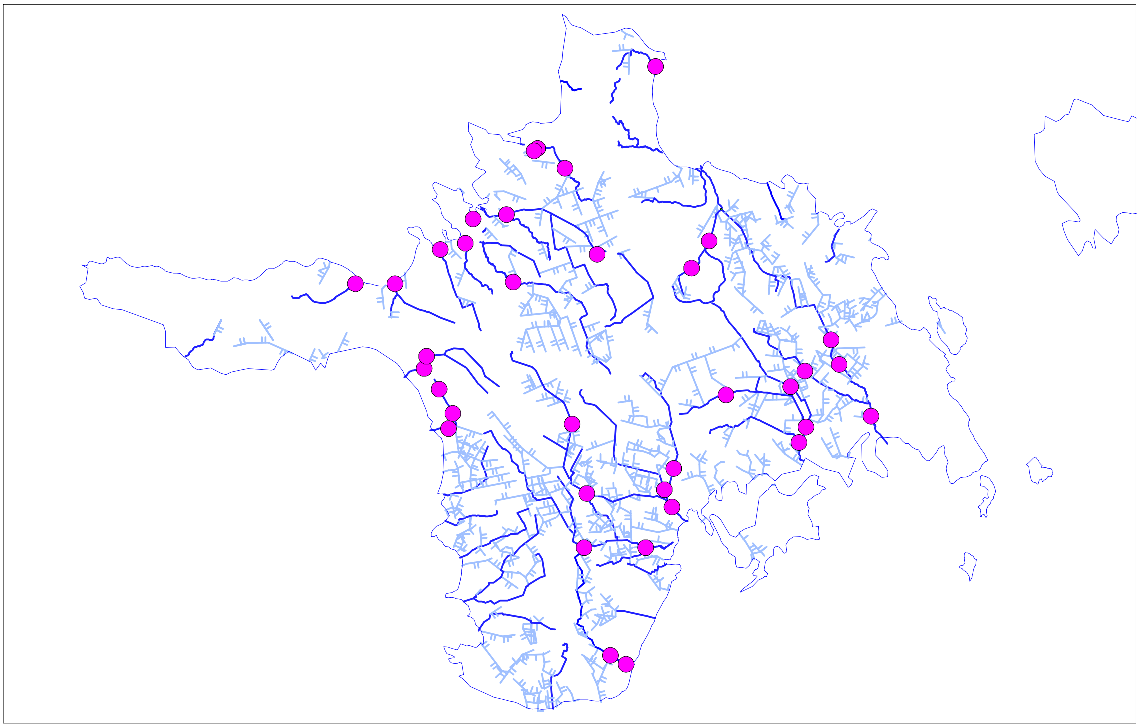


Figure 3. Catch sampling sites of the 2002 study of fish fauna in Hiiumaa.

The fish fauna of freshwater bodies of Hiiumaa is rather species-poor. The most common fishes are pike, roach, nine-spined and three-spined spickleback. The real migratory fishes are sea trout, lamprey and eel. No eels have been caught during catch sampling, records of lamprey are scarce, too, but it can be claimed that the species comes to spawn at least in all the same water courses where also sea trout spawns.

Sea trout regularly spawns in the river Vanajogi and in Ongu stream. It reaches the other streams (Poama, Paope, Luidja, Lehtma, Tareste) only in favourable autumns (higher discharge, high level of sea water). There are confirmed data on the occurrence of sea trout in Armioja and its occurrence in Nuutri is likely.

In spring, also pike, roach, dace, ide and (less abundantly) perch and ruffe come to spawn in the rivers and streams. Migration of perch into rivers has declined, probably due to the general decline of the species in the Vainameri sea. The main spawning rivers of cyprinids and pike in Hiiumaa are rivers Suuremoisa, Vaemla and Luguse and Jausa, Kidaste, Pihla and Armioja streams. Roach and ide may rise at least to middle courses. In spring, also burbot comes to spawn from the sea, more abundantly into the river Suuremoisa and Kidaste stream. Each water body where burbot was caught during catch sampling has also a permanent population of burbot in addition to migratory burbot.

According to the population density, the rivers of Hiiumaa are poor in fish in summer. Density of trout is high in Vanajogi and quite high also in Ongu stream. In Nuutri, the population density of brown trout is lower but biomass may reach 150 g/10 rm.

Summer abundance of pike may be as high as 7–8 individuals per 100 m², especially where specimens of the same summer are concerned. In better biotopes the density is 1–2 pikes (biomass up to 400 g) per 10 rm. However, in most cases the density and biomass is one pike and 100 g per 20 rm (in pike-roach rivers).

The population density of burbot in good biotopes is up to 10 but usually 1–2 ind/100 m², the biomass averages 30–40 g per 10 rm.

Migratory roaches that had remained in the river were found in summer usually in small groups consisting of a few specimens, 3–4 fish per 100 rm on an average, the biomass was 100–500 g per 100 rm.

The highest biomass of all rivers was recorded in August 2002 in Armioja and Vanajogi: 438 and 303 g per 10 rm, respectively. Biomass per 10 rm exceeded 100 g also in the river Nuutri, in the middle course of Luguse and in the lower courses of Prassi ditch and Jausa stream. In most cases the biomass remained below 100 g, ranging from 2 g (Luidja) to 94 g (Pihla).

Quantitative data on the distribution of trout, pike and burbot in Hiiumaa are rather similar to the relevant data from smaller water courses of the mainland. Roach is usually more abundant on the mainland but in this case it is not migratory.

The state of fish fauna of the water courses in Hiiumaa is influenced mainly by the hydrological regime.

1.3.2.3 Crayfish

The results of studies (Laanetu, 2002) confirm that the inland waters of Hiiumaa are in a poor state in terms of both their geomorphological and other ecological conditions. The water bodies have lost much of their quality as spawning sites of fish and as crayfish habitats. This deterioration has been caused by human activities, in particular land improvement, forestry and agriculture.

According to the data of 2002, crayfish occurred on the river Luguse and its tributaries, in the lower course of Tulimurru main ditch, in the middle courses of Vaemla, Suuremoisa and Jausa rivers (in the latter, most of the population died in August 2002 because the river dried up), in the middle course of Armioja stream (here the population died already in July due to low water level and dredging of the upper course), single specimens were found also in the lower course of Pihla stream and the river Poama. Crayfish occurred also in Prassi quarry, where the species was populated in 1997 (Figure 4). A more detailed overview of the state of crayfish and of the condition of water bodies is given in Annexes 4 and 5.

Regardless of the efforts to restore the crayfish population (Figure 4), the species has survived only on the water bodies that offer suitable habitat conditions.

The main ecological factor that limits the distribution of crayfish on the water bodies of Hiiumaa is instability of hydrological conditions of water bodies, which is due to the small size of catchment areas and density of drainage networks. Ditching has decreased also the diversity of flowing water habitats, which has led to the impoverishment of the entire aquatic fauna. The population of crayfish has considerably decreased. In order to preserve the species and restore its stock, it is necessary to restore the diversity of flowing water habitats and to stabilise the hydrological regime.

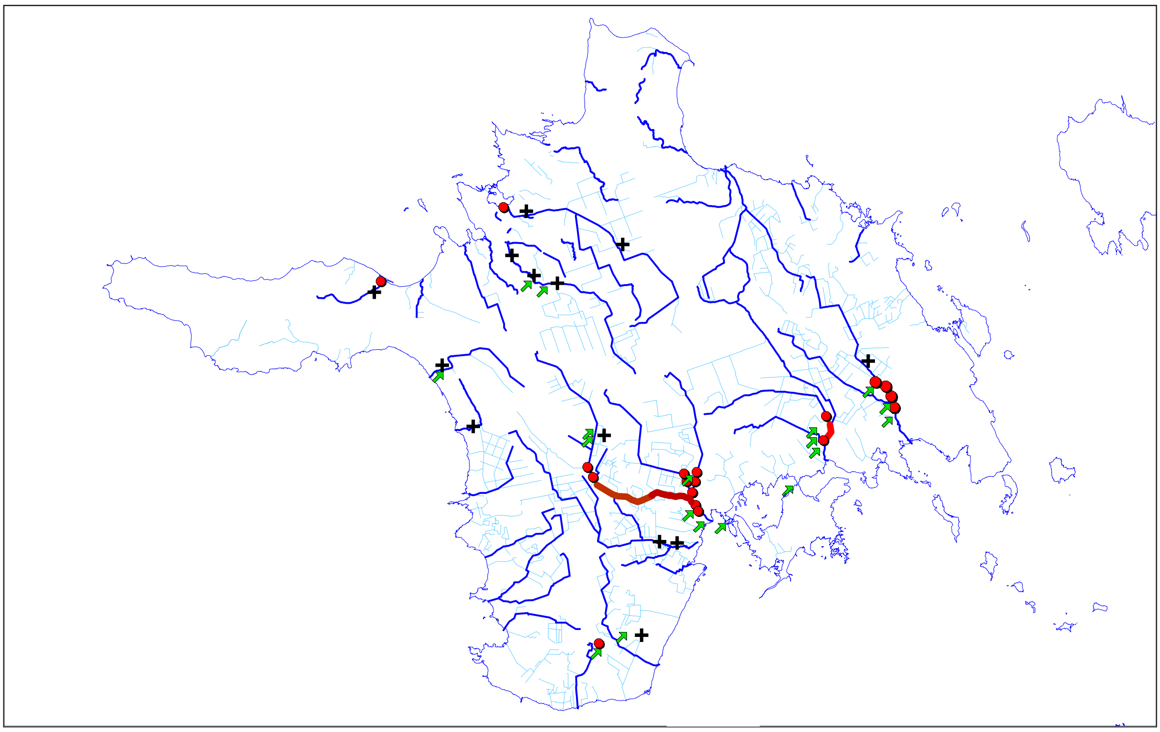


Figure 4. Distribution and introduction of crayfish in Hiiumaa

Legend: distribution and relative population density of crayfish in Hiiumaa in 2002.

Abundant

Less abundant

Sites of earlier occurrence or death due to drying up of water bodies

Areas of re-stocking

The results of assessment of water bodies revealed that areas suitable for crayfish are found only in the middle and lower courses of rivers. In the lower courses, suitability of water bodies for crayfish is often decreased by the influence of sea water. In most cases, however, the limiting ecological factors are abrupt fluctuations of water level, low discharge and periodical drying of water bodies. To decrease these negative impacts, it is recommended that riffles, weir rapids and stream-narrowing deflectors be installed and pools excavated to stabilise the water regime and to increase the habitat diversity of water bodies (Annexes 9, 10 and 11, pp. 57–63). More attention should be paid to renovation and putting into operation of the existing lock regulators and to the development of riparian woody vegetation, which helps to partly inhibit plant proliferation in the stream bed. Many of the works have been planned in the framework of the Hiiumaa fish spawning sites rehabilitation project (Maa ja Vesi, 2002; Laanetu, 2001).

Based on the suitability of the water courses of Hiiumaa as crayfish habitats, the stock of crayfish in the case of optimum abundance could be 45 to 50 thousand specimens, except specimens aged 0+ and 1+ (Annex 5). Assessment of crayfish habitats yielded that there is the total of 5~~0~~100 km of water bodies suitable for crayfish but the current range covers only slightly more than 10 kilometres.

1.3.2.4 Small mammals

Small mammals are typical food items for the European mink. Nine species have been recorded in Hiiumaa (See p. 8).

The most common species in riparian biotopes are water vole and water shrew, in forested areas – common shrew, bank vole and yellow-necked mouse, in grasslands – voles. In summer, also brown rat and house mouse can be met in riparian areas further off from human settlements but for winter period they move back to the vicinity of human settlements (Aul a.o., 1957).

Several small mammals that are common on the mainland (such as striped field mouse, pygmy shrew and harvest mouse) have not been recorded in Hiiumaa although suitable habitats exist here (Ernits a.o., 1984, U. Timm, pers. comm.).

During the autumn school of the Estonian Theriological Society in 1982, seven species of small mammals were caught: common shrew (*Sorex araneus*), water shrew (*Neomys fodiens*), yellow-necked mouse (*Apodemus flavicollis*), house mouse (*Mus musculus*), bank vole (*Clethrionomys glareolus*), field vole (*Microtus agrestis*) and common vole (*Microtus arvalis*), three species were caught on the bank of a forest river (*Sorex araneus, Neomys fodiens* ja *Clethrionomys glareolus*). Abundance and distribution data from this study are of a rather general kind (Ernits a.o., 1984).

L. A. Harrington (MacDonald et al., 2002) carried out five 24-hour catches in the riparian biotopes of upper courses of Tihu ditch and Pihla stream in 1999. The trap line consisted of 25 traps placed at a one-metre distance from the water line at the interval of 10 m. Three species were caught – *Clethrionomys glareolus*, *Microtus agrestis ja Apodemus flavicollis*, all in relatively low numbers. Catch rate was 4–8% on Tihu ditch and 23% on Pihla stream.

U. Timm carried out catches on 27–28 August 2002 and caught 6 species of small mammals (unpublished data). Catches were made in riparian biotopes of bigger water courses, the total of 8 trap lines were installed, each consisting of 25 traps located at a 10-metre interval. The most abundant species was *Sorex araneus* (13), less abundant were *Clethrionomys glareolus* (4), *Microtus agrestis* (4), *Neomys fodiens* (3), *Apodemus flavicollis* (2) and *Microtus arvalis* (1).

Data concerning the abundance and density of mammals in different habitats in Hiiumaa are clearly insufficient and require additional research.

1.3.3 Shelter possibilities

Shelters available in the riparian biotope play an important role in the habitats of the European mink, like in those of any other semi-aquatic animal (e.g. otter). Being a small carnivore, the European mink needs suitable shelters to protect itself from other carnivores (fox, dogs, large birds of prey) but shelters are important also as shapers of its feeding conditions because hiding places available under tree roots are used by various small mammals and amphibians (on the bank) and by crayfish, burbot, hibernating frogs, etc. (in the water). In addition to its main den, the European mink needs also other dens for temporary stay. In most cases these are located in the bank, between tree roots, more seldom in hollow trees, between stones, etc. (Danilov & Tumanov, 1976).

The density of shelters suitable for the European mink on the water courses of Hiiumaa was assessed by an expert analysis within the framework of drawing up this management plan. Where the European minks had already formed their home ranges, shelters actually used by the animals were taken into account additionally. Density of shelters was assessed in three categories: high, medium and low. In total, 212.2 km of bank of 27 water courses was assessed (Annex 6) using the following parameters:

1. type of water body – natural or dredged
   1.1 dredged water body – dredged recently or long ago (recovering)
2. existence of woody vegetation on the bank – yes/no
   2.1 woody vegetation – young, middle aged or old
3. height of bank – low or high
4. occurrence of other shelters – bridges, beaver dens, etc.
5. existence of buildings/facilities on the bank – roads, houses, etc.

The water courses of Hiiumaa are largely dredged, especially in the area of middle and uper course. Natural steams and rivers have preserved mostly in lower courses. Natural condition and shelter density are clearly interconnected. Shelter density was **low in 106,8 km**

(50,3%), **medium in 79,8 km** (37,6%) and **high in 25,6 km** (12,1%) of water courses (Figure 5).

Water courses with better shelter possibilities and suitable for the European mink are located in forest landscapes. Such water courses are the river Nuutri (with Tubala stream), river Vanajogi, Ongu steam, Kidaste stream, Pihla stream ja Lehtma stream. Good shelter possibilities are available in lower courses (their natural stretches) of the river Luguse (together with Rebasselja stream and lower course of Tulimurru main ditch), river Jausa and Armioja stream and in the middle course of Tammela stream. Stretches with poorest shelter possibilities are located mostly on canalised rivers running through agricultural landscapes.

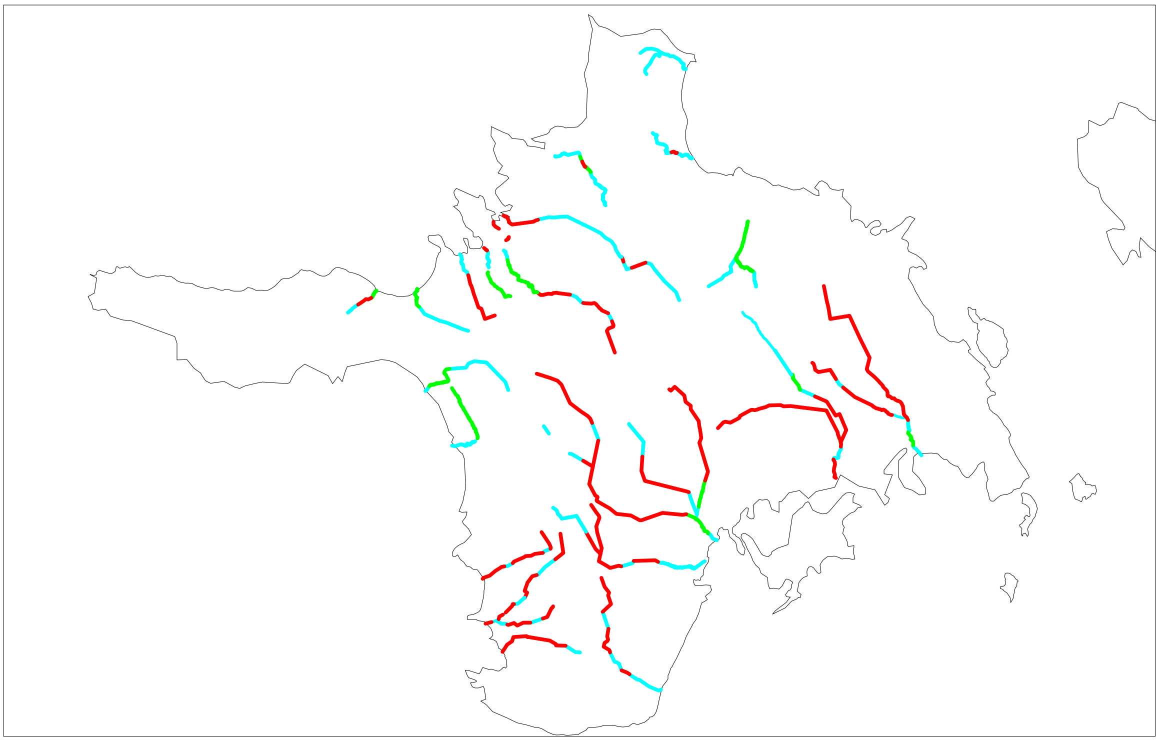


Figure 5. Shelter possibilities of the European mink (*Mustela lutreola*) on the water bodies of Hiiumaa, assessed in 3 categories: ——— low ——— medium ——— high

1.3.4 Access to water in winter

In our climate zone it is important that the habitats of the European mink offer possibilities for access to water in winter. When water bodies freeze, minks stay in the area of fast-flowing or spring-fed stretches of river (Danilov & Tumanov, 1976), where it is easier to get under the ice for prey. Such areas are best suitable also as hibernating places for the most important prey item of the European mink – the common frog (Sidorovich, 1997a).

Access to water in winter was assessed in the winter of 2002/2003 on 23 water bodies of Hiiumaa (199.4 km in total). Possibilities of access to water were divided into two categories: good or bad. The assessment was based on the existence of open water due to stream velocity or springs, and also on discharge and the structure of bank – access to water is easier on banks that offer good shelter possibilities, while ditches and streams with smaller discharge may freeze to the bottom and animals cannot find prey there. Division into two categories is sufficient because the extent of freezing varies between years

Access to water in winter was regarded as **good in 53.8 km** (27%) and as **bad in 145.6 km** (73%) of water courses. Conditions for getting under the ice were better on rivers and streams with a higher gradient and a natural streambed, or in stretches (lower courses) with abundant shelters and varying stream velocity. Access to water in winter is relatively good on the river

Nuutri, on Tammela main ditch, river Vanajogi, Ongu stream, Armioja stream, Pihla stream and Kidaste stream. As the cold winter of 2002/2003 followed a dry autumn and access to water was very difficult for the European mink and other semi-aquatic mammals, this estimate characterises the minimum conditions. In years of medium water level and medium temperature, access to water in winter is likely to be easier.

A more detailed overview of the possibilities of the European mink for access to water in winter on different water courses is presented in Figure 6 and Annex 7.

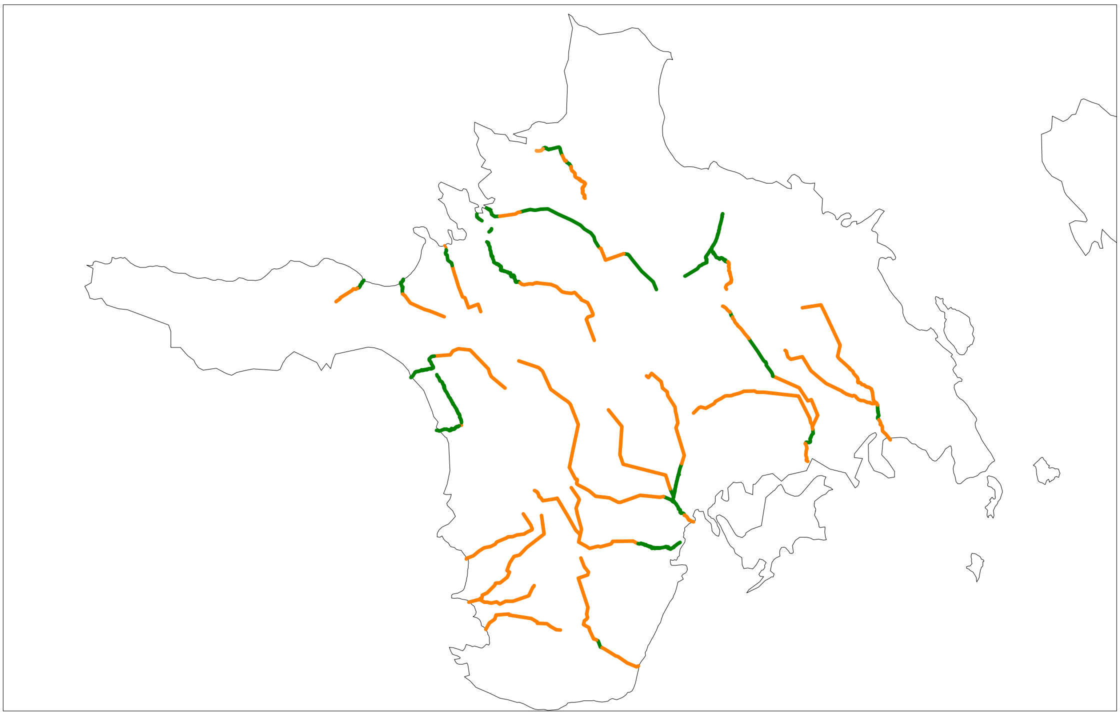


Figure 6. Winter access of the European mink (*Mustela lutreola*) to water on the water courses of Hiiumaa, divided into two categories: good bad

1.4 State and protection of the European mink on global level and in Estonia

1.4.1 Global state

1.4.1.1 Earlier distribution in Europe

At the end of the 18th century, the European mink *(Mustela lutreola)* had a nearly continuous distribution in all of the European mainland (Novikov, 1939; Heptner et al., 1967; Youngman, 1982; Maran & Henttonen, 1995). In the east the range bordered on the Urals, although some data suggest that it has reached also a little eastwards from the Ural mountains. In the north, the range reached central Finland. There are no data, however, on the spreading of the European mink across the Gulf of Bothnia, to Scandinavia. Southernmost data on the species originate from early 19th century, when the species inhabited the mountain streams of the eastern coast of the Black sea. The western border of distribution reaches the provinces of eastern Spain and western France (Lode, 2001; Chanudet & Saint-Girons, 1981; Palomares, 1991). It is interesting that both in Spain and in France the occurrence of the European mink was discovered relatively recently: in France in the middle of the 19th century and in Spain only in 1951. This has caused a lot of discussion on whether the European mink is a newcomer in these areas or a surprisingly lately discovered native. Currently the opinion that the European mink is a newcomer on the Iberian peninsula and in France tends to prevail (Michaux et al., in print).

There are no data on earlier occurrence of the European mink from Norway, Sweden, Denmark, Portugal, Spain and Belgium. Only historical records from the years 2300– 2100 B.C. are known from the Netherlands (Bree, 1961a, b).

1.4.1.2 Decline of the range

Changes in the range of the European mink have been addressed in great detail in literature (Maran 1994; Maran & Henttonen, 1995; Maran et al., 1998; Lode, 2001). Earliest data on extinction of the species originate from the middle of the 19th century from central Europe – Germany, Switzerland, and a little later also Austria. In early 20th century disappearance of the species was noticed in Poland, Hungary and Czech and Slovak areas. By 1930–50 the European mink had disappeared from the territory of these countries.

In Finland, Estonia, Latvia and Lithuania the species became extinct in the second half of the 20th century, in Belarus it is on the verge of extinction just now. In Finland the species was considered to be extinct already in the 1950ies and, although one specimen was caught surprisingly in 1992, the species can be regarded as extinct from the middle of the 20th century. In Latvia the last known specimen was captured in 1993 (Ozolins & Pilats, 1995) and in Lithuania in 1978/79. In Estonia the last specimen was captured in 1996 near Arukula. Small and declining populations still exist in the north-east and south of Belarus.

Insufficient data are available on the Ukraine, Moldova, Romania and Georgia. In the Ukraine the decline of the species began in late 1950ies and only a few populations had survived in the Carpathians by the 1980ies. In Moldova the species began to decline in the 1930ies and by the 1980ies only a few relic populations still existed on the banks of the river Prut along the Romanian border. In Romania the European mink was probably still abundant even as late as the 1960ies. To date there is confirmation on its survival only in the delta areas of the Danube (A. Kranz, pers. comm. 2003). From Georgia there are data on the European mink's occurrence from early 20th century. The current state has not been assessed but local zoologists consider it extinct.

In the European part of Russia the European mink was still a common game animal at the beginning of the 20th century. In early 1950ies its disappearance was noticed in many regions and there were active disputes on the reasons and extent of this phenomenon in Russian scientific literature (Ternovskij, 1975; Ternovskij & Ternovskaja; 1988, Tumanov & Zverjev, 1986). An overview of the state of the European mink in the Soviet Union, prepared in early 1980ies, revealed drastic changes in all regions except the Tver region. At the beginning of the 1990ies a similar overview was published on the European mink's state in the protected areas of the Soviet Union (Maran, 1992), revealing the further extent of the change: of the 33 protected areas where information was gathered, the European mink had become fully extinct in 16, its state was critical in 13 and the population was stable in only four protected areas. The study was repeated in 1995 (Maran et al. 1998), revealing that the rapid decline of the species in protected areas continues. A study conducted in 1994 (Sidorovich & Kozhulin, 1994) in the Tver region, which used to be regarded as one of the core areas of the European mink, revealed that even here the European mink has survived in only a third of its further range (Katchanovsky, pers. comm., 1999).

Although some more recent information has been received on the current range of the species in the eastern regions of Russia, the state of the populations is still critical in these regions, too (Saveljev & Skumatov, 2001).

In France and in Spain there is an isolated range reaching from south-western France to northern Spain. During the last decade the French population has been declining with an increasing speed (Maran & Henttonen, 1995). The Spanish population, however, has broadened its range towards the south(Ruiz-Olmo & Palazon, 1990). At the same time, recent data indicate that the American mink has reached the range of the European mink. This gives a reason to believe that decline of the Spanish population will soon accelerate (Santiago de Palazon, Ruiz-Olmo, Sisco Manas, pers. comm., 2003).

Figure 7 gives an overview of the former and current distribution of the European mink.

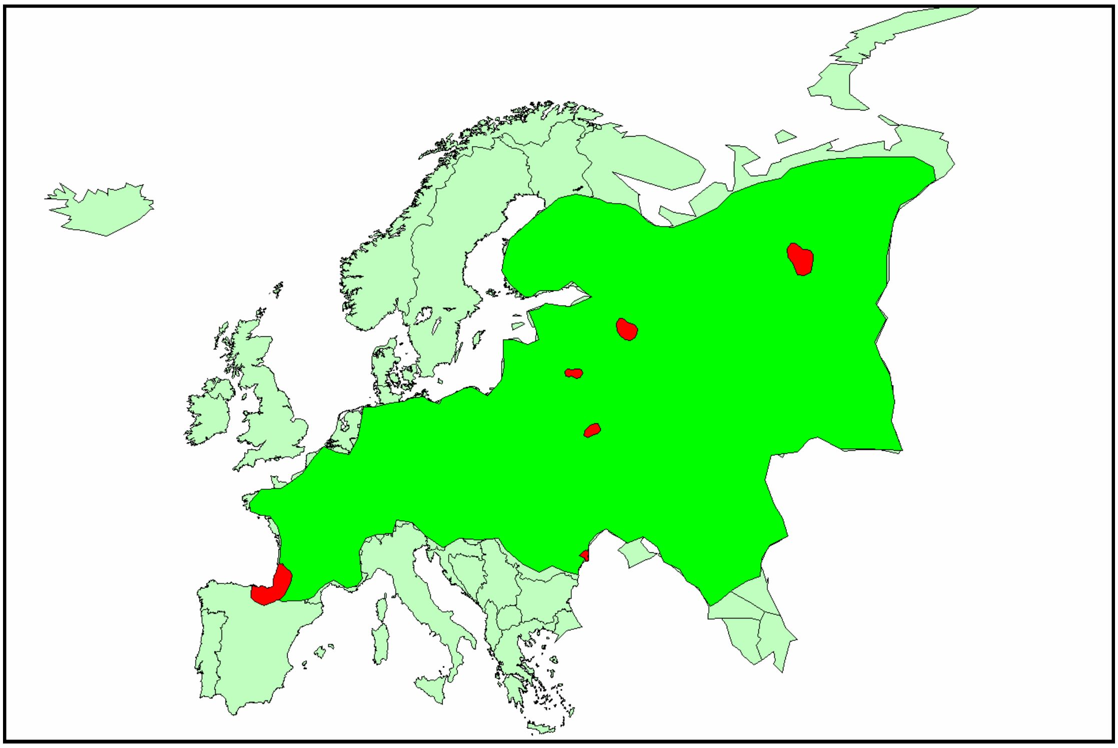


Figure 7. Former (green) and estimated current distribution (red) of the European mink (*Mustela lutreola*).

1.4.1.3 Current distribution in Europe

Only one viable population of the European mink is known to have survived to date in Europe – in Spain. The European mink is known to occur in the following administrative units: Castilla y León (Soria, Burgos), La Rioja, Navarra, Basque (Alava, Guipuzcoa and Vizcaya). However, in several of these the first sign of the process of decline have already been observed. The decline is associated primarily with the invasion of the American mink *(Mustela vison)* in the range of the European mink (Santiago de Palazon, Ruiz-Olmo, Sisco Manas, pers. comm., 2003).

In France the species is rapidly declining and has preserved in only 7 regions: Gironde, Landes, Charente, Charente-Maritime, Pyrenees Atlantiques, Lot-et-Garonne and Dorgogne (Maizaret, 1998). It has been estimated that it has preserved in France on only 978 km of water courses. (Lode, 2002)).

There is evidence of the occurrence of declining fragments of European mink population in Russia and Belarus (Sidorovich, pers. comm., 1999, 2001; Katchanovsky, pers. comm., 1999). Confirmation has been received on preservation of a European mink population also in a limited area of Danube delta in Romania. (Gotea & Kranz, 1999; A. Krantz, unpublished 2003).

In summary, the European mink has preserved in less than 5% of its former range (Figure 7) and the range is declining ever more rapidly. It has been estimated that the species will become extinct within the next few decades unless the protection measures taken on pan-European level yield the expected results already in near future.

1.4.2 Protection on the global level

The first steps were taken for the preservation of the European mink as a species in Russia in the 1970ies, when Dr. V. Ternovski initiated captive breeding of European minks at the Biological Institute of Novosibirsk. Although the main and official goal was to obtain new and valuable breeds of fur animals by cross-breeding different mustelids, the actual main objective was to avoid extinction of the European mink by captive breeding and by later establishment of new populations of the species on two islands of the Kuril archipelago in the Soviet Far East – Kunashir and Iturup. Unfortunately the formerly very successful breeding activities in Novosibirsk have ceased by now and release of a founder group of a few hundred animals on two islands did not result in the formation of viable populations: the species has disappeared by now on both islands. There have been several explanations to this. The most likely reason seems to be the fact that it was a single action which failed to overcome the effect of high mortality on the population and - critical abundance was not reached.

Currently there are several activities under way or planned in Spain and Germany. In 2000 French conservationists launched projects aiming at preventing the invasion of the American mink into the habitats of the European mink (in particular on the river Ebro) and establishing protected areas for the protection of the European mink. Unfortunately the results achieved so far have not been encouraging and the American mink continues to extend its range into that of the European mink. In parallel with the projects dealing with establishment of protected areas, a captive breeding project was launched in Spain in 2003. The first captive breeding centre for 40–50 specimens should be ready by the end of 2003.

Species protection movement "Euronerz" was initiated in Germany in the first half of the 1990ies. It is based on private initiative and aims at introducing captive breeding of the European mink in smaller zoos. "Euronerz" is member of the European Mink EEP Programme (European Endangered Species Programme).

The critical state of the European mink is reflected in almost all international and national nature conservation lists, laws and agreements (Table 5).

Table 5.

International protection status of the European mink (*Mustela lutreola*)

IUCN Red List (2003)	**Endangered**
IUCN Action Plan for Small Carnivores	First priority of European species protection
Bern Convention	**Strictly protected species** (Appendix 2)
Habitats Directive	**Species of Community importance** Annex II, Annex IV **Priority species (2004)**
National laws	**Protected**, except in Russia (not protected on the federal level, but protected in regions)

1.4.3 State in Estonia

Maran (1988, 1991) has published a retrospective analysis of changes in the range of the European mink as of 1987. The overview was prepared on the basis of both the author's data and data from earlier questionnaires and from literature (Figure 8). In 1900–1914, the European mink wad continuously distributed in all of the Estonian mainland. Similarly, in 1918–1949 it was distributed in all of the mainland, though in this period there appeared information in professional literature that the species is rather rare in several places. A questionnaire conducted after World War II showed that the European mink was distributed almost everywhere in mainland Estonia. Unfortunately, the first fur farms of the American mink *(Mustela vison)* were established in Estonia at the time. As animals could escape into the wild from the farms, it is impossible to give precise estimates of the state of the European mink in this period but we can suppose that the species was continuously distributed in most of Estonia and the first feral populations of the non-native species were forming only in the surroundings of fur farms. Occurrence of the American mink is first noted in the Estonian professional literature only in 1979 (Paakspuu & Meriste, 1981).

Field work and questionnaires conducted in 1980–1987 revealed an abrupt aggravation of the problem (Maran, 1988, 1991). Viable populations of the European mink had preserved only in north and east Estonia, while the alien species had invaded the rest of the mainland and Hiiumaa. Scarce data confirmed the spreading of the American mink also in the vicinity of a fur farm in Saaremaa, near Kuressaare.

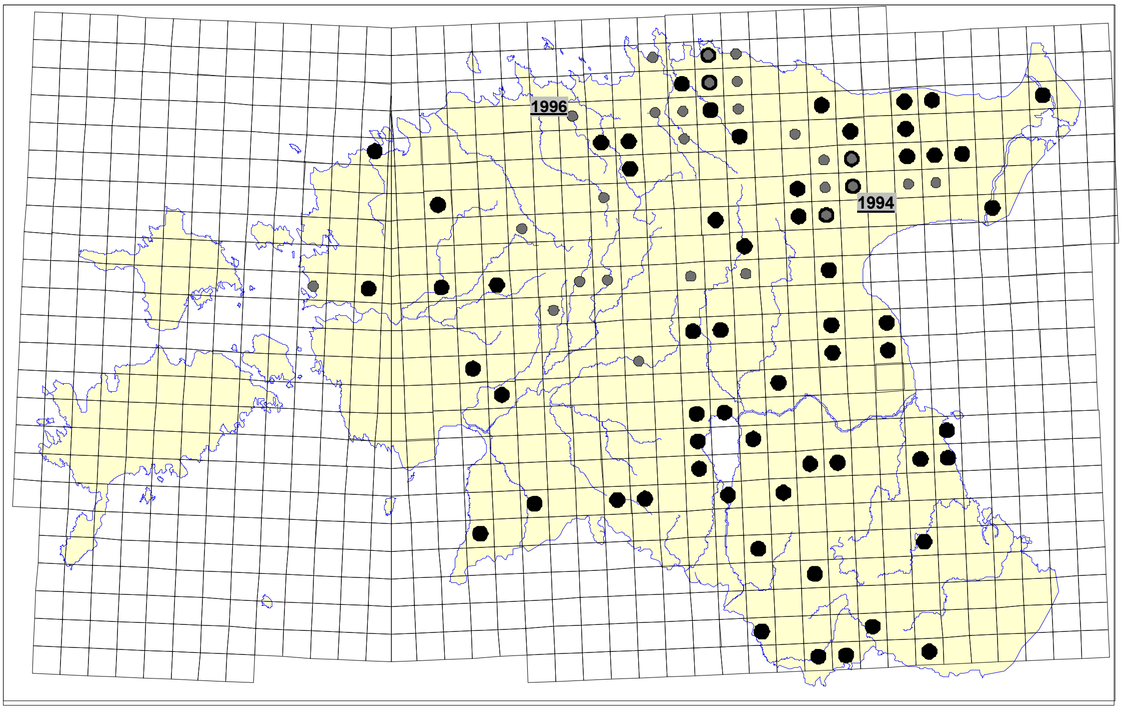


Figure 8. Distribution of the European mink (*Mustela lutreola*) in Estonia: black ring – data from 1920–1940; grey ring – data from 1980–1996. Years are given for the latest documented captures.

The American mink began to occupy the remaining areas of distribution of the European mink extremely rapidly and unnoticably at the beginning of the 1990ies. The earliest data on the occurrence of the American mink in North Estonia originate from 1988 from Ojaaarse, Lahemaa National Park (Maran, 1991). It is likely, however, that the American mink reached these areas already earlier. The latest confirmed record of the American mink dates from 1996 from Arukula (Maran, unpublished). The previous documented capture dated from 1994 (despite intensive field work and trapping) from the vicinity of Oonurme village (Maran, unpublished).

The existing data allow the conclusion that, as of 1996, the European mink had become extinct in the wild in Estonia.

1.4.4 Legal basis for protection in Estonia

According to subsection (1) of section 21 of the **Protected Natural Objects Act** (RT I 1994, 46, 773, 2002, 6, 21; 53, 336; 61, 375; 63, 387; 99, 579), the European mink is listed as a protected species of category I. Subsections 2–9 of the same section stipulate that it is prohibited to cause damage to the European mink and its habitats. In addition, it is prohibited to capture, kill and chase European minks and to cause danger to them by disturbance. It is also prohibited to disclose information on the exact sites of European minks if this may pose a risk to the animals.

Being semi-aquatic small carnivores, European minks are critically dependent on water bodies and their riparian zones. Protection of banks of water bodies is regulated by the **Act on the Protection of Marine and Freshwater Coasts, Shores and Banks** (RT I 1995, 31, 382; 1999, 95, 843; 2001, 50, 290; 2002, 61, 375; 63, 387; 99, 579). According to this act, one of the objectives of the protection of coasts, shores and banks is to preserve valuable natural habitats. Coasts, shores and banks are divided into three zones starting from the mean water level line: production restriction zone, water protection zone and construction prohibition zone.

Coasts of the Baltic Sea, Lake Peipsi and Lake Vortsjarv, shores of lakes and reservoirs with an area in excess of 10 hectares (ha), and banks along each side of rivers and water courses with a catchment area in excess of 25 square kilometres (km^2), shall be 200 metres (m) wide.

Shores of lakes and reservoirs with an area of between 5 ha and 10 ha and banks along each side of water courses and rivers with a catchment area of between 10 km^2 and 25 km^2 shall be 100 m wide.

The width of coastal, shore and bank areas of other water bodies shall be determined by municipalities. Such areas shall be at least 10 m, but not more than 25 m wide.

In coastal and bank areas it is prohibited to:

1) build and expand enterprises and storage facilities where hazardous substances of class I, II or III are used, produced or stored;
2) build and expand enterprises which affect the state of a water protection zone or a beach;
3) spread sewage sludge in periodically flooded bank areas. Depending on the frequency of floods, the use of chemical pesticides and fertilizers may be prohibited in such areas, except in special cases set out in subsection 11 of §9 of this Act;
4) establish human cemeteries and burial sites for animals;
5) graze cattle in areas of woody vegetation in water protection zones of inland water bodies;
6) elimination of outbreaks of plant diseases and pests with toxic chemical agents on coasts, shores and banks may be undertaken only with permission granted on a case by case basis by the Minister of Environment or an official authorized by the Minister of Environment.

On the banks of water bodies or stretches of water bodies registered as spawning grounds or habitats of salmonids, the restrictions on production activities referred to in subsections 1 and 2 are extended to the distance of 200m from the water level line. The list of spawning grounds and habitats of salmonids shall be approved by the Minister of Environment.

The width of the water protection zone is:

1) for the Baltic Sea, Lake Peipsi and Lake Vortsjarv – 20 m;

2) **for other lakes, reservoirs, rivers and water courses – 10 m**;

3) **for recipients of land improvement systems up until the place of discharge into natural water bodies – 1 m**.

In water protection zones economic activity is prohibited. The prohibition does not apply to grazing, mowing and reed cutting:

1) unless woody vegetation and soil is damaged or destroyed;

2) if prohibited seasons established by the Minister of Environment for the protection of breeding birds are adhered to.

In addition to the above, the following restrictions apply to the use of natural resources on coasts, shores and banks:

1) Extraction of mineral resources and earth substance is prohibited in water protection zones and allowed in other coastal, shore and bank areas subject to the permission of the Minister of Environment.

2) The main function of forests growing in the shore areas of the Baltic Sea, Lake Peipsi and Lake Vortsjarv is to protect soil and water and to maintain recreation possibilities; these forests are classified as protection or protected forests. Final cutting of forest in the above areas is permitted only in the form of shelterwood cutting.

3) Cutting of woody vegetation in a water protection zone is prohibited except where necessary for maintenance of water conduits or reservoirs, or for maintenance or regeneration of woody vegetation by sanitary or shelterwood cutting.

4) Where the use of a coastal, shore or bank area has caused destruction of vegetation, damage to soil, or deterioration of the state of a water body, the Minister of the Environment may apply for altering the use of the land parcel for three years at the maximum, or to establish for the same time period:

1) stricter standards for the use of pesticides, fertilizers and preservatives;

2) limits on the number of animals grazed.

As can be seen from the above, the Act on the Protection of Marine and Freshwater Coasts, Shores and Banks has regulated several activities important from the point of view of protection of European mink habitats. However, activities related to altering the water regime have not been sufficiently regulated. This was regulated in more detail by the **Land Improvement Act** (RT I 1994, 34,534; 2002, 53, 336) and its implementing provisions that were in force until 30 June 2003. On **1 July 2003, the new Land Improvement Act came into force.** (RTI, 17.02.2003, 15, 84).

This Act will set out requirements for the design, construction and maintenance of land improvement systems.

Yet the Act does not address environmental risks that may be associated with land improvement. Prevention of possible negative impacts of land improvement remains the task of the applicant for approval of a project. Approval of a land improvement project and grant of construction permits is refused when the land improvement works violate the protection regime, cause unreasonable damage to or alteration of natural environment or cause damage to other land owners or land or water users.

…

§ 15. Basis for refusal of construction permit

Construction permit shall be refused when:

1) construction project is not in conformity with design criteria;

2) construction project is not in conformity with land improvement research, where such research was foreseen by design criteria;

3) construction project does not meet the standards for design of land improvement systems and the formal and substantive requirements for construction projects;

4) the project has been prepared by a person not registered according to subsection 4 of § 9 of the Land Improvement Act, where such registration is foreseen;

5) design criteria were issued more than three years ago;

6) the applicant has knowingly provided incorrect or incomplete data in the application or the applicant affects the issuer of construction permit in an unlawful manner;

7) **significant environmental impact has not been pre-assessed, where environmental impact assessment is foreseen;**

8) state fee has not been paid.

Conclusions and proposals for improving the efficiency of protection of the European mink

The European mink can be protected as a species on two different levels:

a) by regulating operations with specimens of the species;

b) by protecting the species by protection of its habitats.

While the European mink is relatively strictly protected on the first level (disturbance, capture, killing, appropriation, trans-frontier shipment and trade in specimens of the species is prohibited), the protection of habitats of the species is still inadequate.

An amendment to the Protection and Use of Wild Fauna Act (entered into force in 2002) abrogated the possibility to delimit important habitats for animals (such as the European mink) and to establish special requirements for the use of these habitats. Abrogation of this provision made it impossible to apply this act for the protection of permanent habitats of animals. However, permanent habitats of the European mink are located in the riparian zone of water bodies. Therefore they should be protected according to the same scheme as the one currently applied to the protection of salmonid habitats. This means that the Act on the Protection of Marine and Freshwater Coasts, Shores and Banks should be amended to allow application of the Act for the protection of the permanent habitats of all protected species associated with water bodies.

To that end it is necessary to stipulate:

1) the principles of delimiting permanent habitats and authorisation (e.g. for the Minister

of Environment) for approving the lists of permanent habitats;
2) restrictions to be established in permanent habitats;
3) the list of protected species to the protection of which the provision is applied.

In order to avoid the risks associated with re-establishment of mink farms, it would be necessary to:

1) regulate the import of breeders;
2) establish keeping conditions which would minimise the possibility of animals escaping into the wild;
3) establish the requirement for marking of animals.

1.5 Protection of the European mink in Estonia

1.5.1 Protection in captivity

Tallinn Zoo has been dealing with captive breeding of the European mink since the 1980ies. The first years were spent largely on ascertaining the state of the Estonian population of the species and on capturing founder specimens for captive breeding. The first success in captive breeding was achieved in 1986. In 1992, the European Mink EEP programme was initiated under the aegis of the European Association of Zoos and Aquaria. The aim of this programme is to coordinate captive breeding of this endangered species, taking into account the genetic and demographic conditions necessary for preserving the gene pool of the species. The European mink EEP is coordinated by Tallinn Zoo and foundation „Lutreola". From 1995, European minks breed regularly in Tallinn Zoo and in 1998 a special Endangered Species Centre (ESC) was established at the zoo for the protection and captive breeding of the species. The ESC can support about a hundred European minks. The captive population kept in the ESC forms nearly a half of the European captive population and has made it possible to take next steps for restoring the species in Estonia as island populations.

1.5.2 Activities already implemented for recovery of the European mink in Hiiumaa

1.5.2.1 Removal of the American mink

For establishing an island population of the European mink, American minks had to be removed from the island. This activity was preceded by a feasibility study to ascertain the number of American minks on the basis of occurrence of suitable habitats. Based on studies conducted by G. Philcox and A. Crogan in 1997 (Macdonald et al., 2002) the capacity of habitats in Hiiumaa and thus also the maximum size of the American mink population was estimated at 105–203 specimens.

Based on the track census conducted by Dr. Vadim Sidorovich in 1998 in the course of removal of American minks, the maximum possible number of animals in Hiiumaa was estimated at 74, which was clearly below the capacity of habitats. The lower number was explained by the trapping period falling on a low abundance period of the population.

In two periods the removal was carried out by local hunters (01.–21.12.1998 and 10.–21.02.1999) and in four periods by Belarussian experts (14.03.–22.04.1999; 02.–25.08.1999; 26.11.–15.12.1999 and 28.02–20.03.2000). The total of 53 minks were captured, three of these after the end of the active removal period (Figure 9). Considering the significant difference between the estimated total number of animals (74 specimens) and the number of animals captured (53 specimens), it can be supposed that many specimens had died due to natural factors. No more American minks have been captured in Hiiumaa since then despite very intensive field work (Maran, 2000a).

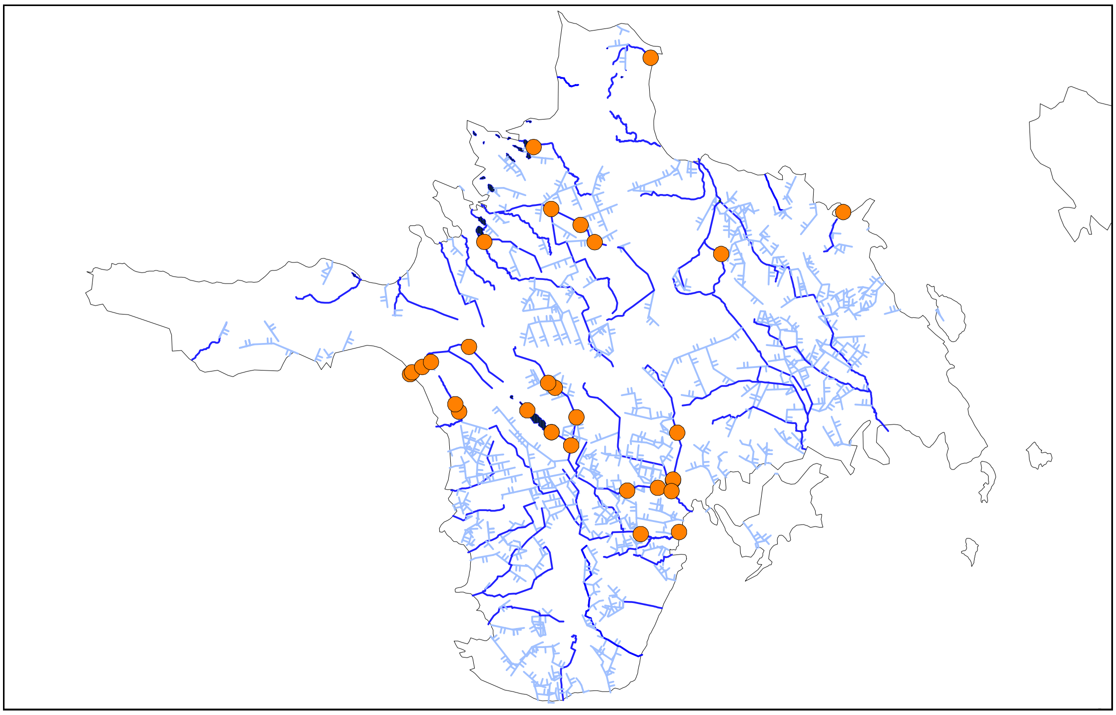


Figure 9. Locations of American minks (*Mustela vison*) captured in Hiiumaa in 1998–2001.

In addition to the water bodies shown on the map, American mink has been encountered also on rivers Vaemla and Suuremoisa, on Vanamoisa main ditch, Poama stream, etc.

1.5.2.2 Recovery activities of the European mink to date

European minks have been released into the wild in Hiiumaa since the year 2000. In 2000–2003, the total of 150 specimens have been released in Hiiumaa in different locations:

June 2000	9 specimens
September 2000	8 specimens
June 2001	41 specimens
April-June 2002	39 specimens (incl. 12 pregnant females)
September 2002	20 specimens
April-June 2003	42 specimens (incl. 14 pregnant females)
September 2003	18 specimens
TOTAL	**172 specimens**

Figure 10 gives an overview of the locations of release.

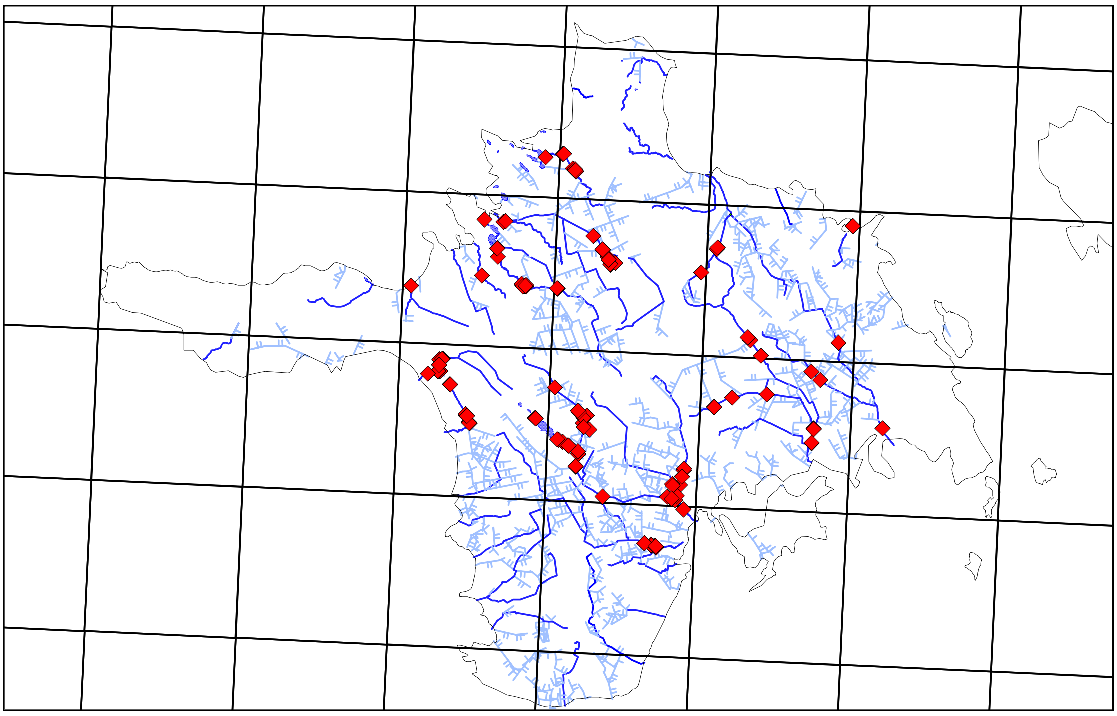


Figure 10. Locations of release of the European mink (*Mustela lutreola*) in Hiiumaa in 2000–2003.

1.5.2.3 Results achieved to date

1.5.2.3.1 Home ranges

Home ranges of European minks or longer-term presence of the animals have been recorded in this period on 10 different water bodies – 9 water courses and one lake (in summer). The home ranges were found by radio-tracking of animals, presence in other places was ascertained by tracks or by live trapping. An overview of the home ranges of European minks and capture sites in winter is given in Figure 11.

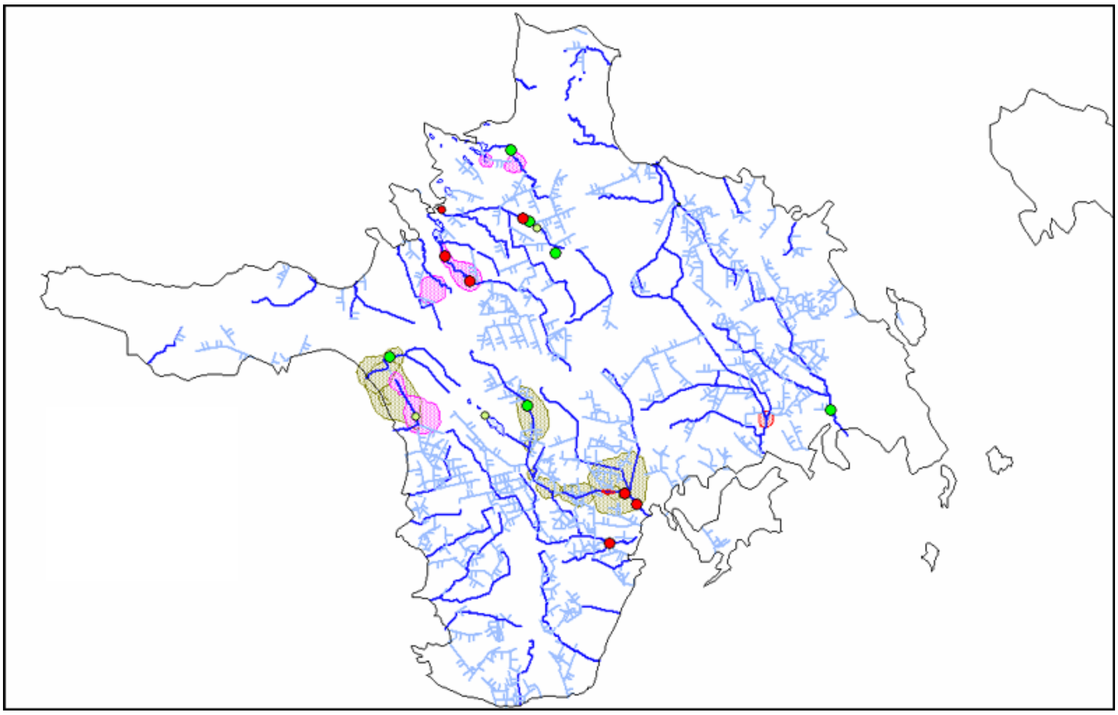


Figure 11. Home ranges of the European mink (*Mustela lutreola*) and sites of post-release recording 2000–2003.

Legend:

- Capture 2002
- Tracks 2002
- Capture 2003
- Tracks 2003

Home range 2000
Homerange 2001
Homerange 2002

In 2000–2003 the following numbers of European minks inhabited the water courses of Hiiumaa:

River Luguse (with Rebasselja stream)	7 specimens (4 over winter)
Armioja	3 specimens (2 over winter, 1 with litter)
Vanajogi	2 specimens (over winter)
Pihla stream	4 specimens (over winter)
Kidaste stream	2 specimens (1 over winter, 1 with litter)
lake Tihu	2 specimens
Ongu stream	2 specimens (1 over winter)
River Suuremoisa	1 specimen (over winter)
River Vaemla	1 specimen
River Jausa	1 specimen (over winter)

In summer 2002, home ranges of three specimens (one of these with litter) were located in woods away from bigger water bodies (unpublished data).

1.5.2.3.2 Breeding in the wild.

Three litters were discovered during the fieldwork of summer 2002: on Armioja stream, Kidaste stream and in the forest between Kaigutsi village and Rebasselja stream. Field signs of litters were found when the young were 1.5–2 months old, the number of young was probably small. No wild-born animals were captured in the course of monitoring-trapping in 2003.

1.5.2.3.3 Rate and reasons of mortality.

In 2000 and 2001, mortality of European minks during the adaptation period (2 months after release) was 32.5–75%. Mortality of females was 40–90%, that of males – 25–60% (Podra, 2002). In 2002, up to 83.3% of females died within the adaptation period, no significant difference was observed between pregnant and non-pregnant specimens (unpublished data). Of animals released in 2000, up to 76.5% died by next spring (Podra, 2002), of animals released in 2001 – up to 85.4% and of those released in 2002 – 90.9% (unpublished data). The extremely high mortality of 2002 can be explained by the exceptionally dry summer of 2002 and the following exceptionally severe winter (many rivers froze to the bottom), which was highly unfavourable for the entire aquatic biota.

Reasons of death recorded in Hiiumaa – analysis of data of 2000–2003:

2000 – other carnivore in three cases, bird of prey in one case and man in two cases, unknown in one case; deaths were recorded within 3–27 days.

2001 – other carnivore in two cases (in forest at the edge of field), dog in two cases, fox in one case, bird of prey in one case; deaths were recorded within 4–21 days.

2002 – other carnivore in two cases, bird of prey in one case, fox in one case, dogs in three cases (two near buildings), one road kill, one disease; deaths were recorded within 1–38 days.

2003 – information was received on three European minks killed by dogs, all near buildings (incidental observations). One animal supplied with a radio transmitter was killed by a bird of prey.

Although it seems at first glance that carnivores are the main reason of death, in reality the situation is more complex and it is not possible to view one single factor as the cause of mortality. The actual cause is interaction between different factors acting upon the animals after their release: new and unknown environment, incidental getting into unsuitable habitats, limited skills of finding and catching prey (despite prior training) and limited skills of hiding from other carnivores. Thus, carnivores are most likely to be simply the ones to finish the life of specimens weakened by this complex of different factors.

1.6 Core habitats of the European mink in Hiiumaa

Considering a relatively small capacity of the island and the small potential size of the European mink population there all the water courses present in Hiiumaa are important for the European mink well-being. A special importance has to be given to the habitats with a higher capacity and with higher potential as good breeding sites. In these so-called **core habitats** the animals breed annually and the number of animals in these habitats should form a basis for a self-sustaining viable population (Figure 12, red color). The importance of less favourable habitats in sustaining a viable population cannot be underestimated either, as they help to buffer the cyclic nature of breeding and to maintain temporary higher abundance of animals. The latter reason is important, considering the fact that, according to the calculations, the capacity of Hiiumaa is sufficient only for supporting a minimum viable population of the European mink.

Core habitats of the European mink were selected on the basis of the criteria addressed in the previous chapters (food resources, shelters, access to water in winter, home ranges identified, places of capture). These are usually the natural or restoring stretches of the rivers and streams with lots of water, but also the lakes connected to these watercourses. These lakes are of high importance as they provide needed food supply in time of litter. The presently available habitats are sufficient for forming of viable population. However, with relatively simple restoration operations the availability of optimal habitats can substantially be increased in most of the water courses (Figure 12, green color). After restoration these sites are likely to gain a quality sufficient to regard them as core areas.

Table 6.

Core habitats of the European mink (*Mustela lutreola*) in Hiiumaa.

Rivers	Lakes
1. Lower course of River Suuremoisa (from river mouth to 22.91477/58.88425)	1. Tihu Suurjarv
2. Lower course of River Vaemla (from river mouth to 22.84841/58.87407)	2. Tihu middle lake
3. Lower and middle course of River Luguse (from rivermouth to 22.59246/58.83096)	3. Tihu third lake
4. Lower course of Rebaselja stream (from River Luguse to 22.71895/58.83498)	4. Mailaht
5. Lower course of Tulimurru main ditch (from Rebasselja stream to 22.69874/58.82688)	5. Allikalaht
6. Lower and middle course of Jausa stream (from river mouth to 22.66000/58.78778)	6. Haavasoo
7. Lower and middle course of River Vanajogi (from river mouth to 22.45548/58.89401)	7. Veskilais
8. Lower course of Armioja stream (from river mouth to 22.53681/58.93595)	8. Tammelais
9. Lower and middle course of Pihla stream (from river moth to 22.62789/58.95131)	9. Kunaauk
10. Lower and middle course of Kidaste stream (from river moth to 22.588515/59.00303)	
10. Tihu ditch between Tihu Suurjarv and Tihu middle lake	

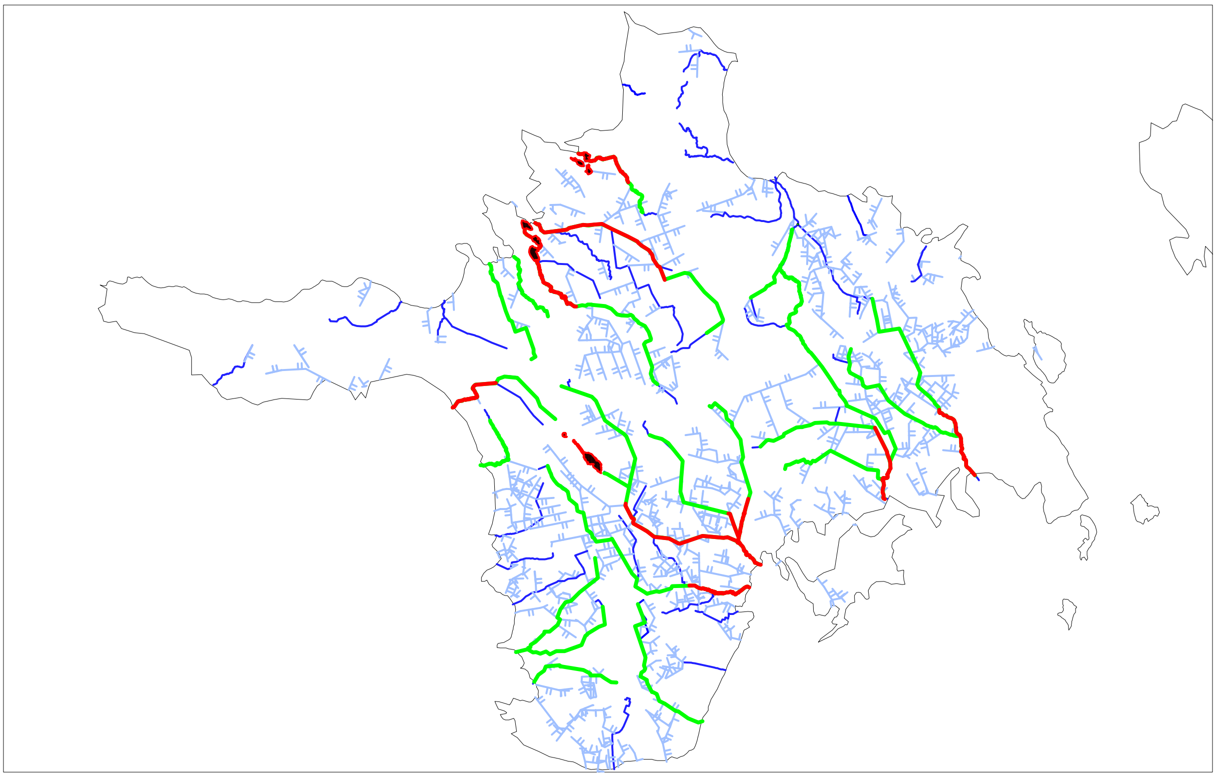


Figure 12. Core habitats and the habitats with future potential of the European mink (*Mustela lutreola*) in Hiiumaa.

Core habitats

Habitats with a good future potential

The core habitats shown in Table 6 and Figure 12 encompass the total of 56 km of bank line of water courses – 26 km of natural river and 30 km of dredged river. Estimated on the basis of the size of home ranges in Hiiumaa and on the basis of winter population density in similar habitats in Belarus (see p. 13), the core habitats in Hiiumaa (in their present condition, according to a very conservative estimate) could support 14 - 28 minks at the minimum in winter, i.e. 28–30% of the possible size of the entire population in winter. The remaining 36 – 64 specimens or 70-72% of the population could be located on other water courses (appr. 270 km in total) which have a lower quality as European mink habitats.

Most of all the core areas are important for the female with litter as at the time of raising the litter female needs a good food resource. The population with equal sex ratio could raise 7 – 14 litters in core areas, provided that all the females will be conceived. According to the study in Belarus (Sidorovich 1997b) that is common for wild European mink populations. On the ground of the data from Belarus the annual reproductivity of core areas could be around 17 – 34 young (the average number of young older than one month is 2,4; Sidorovich, 1997b). In fact, it is likely that even higher number of young will be raised up annually as part of litters could be delivered at lakes or in dredged rivers, which are not considered as core areas (like streatches of River Luguse, River Vaemla, River Suuremoisa, Armioja stream).

2 POSSIBLE RISK FACTORS

2.1 Prioritisation of risk factors

Factors endangering the survival of the European mink population were defined on the basis of the reasons of decline of the species in its former range, ecology of the species, and condition of habitats in Hiiumaa. Risk factors were divided into three groups: 1) factors endangering specimens during the establishment of population (Ch. 2.2), 2) factors endangering specimens in the established population (Ch. 2.3) and 3) factors endangering habitats (Ch. 2.4).

Risk factors were prioritised on the basis of the following indicators:

- previous experience of recovery of the European mink in Hiiumaa (abundance and location of European minks in Hiiumaa)
- main difficulties in establishing a population (high mortality during adaptation period, animals staying in unsuitable habitats)
- main causes of extinction in the former range (American mink)
- specific features of Hiiumaa (habitats, predators)
- public opinion.

Based on these indicators, risk factors were divided between three levels of importance on a cognitive basis:

I highly important
II important
III of low importance

2.2 Factors endangering the establishment of population

Table 7.

Factors endangering the establishment of the population of the European mink (*Mustela lutreola*) in Hiiumaa, ranked by levels of importance.

<table>
<tr><th colspan="2">Risk factor</th><th>Importance</th></tr>
<tr><td rowspan="3">2.2.1 High mortality during adaptation period</td><td>2.2.1.1 Getting killed by other carnivores</td><td rowspan="3">Highly important</td></tr>
<tr><td>2.2.1.2.3 Getting killed by stray dogs</td></tr>
<tr><td>2.2.1.2.4 Getting killed in human settlements</td></tr>
<tr><td rowspan="2">2.2.2 Development of negative public attitude</td><td>2.2.2.1 Due to economic damage caused</td><td>Important</td></tr>
<tr><td>2.2.2.2 Due to misconception</td><td rowspan="4">Of low importance</td></tr>
<tr><td rowspan="3">2.2.1 High mortality during adaptation period</td><td>2.2.1.2.1 Drowning in illegal fishing gear</td></tr>
<tr><td>2.2.1.2.2 Incidental killing in the course of hunting</td></tr>
<tr><td>2.2.1.2.5 Road kills</td></tr>
</table>

2.2.1 High mortality of European minks during adaptation period

The high mortality of European minks after their release into the wild (up to 83%, see p. 34) is the main inhibiting factor in establishing the population. Animals brought from captivity lack the experience and skills necessary for survival in the wild. This leads to the death of many specimens already in the first days or weeks and by the breeding period there are too few specimens left for founding a viable population.

2.2.1.1 Getting killed by other carnivores

- **Highly important**

Killing by other carnivores is an important obstacle to establishing the wild population of the European mink (see p. 34). So far it has been ascertained that European minks have been killed by fox and bigger birds of prey, one possible killer (species not identified) was either pine marten or raccoon dog. In addition, European minks may be endangered by lynx (in wooded areas) and white-tailed eagle (on river mouths and lakes).

According to individual observations and opinions of hunters, the numbers of fox, raccoon dog and pine marten are high in Hiiumaa. This is confirmed also by hunting data – in 1997–2001 the number of foxes hunted has risen every year, a certain rise can be noted also in the number of raccoon dogs hunted. Hunting of pine marten has remained on a stable low level compared to hunting of the other species (www.hiiukt.ee).

2.2.1.2 Anthropogenic causes

Mortality of European minks can be rather largely influenced by anthropogenic causes because animals grown up in captivity have lost their innate fear of man. Danger can be posed by direct human activity but also factors related to domestic animals (described in the following sub-chapters).

2.2.1.2.1 *Illegal fishing gear*

- **Of low importance**

Fishing gear – nets and weirs – pose a danger for all bigger semi-aquatic mammals, incl. the European mink, because animals can easily drown in them. At the time of establishing a population, every specimen is extremely valuable and death of an animal impedes the founding of a population. Therefore, illegal fishing gear may pose a certain danger during the period of establishing a population.

Fishing gear is placed mostly in bigger rivers (richer in fish), such as Suuremoisa, Vaemla or Luguse, but also in Kidaste, Pihla, Jausa and Armioja streams, especially their mouth areas, in the vicinity of culverts, or in outflow areas of lakes and lakelets. On the above-mentioned rivers, fishing gear has been found mainly in spring because these rivers are spawning grounds for cyprinids and pike. On the rivers of northern Hiiumaa and on Suuremoisa and Vaemla rivers, also burbots that come to spawn there in winter are caught. In trout rivers – Vanajogi, Nuutri and Ongu stream – fishing gear may be found in autumn.

2.2.1.2.2 Incidental killing during hunting

- **Of low importance**

European minks can get killed during hunts mainly in two ways: they can get killed by hunting dogs and hunters can mistake them for other game. One specimen shot with pellets has been found during fieldwork and, according to oral data from hunters, swimming European minks have been close to being shot, mistaken for American minks. During the formation period of a population, the fact that some specimens get killed in hunts may have some influence on the formation of the population. The likelihood of getting killed in hunts is increased by inadequate fear of European minks for both man and dogs.

2.2.1.2.3 Stray dogs

- **Highly important**

Being big and dangerous carnivores, stray dogs can kill all smaller and weaker animals, including the European mink. Stray dogs endanger European minks mainly on water bodies located in the vicinity of human settlements but there has been at least one occasion where a European mink was killed by a dog far away from human settlement. During the establishment of population, the possibility of getting killed by dogs is higher because minks are not shy enough. The risk factor is aggravated by the relative abundance of stray dogs (personal experience, observations of hunters) also in spring, when pregnant females or females with litter may get in danger.

2.2.1.2.4 Getting killed in human settlements

- **Highly important**

The most likely cases where European minks can get killed in human settlements are incidents where a they attack domestic animals (chicken, rabbits, etc.) and are killed by man or a dog. So far, man has killed at least one specimen near houses and also dogs have killed a few. The danger of minks coming into human settlements is higher during post-release weeks, when the released animals are unable to find sufficient food in the wild. The risk factor is aggravated by the fact that minks are inadequately shy of both man and dogs.

2.2.1.2.5 Road kills

- **Of low importance**

Due to their insufficient fear of man and limited skills for survival in the wild, minks are more likely to come to roads during the adaptation period. There has been at least one incident where a European mink got killed by being hit by a car. Road kills may impede the establishment of a population to some extent.

2.2.2 Development of negative public attitude

Negative attitude is currently the only risk factor that may become important in certain circumstances. Negative attitude towards the establishment of a European mink population may be caused by frequent conflict situations with local people and by misconceptions due to low awareness.

2.2.2.1 Economic damage caused

- **Important**

European minks can cause economic damage by killing domestic animals (so far they have killed a few chicken, rabbits and kittens) or by eating fish or crayfish kept in ponds. Minks can easily come to human settlements immediately after their release.

2.2.2.2 Misconceptions

- **Of low importance**

Attitude towards the European mink may worsen because of seeing it as a competitor – it is quite a frequent misconception that carnivores cause considerable damage to the populations of prey species or destroy them completely. In the case of the European mink, such misconception may spread because minks living on water bodies eat fish and crayfish, which, together with small mammals, form an important part of their diet. Furthermore, there are no data on earlier occurrence of European minks in Hiiumaa. In reality, however, there is no danger that the European mink could affect the abundance of any of its prey species. The European mink has been part of the biota of inland water bodies of Estonia for millennia, just as have the local fish species, amphibians, crayfish and most of small mammals. Thus these species have co-adapted during the evolution and are able to coexist.

Also, the restrictions, which has to be established for preservation of core areas, may result in rise of negative attitude. Although a very few additional restrictions to those already in place have to be established, they might give ground to rise of “myth” far from reality. As most of the new restrictions target forestry and land reclamation activities it is likely that the possible “myth” may claim that Europena mink conservation will bring along significant restrition in property rights.

2.3 Factors endangering the established population

Table 8.

Factors endangering the future established population of the European mink (*Mustela lutreola*), ranked by levels of importance.

Risk factor		Importance
2.3.1 Re-establishment of American mink population	2.3.1.1 By invasion	Highly important
	2.3.1.2 Due to establishing a farm	
2.3.2 Risk factors related to scarcity of habitats and the size of population	2.3.2.1.2 Genetic risks	
	2.3.2.3 Lack of habitats	
	2.3.2.2 Big and abrupt variations of environmental conditions	
2.3.3 High mortality of minks in the established population	2.3.3.2.3 Getting killed by stray dogs	Important
	2.3.3.1 Getting killed by other carnivores	
2.3.2 Risk factors related to scarcity of habitats and the size of population	2.3.2.1.1 Demographic risks	
2.3.6 Discontinuation of the gathering of scientific information necessary for successful conservation management		
2.3.5 Development of negative public attitude	2.3.5.1 Due to economic damage caused	
	2.3.5.2 Due to misconceptions	Of low importance
2.3.3 High mortality of animals in the established population	2.3.3.2.1 Drowning in illegal fishing gear	
	2.3.3.2.2 Incidental killing during hunts	
	2.3.3.2.4 Getting killed in human settlements	
	2.3.3.2.5 Road kills	
2.3.4 Disturbance	2.3.4.1 Road construction on the banks of water courses	
	2.3.4.2 Forestry activities on the banks of water courses	
	2.3.4.3 Construction activity on the banks of water courses	

2.3.1 Re-establishment of the population of American mink

One of the greatest dangers to the future European mink population is possible re formation of the population of American mink in Hiiumaa. This may become possible in two ways:

1. invasion of American minks to Hiiumaa by sea.
2. restoration of fur farms for the breeding of American minks in Hiiumaa.

2.3.1.1 Invasion

- **Highly important**

Hiiumaa is separated from the mainland by appr. 22 km of sea. Between Hiiumaa and the mainland there is Vormsi island and two islets, Harilaid and Kadakalaid. An overview of the distances is given in Figure 13.

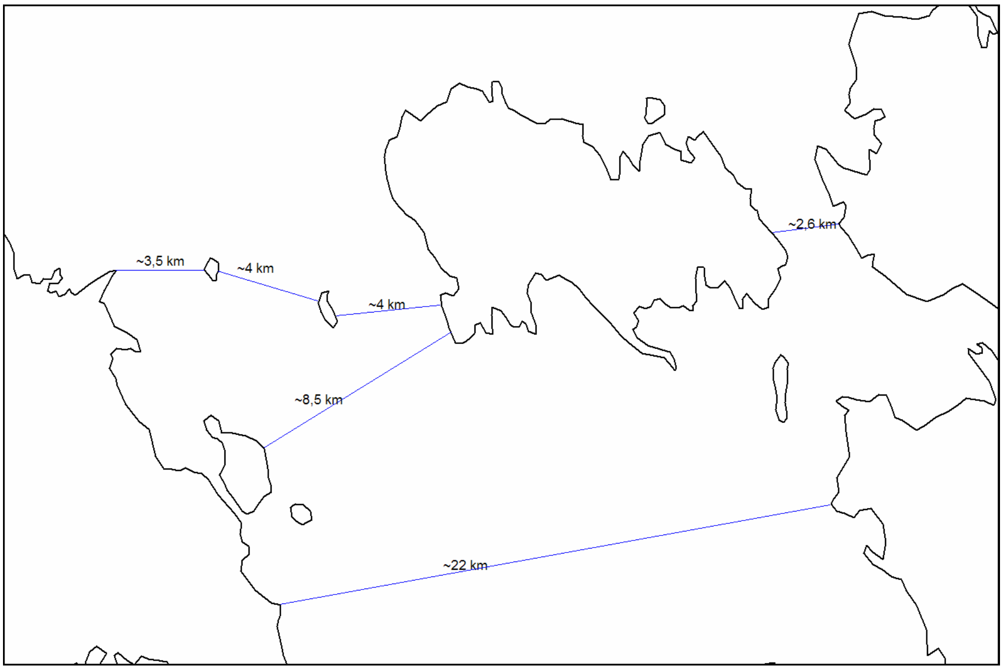


Figure 13. Distances between Hiiumaa and the mainland.

The possibility of a new American mink population forming on the basis of specimens originating from the mainland is determined by the specific features of the biology of the species, by the distance of Hiiumaa from mainland and by the number of animals required for founding a new population. The possibility cannot certainly be fully excluded but its likelihood can be assessed.

Minks are animals with a rather sessile life style. However, there are two periods in there life cycle when animals can undertake longer migrations (especially in the case of high abundance). In February and March male minks move rather long distances in search of females. And in late summer and early autumn the young undertake longer journeys to find a home territory. These two are the most likely periods when minks may migrate to sea islands. In the first period the sea is either frozen or the water is very cold and minks are unable to swim for longer periods without freezing. The existence of ice cover probably increases the possibility of invasion. It must be taken into account, however, that ice cover is never even and considering the eye height of minks, it is very difficult for them to see any landmarks and reach an island or islet. The same concerns open water in even just slightly windy weather. At the first glance, the islands and islets located between Hiiumaa and the mainland may seem to be the so-called stepping zones that could give the animals a chance to move from one to another and thus increase the possibility of some specimens reaching Hiiumaa. However, neither Vormsi nor Harilaid and Kadakalaid can be regarded as classical stepping stones: in reality they do not have enough habitats for the formation of a viable population that could send migrants further to the next islands. They can support only one or two specimens for a short period of time and are therefore more likely to act as traps that single specimens can get into and survive in until they perish. In Vormsi, where habitats suitable for the American mink are more abundant than on the islets, questionnaires have revealed that American minks have been encountered only twice within the last few decades. The last time was more than seven years ago (Podra, 2001). However, ferry channels in the frozen see in winter may constitute a river-like channel that may give a movement direction for minks.

From the above it is clear that there is an extremely small probability of American minks reaching Hiiumaa. In addition, formation of a viable population would require more than a single specimen. Both a male and a female would need to reach the island simultaneously. Considering the relatively high natural mortality of American minks, it is highly unlikely that even if a pair reaches the island simultaneously, they could survive there until the breeding period, then meet, mate and have offspring. It is also equally unlikely that the hypothetical offspring could survive until the next breeding period and breed. According to a thumb rule of biology of small populations, the likelihood of long-term survival of a population smaller than 30–40 specimens is very small (Ralls & Ballou, 1986, Caugley & Sinclair, 1994).

In summary, it is highly unlikely that the population of American mink could be restored on the basis of immigrants from the mainland and this factor does not pose a great danger to the survival of the European mink population in Hiiumaa.

2.3.1.2 Fur farming

- **Highly important**

It is almost certain that the earlier American mink population of Hiiumaa was founded by specimens that had escaped from the fur farm that operated in Palade from 1973 (November) to 1995 (December). In fact, mink farms have proved to be very effective founders of populations of the non-native species everywhere. This is no surprise, considering the high likelihood of animals escaping from farms. According to an estimate of a worker of a soviet-time fur farm, 10–20 animals escaped from bigger farms annually (Maran, 1991), and in the first years of operation of farms the escape rate was even higher.

Regardless of the present low period of fur farming both in Estonia and elsewhere in the world, creation of new farms is not impossible. On the contrary: considering the fact that fur farming is overcoming the low period of market and is beginning to recover, and also the fact that farming of American minks is prohibited in several European countries (e.g. in England) or being prohibited (Germany, the Netherlands), and considering the suitability of the Estonian climate for mink farming, revival or even boom of Estonian mink farming can be expected. This will certainly be a great ordeal for the Estonian natural environment. Revival of mink farming in Hiiumaa would inevitably destroy the results of all the work already done for establishing the population of the European mink.

The current legal acts of Estonia do not include any substantive provisions that would restrict or even regulate fur farming of American mink as an invasive non-native species. Nor is there a solid legal basis for regulating the establishment of new farms on the islands, where alien species can break the ecological balance particularly easily. The only existing provision proceeds from the Hunting Act: according to the Hunting Rules approved by regulation No. 28 (15.06.1995) of the Minister of Environment, the American mink is listed as a game species. § 25 of the Hunting Act concerning the taking of game animals from the wild and keeping them in captivity stipulates that:

(1) A game animal may be taken from the wild in order to:

1) treat an injury or illness or to raise an abandoned young animal;

2) establish or supplement an animal collection for scientific, educational or commercial purposes;

3) strengthen the local population;

4) establish or supplement animal farms for economic purposes.

(2) The taking of game animals into captivity shall be approved by the Veterinary and Food Board.

(3) In cases specified in clause (1) 1) of this section, a game animal may be taken from the wild without authorisation by a person performing official functions. If the manner of taking game animals from the wild differs from permitted hunting methods, it will require permission by the Minister of Environment.

(4) Game animals may be taken from the wild for the purposes specified in clauses (1) 3) and 4) of this section provided that the place of keeping the animals in captivity is registered with the Ministry of the Environment.

(5) The procedure for submission and review of applications for registration of places of keeping game animals in captivity and the procedure for registration of such places shall be established by a regulation of the Minister of Environment.

(6) Registration of a place of keeping game animals in captivity shall be refused if the escape of game animals into the wild or the spread of diseases cannot be prevented there or if the place does not meet the requirements of the Animal Protection Act (RT I 2001, 3, 4; 2002, 13, 78).

(7) A game animal that has been kept in captivity can be released into the wild if it was taken from the wild in order to:

1) treat an injury or illness or raise an abandoned young animal;

2) strengthen the local population.

Thus the law requires that all fur farms for American minks have to be registered and registration is refused if escape of animals cannot be excluded. Considering the previous experience, such exclusion is impossible. Thus, American mink farming should be practically impossible in Estonia.

However, there may arise the question of whether farm minks can be regarded as game animals from the legal point of view. After all, farmed specimens have been kept in captivity for generations, they already form different breeds and have been taken from the wild in the territory of another country very long ago (before the entry into force of this Act).

2.3.2 Risk factors related to scarcity of habitats and the size of population

Hiiumaa has only just as many habitats for the European mink (see pp. 15–17) as necessary for supporting a minimum viable population. Thus the established population can be easily influenced by all factors that endanger small populations. Risks related to scarcity of habitats and the size of population can be divided into three groups: demographic and genetic risks associated with the small size of population and risks related to scarcity of habitats.

2.3.2.1 Risks associated with the small size and isolated location of population.

In big populations each single specimen is not as important for the survival of the population as it is in a small population. In a small population the loss of every specimen is an event of much bigger weight. Therefore there are several internal and external stochastic risk factors which big populations are able to buffer but which can bring small populations to extinction. Such factors include random variations of intra-population demographic and genetic processes and of external environmental factors (incl. abrupt changes of environmental conditions or catastrophes). According to the most conservative calculation, winter abundance of the future European mink population will remain between 50 and 92 specimens (see pp. 16-17). A population of this size certainly has to be regarded as small and therefore it is important to take into account the above risk factors.

2.3.2.1.1 Demographic risks

- **Important**

In our climatic zone, winter is the most difficult season for all species, including the European mink. If the calculations made (see pp. 16-17) are correct, approximately 50–92 animals can survive in Hiiumaa during the winter low period. Random fluctuations of demographic processes, e.g. fluctuations of the male-female ratio or death or birth rate, may lead to the disappearance of a population. Both calculations and experience have shown that a population smaller than 30–40 specimens is highly likely to become extinct due to those demographic factors (Ralls & Ballou, 1986, Caugley & Sinclair, 1994). Thus, demographic factors do not constitute a big danger for the Hiiumaa population but they may become important in case fluvial habitats are largely destroyed due to unsustainable or insufficiently considered economic activities or in the case of exceptional and abrupt environmental changes of catastrophic scale.

2.3.2.1.2 Genetic risks

- **Highly important**

Although from the demographic point of view a population can survive when the numbers exceed 30–40, from the point of view of survival of species it is essential to preserve also the genetic diversity of the species. Genes, too, can undergo several random stochastic processes (e.g. gene drift). In a smaller population these can easily lead to abrupt decline of genetic diversity and, in the worst case, to gradual extinction of the population. Abrupt fluctuations of numbers are particularly dangerous in that regard. In preserving the genetic diversity of mammals, the objective is usually to preserve 90% of the original heterozygosity during 100 years (Soule, 1987; Ralls & Ballou, 1986). Based on this objective, the population in Hiiumaa should include 364–693 specimens, of which 30–50% should be actively involved in reproduction (Maran, in print). Thus, the size of the Hiiumaa population before the breeding period should be 109–347 specimens. This is a very conservative estimate obtained by analysing the demographic parameters of captive-bred animals with a special computer programme (*Capacity v.3*, J. Ballou; a new version of the same programme is integrated into the population management software package PM2000 – www2.netcom.com/~pm2000/). Therefore it is expected that in reality the required size of population is considerably smaller. According to the calculations and in the current conditions, the environment of Hiiumaa is capable of sustaining at least 50–92 animals (see pp. 16-17). This size of population is quite close to the minimum required for preservation of genetic diversity. Such small size makes the population particularly vulnerable to environmental fluctuations, such as long periods of draught.

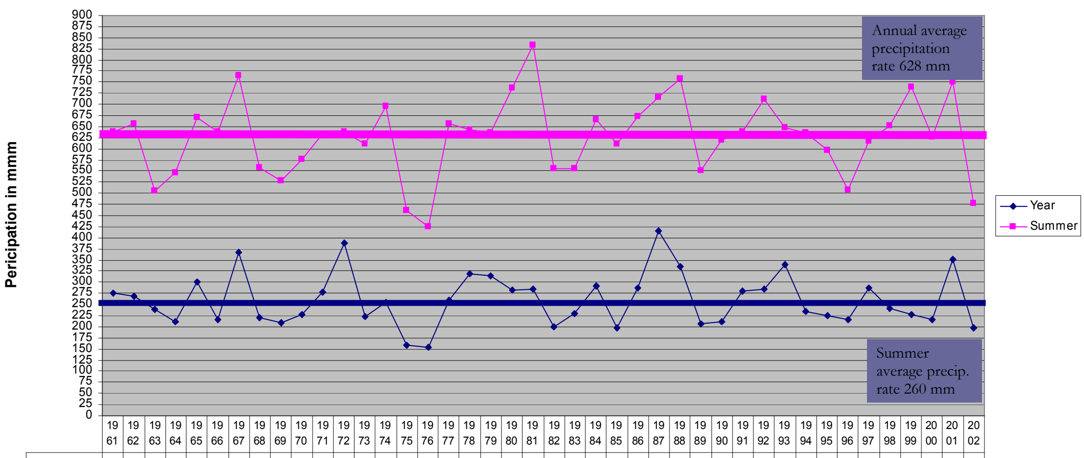
2.3.2.2 Big and abrupt variation of environmental conditions

- **Highly important**

Abrupt variations of environmental conditions (catastrophes, such as outbreaks of diseases or severe draught) can endanger the survival of small populations.

In the extremely dry summer of 2002, a big part of the water courses in Hiiumaa ceased flowing and several of them dried up. In the course of fieldworks, 156.2 km of water courses were observed. Of these, appr. 107.6 km or 68.9% had dried or were divided into pools. Slight flow had preserved mostly in lower courses or in spring-fed areas (48.6 km or 31.1% in total). If the total length of water courses is taken as a basis, the share of stretches with flow would be even smaller because only bigger water courses were observed, while almost all smaller water courses dried completely. Crayfish populations were strongly damaged and many streams were still dry even in autumn, when amphibians moved there to hibernate. Dying of fish and frogs was observed in winter on Kidaste stream, Armioja and river Suuremoisa (probably due to the lack of oxygen). The influence of exceptional draught in summer was significantly aggravated by the following exceptionally long and severe winter, which left its sign on most of the important prey species of the European mink. The described situation is likely to have an effect on the food resources of minks also in several following years. Also the summer of 2003 was very dry, which will inflict another destructive blow on the biota of the damaged fluvial habitats of Hiiumaa. An overview of the extent of drying of rivers is given in Figure 15.

Looking at summer average precipitation rates and air temperatures in Hiiumaa in a longer period, it can be seen that periods of draught are not exceptional but occur even in certain cycles (Figure 14). The biota of water courses in Hiiumaa is strongly influenced by excessive drainage and, considering the current condition of water bodies, it is very vulnerable to draught and severe winters. In the longer run this will influence not only the biota of water courses but also human activities.



	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Year	275	269	239	211	301	216	367	219	209	228	278	388	222	254	158	154	259	319	315	282	284
Summer	639	657	506	547	670	637	766	559	527	575	633	638	611	695	462	425	658	644	637	737	834

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Year	200	230	292	197	287	416	335	207	212	280	284	339	234	226	215	288	240	227	216	351	197
Summer	556	556	666	611	673	716	757	551	620	638	712	647	637	597	508	618	653	739	627	750	477

Figure 14. Precipitation rates in Hiiumaa (legendid: precipitation rate mm, year, May-Sept.)

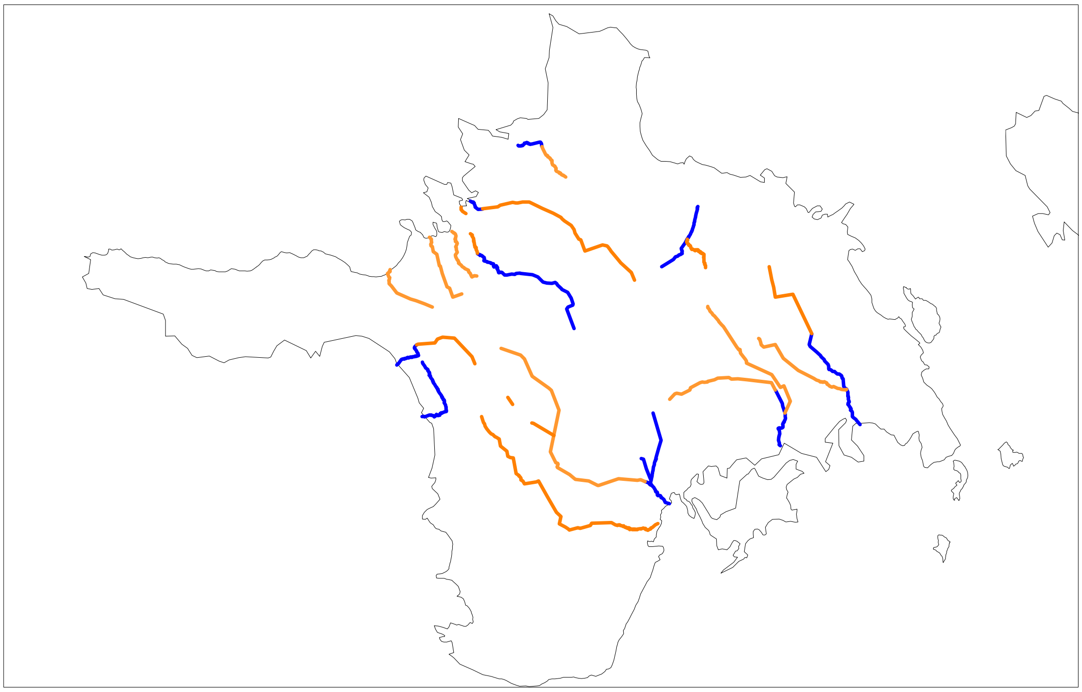


Figure 15. Condition of water courses in Hiiumaa in the extremely dry summer of 2002.

flow **dry or pools**

2.3.2.3 Scarcity of habitats

- **Highly important**

The total length of water courses in Hiiumaa is 326 km. In addition, there is appr. 100 km of bigger drainage ditches and appr. 25 km of lake banks as summer habitats (see p. 16). Most of the habitats are of relatively low quality – rivers are mostly dredged and straightened into ditches, the total length of natural stretches is appr. 33 km. Main ditches and small streams constitute additional habitats but are of low quality, too.

Theoretically, the habitats of Hiiumaa can support a minimum viable population of the European mink (see pp. 16, 17). However, as the size of population will remain close to the minimum possible size, poorer condition of habitats than expected may become a critically important problem, especially in the case of abrupt fluctuations of environmental conditions or deterioration of habitats due to economic activity.

2.3.3 High mortality of minks in the established population

High mortality of animals in the established population can play an important role in the survival of the population, especially in case several negative impacts occur simultaneously. However, wild-born individuals are not as vulnerable as those brought from captivity. Several causes of death (e.g. natural enemies) are far less important in these animals.

2.3.3.1 Getting killed by other carnivores

- **Important**

European minks already adapted to natural conditions are much less likely to fall victim to other carnivores than they are in the adaptation period. Therefore, other carnivores are not an important risk factor for European minks in an established population. Still, some specimens can get killed by other carnivores also (see p. 15), especially in winter, when minks have to move long distances on ice to find access to water. This is particularly the case in water bodies that freeze to a big extent and offer limited shelter (Figures 5 and 6).

2.3.3.2 Death due to anthropogenic reasons

In an established population, anthropogenic causes of death will probably play only a small role because wild-born specimens are shyer of man and contacts with man will be less frequent. It is possible that some individuals will get into human settlements and get killed there during the time of dispersal of litters, when they search for home territories. Also stray or hunting dogs, fishing gear, etc. may play a certain role but this is not likely to endanger the survival of the population

2.3.3.2.1 Illegal fishing gear

- **Of low importance**

See pp. 38, risk factor 2.2.1.2.1.

2.3.3.2.2 Incidental killing in the course of hunting

- **Of low importance**

See pp. 38, risk factor 2.2.1.2.2.

2.3.3.2.3 Stray dogs

- **Important**

See pp. 38-39, risk factor 2.2.1.2.3.

2.3.3.2.4 Gettng killed in human settlements

- **Of low importance**

European minks adapted to the wild will not come to human settlements as often as immediately after release but it still cannot be fully excluded. Minks are most likely to come to human settlements in early autumn when the young have become independent and are moving around widely, looking for suitable home territories – intra-specific competition is the highest in this period. In some cases European minks can visit human settlements also in winter due to the lack of food (two cases are known to date). This can occur mostly in households located on water bodies. This risk factor is expected to act only on single specimens in future and is thus not as important as in the adaptation period. See also p. 39 and risk faktor 2.2.1.2.4.

2.3.3.2.5 Road kills

- **Of low importance**

Minks adapted to the wild can get killed when they cross roads across bridges where it is not possible to pass the bridge along the bank line (according to personal observations of the authors, minks prefer running across the road or along the under-bridge bank line to swimming to the other side of the bridge). In summer, traffic is rather dense on bigger roads and single specimens can get killed. Considering the present number of cars, however, this factor does not pose a serious risk to the population, especially as the water level is low in summer and there usually exists a dry under-bridge strip of bank across which animals can move. See also p. 39 and risk factor 2.2.1.2.5.

2.3.4 Disturbance

Direct disturbance is not likely to influence minks to such an extent that it could endanger the survival of the population. It may be of some importance particularly in the case of females with litters because they may be unable to find a new stretch of river uninhabited by other specimens. In a small population it is very important that all litters grow up.

2.3.4.1 Road construction on the banks of water courses

- **Of low importance**

Disturbance associated with road construction may be important if it occurs during the period of raising the young – the female may be unable to move her litter elsewhere because the banks are divided into separate territories of different individuals.

2.3.4.2 Forestry activities on the banks of water courses

- **Of low importance**

Cutting – cutting in spring and early summer may pose a certain danger near the bank (<50 m) if it occurs in the territory of a female with litter. However, cutting areas usually do not reach long stretches of bank and animals can move elsewhere.

Transport of material – timber is often transported out of forest along the embankment of a dredged part of river and disturbance may occur on a long stretch of bank. Therefore it is difficult for pregnant females or females with litter to find a new home range. In other seasons transport of timber along the bank does not have any significant effect on animals because it affects only a part of the territory of a single animal.

2.3.4.3 Construction activities on the banks of water courses

- **Of low importance**

Currently the width of construction prohibition zone in most fluvial habitats is 50 or 25 m (depending on the drainage area), which is sufficient for avoiding significant disturbance by people and domestic animals. Where the zone is decreased to 10 m, disturbance may become a problem (if a farm yard reaches the bank, the bank is managed, too), because it increases the danger of conflicts between European minks and domestic animals. Conflicts may be dangerous for European minks or they may create conflicts with man because minks may kill domestic animals (chicken, rabbits). However, in an area of dispersed population yard territories form only a small part of the stretches important for the European mink. Disturbance related to human settlements is thus not an important risk factor.

2.3.5 Development of negative public attitude

Attitude of the people of Hiiumaa can become more negative mainly due to frequent conflict situations – minks killing domestic animals (chicken, rabbits). Delays in compensating the damage caused would aggravate the problem. Negative attitude due to possible misconceptions is less important.

2.3.5.1 Negative attitude due to economic damage caused

- **Important**

European minks can cause economic damage by killing domestic animals (so far they have killed a few chicken, rabbits and kittens) or by eating fish or crayfish kept in ponds. It cannot be fully excluded that individuals that have survived in and are adapted to the wild get into human settlements but this is likely to happen much more seldom than in newly released animals. Pine marten, for instance, which is much more abundant in Hiiumaa, gets into human settlements more often and thus it causes also more damage.

2.3.5.2 Misconceptions

- **Of low importance**

See pp. 39-40, risk factor 2.2.2.2.

2.3.6 Discontinued gathering of scientific information necessary for successful conservation management.

- **Important**

In parallel with the establishment of the European mink population, there has formed a comprehensive data base on the course of activities and on the different development stages of the population. This database is essential for analysing the situation and for identifying the right courses of action. The gathered data are essential for both successful establishment of the population in Hiiumaa and in a broader context – as a good experience that others can learn from in facing similar tasks. Further activities can be successful only if regular gathering of scientific information continues. Broken flow of information will inevitably lead to inadequate management decisions, which, in the best case, would make all management activities expensive but, in the worst case, would lead to the destruction of the establishing population.

2.4 Risk factors related to habitats

Table 9.

Risk factors related to the habitats of the European mink (*Mustela lutreola*) in Hiiumaa, ranked by levels of importance.

Risk factor		Important
2.4.1 Scarcity of food resources	2.4.1.1 Changing and limited abundance of amphibians	Highly important
	2.4.1.2 Poor condition of fish fauna	
2.4.2 Scarcity of shelters		
2.4.3 Scarcity of places with open water in winter		
2.4.4 Human activities damaging the habitats	2.4.4.1 Impact of drainage on habitats	

2.4.1 Scarcity of food resources	2.4.1.3 Poor condition of crayfish	Important
2.4.4 Human activities damaging the habitats	2.4.4.2 Water pollution	
	2.4.4.3 Forestry activities	
	2.4.4.4 Construction activities	Of low importance

2.4.1 Scarcity of food resources

Scarcity of prey is one of the most important factors limiting the abundance of carnivores. The European mink is a so-called umbrella-species in fluvial habitats, that is, the welfare of the species depends of that of the entire aquatic biota. The abundance of amphibians (the main prey item) in fluvial habitats is extremely important, but also the occurrence of fish and crayfish, which are eaten in great amounts too, especially in summer and especially by females raising a litter.

2.4.1.1 Changing and limited abundance of amphibians

- **Highly important**

In August 1999, Dr. V. E. Sidorovich estimated the population density of frogs (*Rana sp.*) in Hiiumaa and ascertained that in forest landscapes and in riparian biotopes it does not differ considerably from the averages in Belarus (Macdonald, 2002; see also pp. 17-18). In dry forest types dominated by pine, on dry grasslands and on the sea coast the density is lower.

Extensive drainage works carried out in the Soviet time have had a negative impact on the distribution and abundance of amphibians – due to rapid runoff, spawning waters dry up too quickly, which hinders the development of tadpoles. In the area of drained virgin lands there are only a few spawning water bodies, most of them man-made (in eastern and southern areas of Hiiumaa). The location and condition of spawning waters in spring-summer of 2002 is shown in Figure 16.

Of the 53 spawning water bodies observed in 2002, 20 dried completely, in the remaining 33 there was water until mid-June – mostly very low and small pools or otherwise badly suitable water bodies (flowing water) and the productivity of spawning sites was probably very low. Although the summer of 2002 was very dry and the observations do not reflect the usual situation, the condition of spawning sites in general is still rather poor – according to visual observations of water bodies in 2000–2001 and 2003, the situation did not differ much from that in 2002 (spring is usually dry on the island). Thus it can be expected that the mortality of young stages of amphibians will be high in Hiiumaa in all at least slightly drier years. Amphibians, especially frogs (*Rana* sp.), are the most important prey items of the European mink and the decrease of their abundance will seriously endanger the survival of the Hiiumaa mink population.

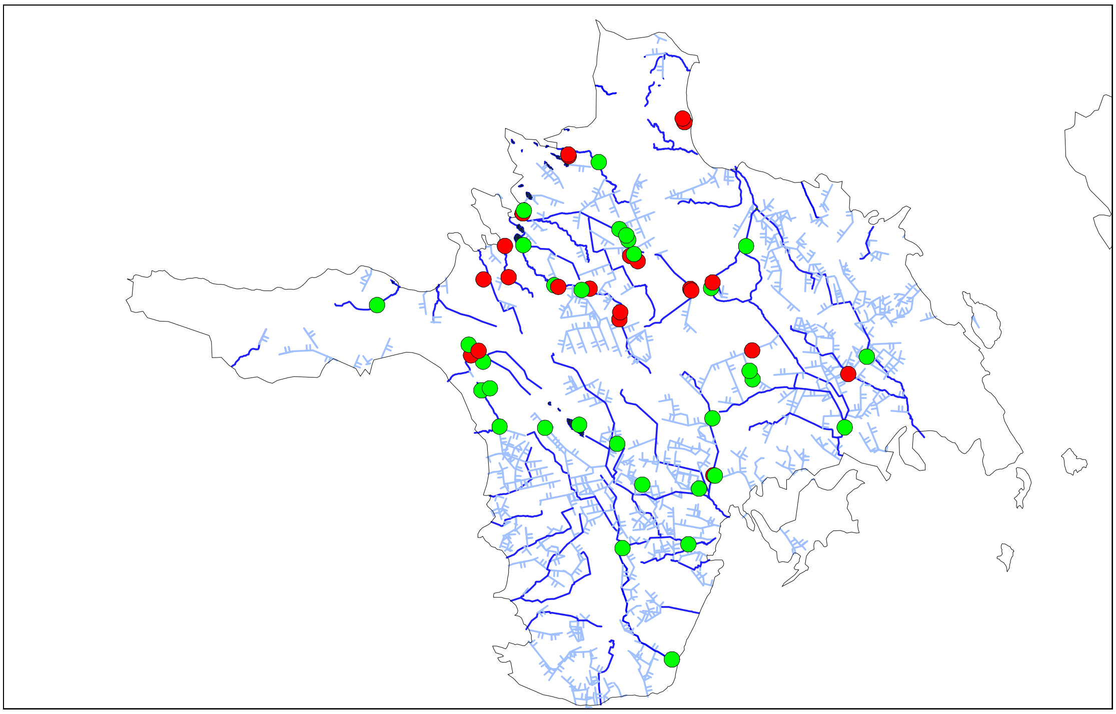


Figure 16. Condition of spawning sites of frogs in spring-summer 2002.

- 🟢 - **water in mid-June**
- 🔴 - **dry in mid-June**

2.4.1.2 Poor condition of fish fauna

- **Highly important**

According to a study conducted by M. Kangur (2003) and also earlier studies (Jarvekulg, 2001; Laanetu, 1998), there are few fish species (15) in the inland water bodies of Hiiumaa and population density in summer is low. In trout rivers (Vanajogi, Nuutri and lower course of Ongu stream) the abundance is somewhat higher. Pike was rather abundant in the lower course of Kidaste stream and Suuremoisa river, and also in Pihla stream (see pp. 18-19).

Compared to smaller water courses on the mainland, the quantitative indicators for trout, pike and burbot are rather similar. Roach is mostly more abundant on the mainland (non-migratory roach). The main factors influencing the condition of water courses in Hiiumaa are hydrological regime (Kangur, 2003) and the condition of other ecological factors (geomorphological condition, etc.), which has been strongly deteriorated by drainage (Laanetu, 2002). Permanent fish populations (only burbot, pike and trout) exist only in bigger water courses (see pp. 18-19).

Where fish are abundant, they form a high share in the diet of the European mink (Maran et al, 1998), particularly in summer (Sidorovich et al., 1997). Fish is an important prey item of the European mink, next to amphibians and rodents, and low abundance of fish certainly has a negative impact on the population, especially in summer, when amphibians have dispersed from the banks, and especially on females with litters, who need a lot of food.

2.4.1.3 Poor condition of crayfish

- **Important**

According to a study by N. Laanetu (2002), there are crayfish populations only in these water bodies of Hiiumaa where the conditions are suitable – rivers Luguse, Vaemla and Suuremoisa (Figure 4). Distribution of crayfish (just like that of fish fauna) in the water bodies of Hiiumaa is limited mainly by instability of the hydrological conditions of water courses due to the small size of drainage areas and density of the drainage network. Ditching has also decreased the diversity of fluvial habitats and impoverished the entire aquatic biota. Studies conducted both in

Belarus (Sidorovich et al., 1997) and in Hiiumaa (unpublished) have revealed that where crayfish is abundant, its forms a rather important share in the diet of the European mink, especially in summer, and the lack of crayfish may thus have a certain impact also on the mink population. As a general rule, the share of crayfish in the diet remains lower than that of amphibians and fish because crayfish occurs in a smaller number of water bodies (at least in Hiiumaa) and also its energetic value is questionable.

Scarcity of food resources is one of the most important factors limiting the abundance of carnivores. For the European mink, the occurrence of amphibians (its main prey items) is essential but also the occurrence of fish and crayfish is important. The latter are of particular importance for females with litters, especially in summer.

2.4.2 Scarcity of shelters

- **Highly important**

Scarcity of shelters is an important risk factor because it can cause the European mink (as a relatively small animal) to fall victim to other carnivores, but it also decreases the capacity of habitats (the home range of each individual will cover a longer stretch of bank than on water bodies rich in shelters) and thus also the maximum size of population.

Frequency of shelters in the riparian biotopes of the water bodies of Hiiumaa has been estimated to be low on 50.3%, medium on 37.6% and high on 12.1% of the total length of water courses (see pp. 21–22).

Shelters are least frequent on those stretches of river that flow mainly in agricultural landscape or have been canalised in the course of forest drainage (see pp. 21–22). Shelter possibilities on dredged stretches of rivers and streams and on man-made main ditches are usually limited by the lack of trees, in particular old trees. Dredged and straightened water courses lack also other places suitable as natural shelters (undercut banks, etc.).

2.4.3 Scarcity of places with open water in winter

- **Highly important**

When water bodies freeze, it becomes more difficult for the European mink and other semi-aquatic carnivores to catch prey from the water. Access to water is easier on water courses with a higher gradient, where there are ice-free areas due to rapids, and also in the areas of springs and in fast-flowing places of natural stretches of rivers. These places are also the best hibernation sites for one of the main prey items of the European mink, the common frog (*Rana temporaria*) (Sidorovich, 1997a). On drainage and main ditches, access to water is mostly difficult due to the profile of stream bed and the associated uniform flow rate. Animals moving long distances on ice in search of access to water can easily fall victim to other carnivores. Winter is the most difficult period for the European mink (just like for other animals), and availability of food is of vital importance in that period.

2.4.4 Human activities causing damage to habitats

The water courses of Hiiumaa are strongly damaged (in particular since the 1950ies) by various human activities – primarily drainage but also agricultural pollution and active forest management. Dredging of water bodies, cutting on the banks, or water pollution, affect the food resources of the European mink through changes in water regime, i.e. by deteriorating the water quality and damaging the drainage area. Establishment of a ditch network and clear cutting on banks speed up the runoff of surface water, which in turn causes big fluctuations of water level, increasing the risk of drying of water bodies and perishing of aquatic life. This also leads to eutrophication and decrease of the self-purification capacity of water bodies. Drainage systems and clear cutting have an impact also on the riparian zone – where the entire woody vegetation is cut off, water bodies are dredged and roads built on their banks, the shelter possibilities necessary for semi-aquatic animals are destroyed.

2.4.4.1 Impact of land improvement on habitats

- **Highly important**

As the bigger water bodies of Hiiumaa are designated as recipients of drainage systems, different maintenance works need to be carried out there. All water courses in Hiiumaa are influenced by land improvement systems to a bigger or lesser extent because drainage systems are located in their catchment areas.

Establishment of new and restoration of old land improvement systems has a negative impact on the food resources and shelter possibilities of the European mink because the water bodies of Hiiumaa have small catchment areas. Ditching of catchment areas increases the fluctuation of water level, extends the duration of low-water or dry periods and increases the sediment content (this is dangerous in particular for crayfish). It also increases the risk of oxygen deficit due to decomposition of organic substances and decreases the variety and self-purification capacity of water bodies. Of different land improvement works, fluvial habitats are damaged most by:

1. establishment of new land improvement systems – especially canalisation of natural stream beds, but also new ditching in the drainage area;
2. reconstruction of old land improvement systems – especially re-dredging of water courses that were dredged long ago and whose natural quality has partly recovered, but also restoration of ditches in the catchment area. Reconstruction has a strong impact on habitats due to the cutting of trees or brushwood – regular brushwood cutting prevents the formation of riparian stands;
3. small-scale maintenance works of the existing land improvement systems – habitats are damaged by digging of new short ditches, to some extent also by removal of trees fallen across the stream bed or into the water. Full removal of brushwood during ditch maintenance has a stronger effect, inhibiting the formation of riparian stands.

2.4.4.2 Water pollution

- **Important**

Water pollution has a negative impact on the entire aquatic biota (e.g. fish, crayfish, amphibians) and on the animals dependent thereon, including the European mink. In Hiiumaa, the main cause of pollution is agriculture, to a lesser extent forest management and settlements.

Agricultural pollution may occur when fertilisers (both mineral and organic fertilisers) reach the water through drainage and through ditches bordering crop fields, but also when land is cultivated too close to the water body (in the water protection zone). Pollution may have a stronger impact on those water bodies that run through agricultural landscapes. Of the core habitats of the European mink, such water bodies are:

River Suuremoisa
Villivalla main ditch
River Vaemla
Tammela stream (lower course)
River Luguse
Rebasselja stream
Tulimurru main ditch
Jausa stream

In the winter and spring of 2003, a significant increase in the level of total nitrogen content (N_{tot}) was observed in the ditch located in the upper course of Rebasselja stream and bordering on fields. The local people of Hiiumaa claim that the crayfish populations of Vaemla and Suuremoisa rivers have suffered severely from agricultural pollution of the Soviet period.

Pollution from forest management has not been recorded. However, in the environmental impact assessment report of the reconstruction of Laasimetsa-Armioja drainage network of Kardla forest district it is noted that clear cutting will increase the runoff of nitrogen (N) and phosphorus (P) from forest soil fourfold (in 8 years) and twofold (in 3 years), respectively. Studies carried out in Finland indicate that forest drainage increases the runoff of both N and P three times, in 5 years and 1 year, respectively (Tonisson, 2003). Active forest management on the banks of water bodies can thus considerably influence water quality and it can be dangerous for the European mink. Pihla stream, river Nuutri, Armioja stream, Ongu stream and river Vanajogi run mainly through forest expanses. According to N. Laanetu (2002) the crayfish introduced to Armioja died in the summer of 2002 due to drainage works in the upper course.

Sewage pollution from settlements may endanger primarily the lower courses of the rivers Suuremoisa and Nuutri, which are located in densely populated areas. The risk is higher in the lower courses of Jausa stream, river Luguse, Armioja and Ongu streams, which run in sparsely populated areas. Short stretches in lower courses might be in danger, yet these are also the best habitats for the European mink. A strongly polluted stretch in the lower course may inhibit the spawning migration of fish (e.g. sea trout) into the water and may thus have an effect on the whole fish fauna of the river.

2.4.4.3 Forest management

- **Important**

Cutting and drainage affect the water regime (see the previous chapter) and thereby also the food resources. Clear cutting and road construction on banks decrease the shelter possibilities of the European mink, impoverish the food resources and facilitate eutrophication of water bodies through changing the light conditions. The litter generated in the course of cutting (branches, tree tops) can end up in water bodies and affect the condition of water.

An important risk factor is clear cutting on banks. It is prohibited by the Act on the Protection of Marine and Freshwater Coasts, Shores and Banks, except in specific cases, e.g. for the maintenance of land improvement systems (see pp. 28–30). Also overly intensive improvement cutting (where bigger trees are cut out) deteriorates the quality of habitats. Clearing of brushwood (e.g. on road edges) in the course of maintenance of land improvement systems inhibits the formation of tree groups that enrich the landscape.

Road construction – roads are often constructed on one bank of a dredged river. The strip of bank separating the road from the river is usually very narrow and has no woody vegetation, which decreases the possibilities of the European mink to use this biotope. Being an animal with a sheltered way of life, the European mink usually avoids crossing open roads and the narrow zone between the road and the bank line does not provide sufficient possibilities for foraging and shelter.

2.4.4.4 Construction activities

- **Of low importance**

Construction activities can endanger the quality of habitats to some extent if, according to the Act on the Protection of Marine and Freshwater Coasts, Shores and Banks (RT I 1995, 31, 382; 1999, 95, 843; 2001, 50, 290; 2002, 61, 375; 63, 387; 99, 579), the extent of bank or construction prohibition zone is decreased in the upper course of a water course, where the drainage area is smaller. Where the construction prohibition zone is decreased to 10 m, the impact of the building may become a problem (if the yard reaches the bank) because it decreases the shelter possibilities and may affect food resources.

3 CONSERVATION MANAGEMENT

3.1 Protection objectives

3.1.1 Formation and maintenance of an at least minimum viable population of the European mink in Hiiumaa

The objective of conservation management of the European mink in Hiiumaa **is to establish in Hiiumaa an at least minimum viable European mink population (for the purposes of this management plan, a population that preserves 90% of its genetic diversity during 100 years is regarded as viable) consisting of 364–520 individuals.** To achieve and maintain this size of population, 109–347 individuals have to be actively involved in breeding in case the ratio between the effective and actual size of population remains between 0.3–0.5. To ensure the formation and survival of a population of this size, conservation management activities have to achieve the sub-objectives described below.

3.1.1.1 Strengthening of the forming European mink population in Hiiumaa

A new population cannot be established by one release of captive-born animals on the island. It requires long-term strengthening of the forming population with captive-born individuals.

3.1.1.2 Securing of a sufficient quantity of habitats

There are just as many habitats of the European mink in Hiiumaa as necessary to sustain a minimum viable population. In extreme years (draught summers, long and cold winters) the abundance of European minks may decline to a dangerously low level. Thus it is important for long-term preservation of the population to ensure the preservation and improvement of the quality of habitats. The quality of fluvial habitats in Hiiumaa can be considerably increased by relatively simple measures that enrich also the nature of Hiiumaa in general.

3.1.1.3 Decreasing of the impact of carnivores

Large carnivores, such as red fox and pine marten, have been among the main causes of mortality of European minks. Their abundance could be regulated with the help of conservation management measures. Achievement of this objective would be beneficial not only for the European mink population but also for many other species that have a competitive or predator-prey relationship with medium-size carnivores.

3.1.1.4 Prevention of possible impact of the American mink

The American mink has been the main cause of decline of the European mink in the entire range of the latter. Therefore, prevention of its possible impact is one of the most important protection objectives of the European mink population in Hiiumaa.

3.1.1.5 Maintenance of positive public attitude

Maintenance of positive attitude of the people of Hiiumaa towards the restoration of the European mink population is an essential pre-condition for various conservation management activities.

3.1.1.6 Ensuring of effective and long-term management of the established European mink population.

Establishment and maintenance of a European mink population requires, contrary to project-based activities typical in these days, continuous long-term activities: first in creating the population and thereafter in ensuring its survival. Without this continuity all of the restoration efforts of the species will become pointless.

3.2 Conservation management activities

The management activities were designed on the basis of risk factors and the protection objectives established on the basis of these.

3.2.1 Strengthening of the forming European mink population

Strengthening of the forming mink population includes several different activities. The first priority is to continue captive breeding and re-introduction of European minks (together with improvement of the methodology for release). It is also extremely important to restore the habitats damaged by land improvement and to preserve the quality of inland water bodies of Hiiumaa because the established population will be relatively small and isolated and one of the guarantees of its long-term survival is the existence of a sufficient quantity of habitats.

3.2.1.1 Captive breeding of European minks and their re-introduction in Hiiumaa

3.2.1.1.1 Keeping of a captive population of the European mink in Tallinn Zoo in the framework of the European mink EEP programme

Protection objective 3.1.1.1
Risk factors 2.2.1, incl. 2.2.1.1, 2.2.1.2 (2.2.1.2.1–2.1.1.2.5)
Priority: I

In order to make it possible to re-introduce European minks in Hiiumaa during a longer period, it is important to sustain a population of sufficient size in the Endangered Species Centre of Tallinn Zoo under the EEP programme. The population currently kept in Tallinn Zoo (100–120 individuals) is capable of securing the genetic diversity of the species for the following 50 years. It is estimated that such a population can supply 40–70 individuals annually for release into the wild.

3.2.1.1.2 Strengthening of the population in Hiiumaa with captive-bred specimens

Protection objective 3.1.1.1
Risk factors 2.2.1, incl. 2.2.1.1, 2.2.1.2 (2.2.1.2.1–2.1.1.2.5)
Priority: I

The results of monitoring of animals released in 2000–2003 and the experience gained in the course of reintroduction of other mammals (Reading & Clark, 1996) have indicated that such activities are very complex and there is little hope to achieve success by short-term introduction of specimens. A natural population can be formed through long-term supporting of the population with captive-bred individuals. As the release of each different species is always a unique activity and the specific features of the geographic location concerned add to the unique nature of each individual case, one is more likely to achieve success if different reintroduction methodologies are consistently applied and tested.

In the case of Hiiumaa, it is necessary to plan consistent releases of European minks for at least five years (ten at the maximum). Considering the capacity of the captive breeding centre of Tallinn Zoo, 40–70 animals can be released annually.

3.2.1.1.3 Improvement and application of the methodology for adapting captive-bred animals to the wild

Protection objective 3.1.1.1
Risk factors 2.2.1, incl. 2.2.1.1, 2.2.1.2 (2.2.1.2.2–2.2.1.2.5)
Priority: I

Experience gained so far has revealed that mortality of animals during the post-release adaptation period is high because captive-born animals lack the necessary skills for coping with wild conditions. High mortality of animals unavoidably delays the formation of a natural population and makes the whole activity very expensive. In order to decrease the time that it takes to achieve success, animals have to be better trained for release but also the living conditions in captivity have to be such that the behavioural repertoire of animals is least distorted or impoverished. To that end, it is necessary to proceed with the ongoing training scheme under which animals are trained to catch prey, to use fluvial habitats and to fear carnivores and man. It is also important to test the ways how to enrich the behavioural possibilities of captive environment, which will contribute to the preservation and restoration of the behavioural repertoire essential for the species.

It is essential for the establishment of a natural population that the most effective methodology of release is developed. The methodology used so far certainly needs to be improved but it is important to test also new methods in parallel. The main method will probably be a combination of the two methods used: release of pregnant females in spring and release of juveniles during the dispersal period. In addition, construction of special enclosures on stream banks in Hiiumaa should be tested to offer pregnant females a place for raising their young, who would then be released into the wild during the dispersal period.

3.2.1.2 Securing of a sufficient quantity of habitats and food resources

3.2.1.2.1 Restoration of spawning sites of frogs

Protection objective 3.1.1.2
Risk factor 2.4.1.1
Priority: I

Restoration of spawning pools of frogs is necessary in places where drying was observed in early summer. Also, new spawning water bodies have to be created in those core habitats of the European mink where suitable water bodies have been destroyed by drainage works. Considering the fact that frogs do not disperse far from the spawning sites – appr. 1 km (Ernits, 1983; Kiili, 1996), the spawning sites located in the immediate vicinity of water courses need to be restored in the first place. In total, 16 spawning water bodies need to be restored and 34 new ones created (50 in total). Ten new spawning sites have already been created and 7 have been restored as pilot activities in the course of drawing up this management plan (see Annex 9).

Restoration works include mainly dredging or expansion of the existing spawning pools or raising of the water level (in the case of ditches) in combination with excavation works. New spawning sites are created in places with more suitable natural conditions: where there are favourable light conditions for the development of tadpoles and where suitable summer habitats and wintering places are available nearby.

3.2.1.2.2 Improvement of the ecological condition of water courses with hydraulic structures

Protection objective 3.1.1.2

Risk factors 2.4.1, incl. 2.4.1.1, 2.4.1.2, 2.4.1.3; 2.4.3; 2.2.1 incl. 2.2.1.1; 2.3.3, incl. 2.3.3.1; 2.3.3.2.3;

Priority: I

Ditching and canalisation of rivers in the course of land improvement has spoiled the hydrological regime and ecological condition of water bodies. In order to restore them at least partly, it is necessary to construct hydraulic structures (riffles and weir rapids, spawning pads). As a result, the living conditions of fish and crayfish and wintering conditions of common frog will improve, the danger of water bodies drying up in draught summers will decrease (pools will form and the water level will stabilise) and access to water in winter will be improved (and thus also the probability of falling victim to other carnivores in winter will decrease)

The possible problems that might accompany the raising of water level are related mostly to the possible decline of the economic value of forest, especially in moister habitat types. Grasslands and cultivated lands could be endangered by the raising of water level if drainage systems are flooded due to damming. Yet it is not necessary to raise the water level that much. It is more likely that moderate raising of water level will increase the value of cultivated and grasslands in areas where the soil dries through easily. Raising of the water level of lake Tihu may influence the state of water because the trees growing on the swaying sward on banks may die and fall into the water. In Pihla bog, changes in the water level may affect the peat industry.

Restoration of the natural state of water bodies on the environment is likely to have wide positive impact which will probably outweigh the possible negative impacts. Raising of the water level of bogs (Pihla and Tihu bog) and lakes (Tihu lakes, Kunaauk) will have a positive impact on the entire aquatic life and thereby also on the bird fauna (waders, geese, crane), amphibians, fish, but indirectly also on many other species whose wood resources are increased. When water stays in bogs longer, the role of bogs as water reservoirs will be restored and the water supply in the upper layers of groundwater is likely to increase. Creation of weir rapids on water courses will improve the general state of water bodies (water quality, purification capacity) and the diversity of aquatic habitats. Raised water level in the area of agricultural lands may improve soil conditions in draught summers. Recreational value of all water bodies will improve – lakes will gain a higher value for fishing, bogs for berry-picking (cranberry, cloudberry), rivers for fishing and for catching crayfish. Also the aesthetic value of rivers and lakes will increase.

Five types of restoration works are necessary for improving the ecological condition of water bodies in Hiiumaa: 11 dams need to be built for stabilising or raising the water level, three culverts need to be installed in combination with raising of water level so as to direct water back to the stream bed, two lock regulators have to be constructed (mostly for allowing migration of fish), spawning pads have to be built in four places to improve the spawning conditions of sea trout (12 in total), and the ecological state of 102,7 km of water courses needs to improved by installing weir rapids and riffles (334 in total). The number and height of dams, weir rapids and riffles to be installed is determined according to the gradient of the stretch of water course concerned. This avoids economic damage from excessive raising of water level. The activity is partly covered by the works planned by Maa ja Vesi AS (2002) for improvement of the ecological condition of water courses in Hiiumaa (Annexes 8 and 9).

An overview of the locations, nature and expected outcome of the works is presented in Table 10, Figure 17 and Annex 9.

Table 10.

Hydrological works to be carried out for improvement of the ecological condition of water courses in Hiiumaa.

Water course	Work	Volume of work, location	Expected positive impact
Kidaste stream	removal of dikes of outflow ditches from the stream bed, installation of culverts in the stream bed together with construction of low (appr. 20 cm) dams on ditches	3 sites in the upper course, coordinates 22.60379/58.98705, 22.60190/58.98943 22.60070/58.99164	improved living conditions of the entire aquatic biota, incl. fish; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter
	raising of water level with appr. 20 cm high dams	2 sites on a former lake in the areas of outflow of drainage ditch and stream, coordinates 22.57696/59.01168, 22.57844/59.01173	improved living conditions of the entire aquatic biota, incl. fish, due to stabilisation of water regime; improved spawning conditions of amphibians in the former lake site; decreased impact of extreme years in the stream
River Nuutri	raising of water level with dams	2 sites, in the upper course on ditches from Maavli bog, coordinates 22.71746/58.94274 ja 22.71771/58.94253	improved living conditions of the entire aquatic biota, incl. fish, in the river; decreased impact of extreme years; improved access to water in winter
	construction of weir rapids and spawning pads	3 spawning pads + weir rapids on the stretch of upper course 22.73420/58.94899 to 22.72799/58.94616 (0.4 km)	improved living conditions of the entire aquatic biota, incl. spawning conditions of trout, in the river; decreased impact of extreme years; improved access to water in winter
River Vaemla	construction of riffles	30 sites in middle and upper course between 22.86492/58.85503 and 22.73049/58.86304 (9.6 km)	improved living conditions of the entire aquatic biota, incl. fish; improved living conditions of crayfish and conditions necessary for introduction created; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter
Ristivalja main ditch	construction of weir rapids and riffles	16 sites in middle and lower course between 22.85670/58.84661 and 22.80639/58.86051 (3.6 km)	improved living conditions of the entire aquatic biota, incl. fish; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter

Water course	Work	Volume of work, location	Expected positive impact
Tammela stream	construction of riffles	4 sites in middle and lower course between 22.86448/58.85637 and 22.83568/58.88185 (5 km)	improved living conditions of the entire aquatic biota, incl. fish; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter
River Suuremoisa	construction of weir rapids and riffles together with a sediment pool	8 sites in the middle course between in the stretch between 22.93619/58.87083 and 22.87465/ 58.92452 (7.6 km)	improved living conditions of the entire aquatic biota, incl. fish; improved living conditions of crayfish and conditions necessary for introduction created; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter
Villivalla main ditch	construction of weir rapids and riffles	3 sites in middle course between 22.93595/58.87071 and 22.86166/58.88899 (4.9 km)	improved living conditions of the entire aquatic biota, incl. fish; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter
River Luguse	construction of weir rapids and riffles (with sediment pools) and placement of single rocks into the river	41 sites in middle and upper course between 22.70321/58.81315 and 22.56712/58.87768 (13.7 km)	improved living conditions of the entire aquatic biota, incl. fish; improved living conditions of crayfish and conditions necessary for introduction created; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter
	construction of weir rapid	2 sites downstream from old mill dam, 22.71061/58.81127	improved living conditions of entire aquatic biota, incl. living and migration conditions of fish; improved living conditions of crayfish; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter
Rebasselja stream	construction of weir rapids and riffles	21 sites in lower and middle course between 22.70995/58.81416 and 22.70981/58.86608 (6 km)	improved living conditions of the entire aquatic biota, incl. fish; improved living conditions of crayfish and conditions necessary for introduction created; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter

Water course	Work	Volume of work, location	Expected positive impact
Tulimurru main ditch	construction of weir rapids and riffles	28 sites in lower and middle course between 22.70976/58.81401 and 22.64921/58.84613 (5.9 km)	improved living conditions of the entire aquatic biota, incl. fish; improved living conditions of crayfish and conditions necessary for introduction created; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter
Lake Tihu Suurjarv	raising of water level with dam	1 site on outflowing ditch, 22.57189/58.84670	improved living conditions of the entire aquatic biota, incl. fish; decreased impact of extreme years both in the lake and in river Luguse
Jausa stream	construction of weir rapids and riffles	25 sites in middle course between 22.67133/58.78640 and 22.57910/58.81199 (7.5 km)	improved living conditions of the entire aquatic biota, incl. fish; improved living conditions of crayfish and conditions necessary for introduction created; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter
Prassi main ditch	construction of weir rapids and riffles	16 sites in middle and lower course between 22.66723/58.71557 and 22.61617/58.73720 (4 km)	improved living conditions of the entire aquatic biota, incl. fish; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter
	reconstruction of lock regulator as a stepped fish pass	4 sites, 22.64901/58.72053	improved migration conditions of fish; improved wintering conditions of amphibians and improved access to water in winter because one weir is replaced by several smaller ones
Kulama main ditch	construction of weir rapids and riffles	10 sites in middle and lower course between 22.50487/58.73707 and 22.57014/58.73876 (4.4 km)	improved living conditions of the entire aquatic biota, incl. fish; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter
Vanamoisa main ditch	construction of weir rapids and riffles	7 sites in middle and lower course between 22.49458/58.75180 and 22.55416/58.75980 (4 km)	improved living conditions of the entire aquatic biota, incl. fish; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter

Water course	Work	Volume of work, location	Expected positive impact
Valjasoo main ditch	construction of weir rapids and riffles	26 sites in middle and lower course between 22.48970/58.75113 and 22.56547/58.79082 (6.8 km)	improved living conditions of the entire aquatic biota, incl. fish; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter
	reconstruction of lock regulator as stepped fish pass	4 sites 22.51145/58.75084	improved migration conditions of fish; improved wintering conditions of amphibians and improved access to water in winter because one weir is replaced by several smaller ones
Ongu stream	construction of spawning pads	3 sites in lower course, located at 22.46160/58.85087	improved spawning conditions of sea trout
River Vanajogi	raising of water level with dam	1 site in upper course, located at 22.51486/58.87668	improved living conditions of fish and decreased impact of extreme years both in river Vanajogi and in Tihu lakes
	construction of weir rapids	3 sites in middle and lower course between 22.43787/58.89313 and 22.41221/58.88077	improved living conditions of the entire aquatic biota, incl. fish; favourable conditions created for introduction of crayfish; improved wintering conditions of amphibians; decreased impact of extreme years
	construction of spawning pads	3 sites in middle course located at 22.43337/58.89244	improved spawning conditions of fish (sea trout)
Paope stream	construction of weir rapids and riffles	16 sites in middle course between 22.45538/58.94603 and 22.48556/58.92385	improved living conditions of the entire aquatic biota, incl. fish; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter
	construction of spawning pads	3 sites in lower course, located at 22.44822/58.95499	improved spawning conditions of sea trout
Armioja stream	construction of weir rapids and riffles	32 sites in middle and lower course between 22.53218/58.93684 and 22.61492/58.90703 and in lower course between lakelets Tammelais and Kunaauk between 22.48344/58.97412 and 22.48175/58.97628.	improved living conditions of the entire aquatic biota, incl. fish; favourable conditions created for introduction of crayfish; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter

Water course	Work	Volume of work, location	Expected positive impact
	raising of water level with dams	3 sites in outflow places of lakelet Kunaauk, located at 22.48549/58.98019	improved living conditions of fish in lakelet Kunaauk; improved conditions for fish migration into Armioja stream
Pihla stream	construction of weir rapids and riffles	21 sites in middle course between 22.63759/58.95317 and 22.60319/58.96930 and in lower course between 22.56180/58.98036 and 22.52765/58.97788	improved living conditions of the entire aquatic biota, incl. fish; favourable conditions created for introduction of crayfish; improved wintering conditions of amphibians; decreased impact of extreme years; improved access to water in winter
	raising of water level with dams	2 sites on drainage ditch flowing out of Pihla bog (22.69032/58.93422) and on upper course of Pihla stream (22.68616/58.93457)	improved living conditions of the entire aquatic biota, incl. fish, in Pihla stream; improved spawning conditions of amphibians in the bog and improved wintering conditions in the stream; decreased impact of extreme years

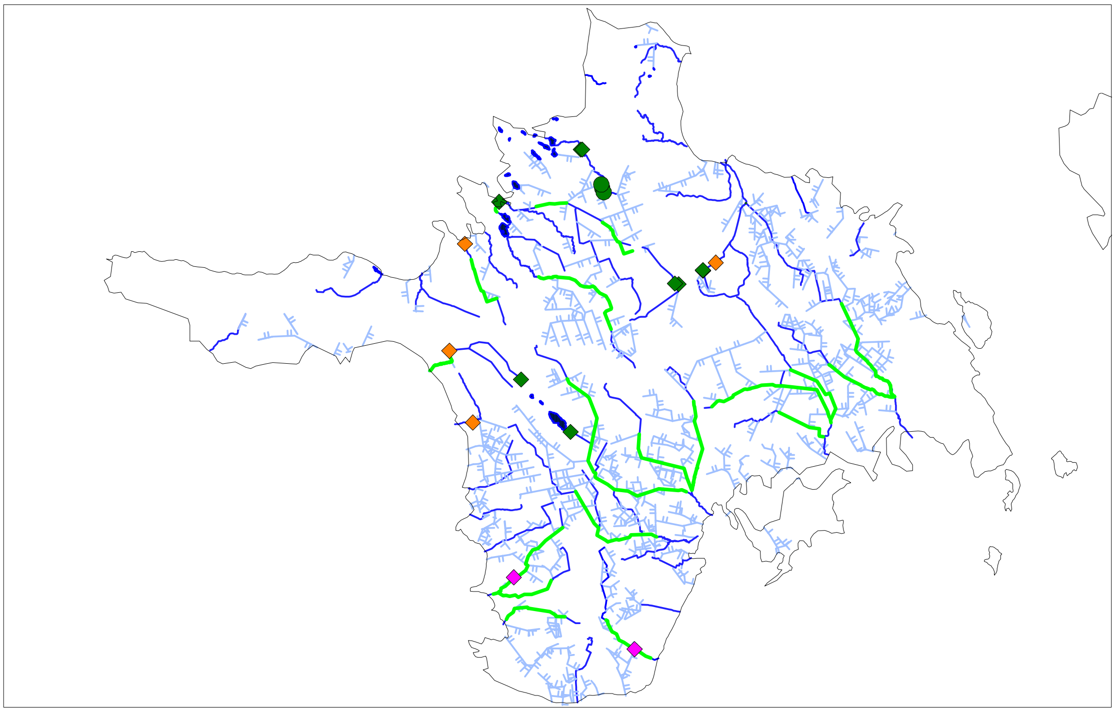


Figure 17. Hydrotechnical works for improvement of the ecological condition of water bodies.

- construction of dam
- installation of culverts in combination of construction of dams
- reconstruction of lock regulators
- construction of spawning pads
- stretches where weir rapids and riffles will be constructed

More detailed locations are presented in Annex 9.

3.2.1.2.3 Re-stocking of crayfish into suitable water bodies

Protection objective: 3.1.1.2
Risk factor 2.4.1 (2.4.1.3)
Priority: III

The precondition for successful re-stocking of crayfish is prior completion of activity No. 3.1.2.2.2, in particular on the rivers and streams of Armioja, Pihlaoja, Luguse, Jausa, Vaemla and Suuremoisa. The range of crayfish needs to be extended into places where the species is lacking and where suitable conditions have been created for the species. Considering the current state of crayfish habitats in Hiiumaa (Laanetu 2002), the populations of the river Jausa and Armioja stream need to be restored and crayfish needs to be introduced in the middle course of Pihla.

Founder specimens of crayfish have to originate from Hiiumaa to avoid the spreading of parasites and diseases. According to preliminary data (Laanetu, 2002), only the population of Luguse is suitable for providing the founders.

Distribution of crayfish is usually limited by abrupt fluctuations of water level, insufficient quantity of water and periodical drying of water courses. To decrease these negative impacts, it is recommended that riffles, weir rapids and stream narrowers are constructed and pools excavated on prospective crayfish rivers in order to improve the water regime and increase the diversity of habitats (see pp. 57–63).

The following water courses and stretches thereof are suitable for re-stocking of crayfish:

- Armioja stream – middle and lower course

- Pihla stream – middle and lower course
- river Nuutri – middle course
- river Suuremoisa – middle course
- Jausa stream – middle and lower course
- Ongu stream – lower course
- river Vanajogi – middle and lower course

It is rather difficult to estimate the time and labour consumption of restoration of crayfish. It is a long process due to both the time necessary for creating new populations and the limited number of founder specimens available in Luguse. In one place of release crayfish have to be released during five consecutive years at the minimum. The river Luguse can annually provide 1000–2000 specimens for re-stocking (Laanetu, pers. comm.). Prior to rehabilitation of water bodies it is recommended that up to 1000 specimens are annually released in areas with satisfactory water condition – Ongu stream, river Vanajogi, lower course of Pihla stream, river Nuutri.

3.2.1.2.4 Creation of shelters

Protection objective 3.1.1.2, 3.1.1.3
Risk factors 2.2.1, incl. 2.2.1.1; 2.2.1.2.3; 2.3.2, incl. 2.3.2.3; 2.3.3, incl., 2.3.3.1, 2.3.3.2. (2.3.3.2.3)
Priority: I

Regular removal of brushwood from the banks of water courses has inhibited the formation of riparian stands and also the generation of single older trees in riparian biotopes. A stretch of bank with old trees (especially a natural stretch) usually offers abundant shelters for the European mink, while in young trees the root cavities, hollows, etc., which the animals could use as shelters or dens, have not developed yet.

While riparian brushwood or young trees offer few shelters, it is necessary to construct new shelters in core habitats, as natural formation of shelters takes too much time (decades). To that end, brushwood or younger (deciduous) trees have to be thinned by improvement cutting and placed in heaps at the distance of appr. 2–3 m from the water line. Creation of additional shelters allows the animals to use smaller home ranges in the case of sufficient food resources (capacity of habitat will increase) and the risk of European minks falling victim to other carnivores is decreased. Shaping of riparian stands by thinning of brushwood will have also other positive impacts:

- growth properties and growth rate of the remaining trees will improve (and thus also the generation of natural shelters both in water and on land);
- roots of the remaining trees or stands will make the banks less vulnerable to erosion;
- amenity of landscape will improve;
- favourable light conditions created by the remaining trees or stands (sheltered areas) improve the condition of water bodies by decreasing the proliferation of herbs;
- thinning of brushwood by improvement cutting decreases the amount of debris (fallen brunches and brushwood) in water bodies – mainly the trees that lag in growth and would otherwise die and fall into the water sooner or later are cut out;

Shelters will be created following the standard of 2 shelters/100m, which allows the European mink to find sufficient shelter also in case its home range covers only a short stretch of bank (~1–2 km). Shelters need to be created on the total of 84.8 km of bank of core habitats (424 shelters in total).

An overview of the works necessary for improving shelter possibilities on different rivers is given in Table 11 and Figure 18.

Table 11.

Creation of shelters on stretches of different water courses.

Water course	**Length of stretch, km**	**No. of shelters**
River Suuremoisa	8.0	40
Villivalla main ditch	3.6	18
Tammela main ditch	4.0	20
River Vaemla	11.1	55
Rebasselja stream	3.8	19
Tulimurru main ditch	1.4	7
River Luguse	14.9	75
Tihu ditch	0.7	3
Jausa stream	5.2	26
Prassi main ditch	2.4	12
Kulama main ditch	4.4	22
Vanamoisa main ditch	2.6	13
Valjasoo main ditch	4.1	20
Paope stream	3.6	18
Armioja stream	7.1	36
Pihla stream	4.3	22
Ristivalja main ditch	3.6	18
Total	**84.8**	**424**

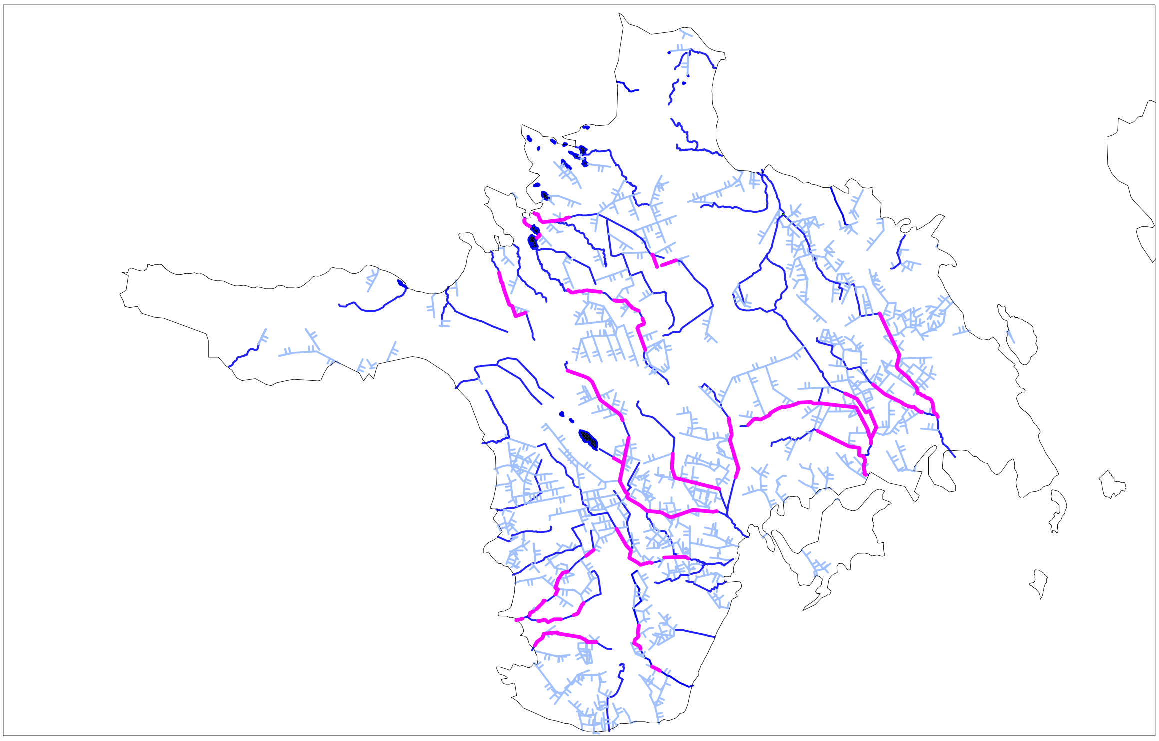


Figure 18. Establishment of shelters (____) in riparian biotopes of water courses in Hiiumaa.

A more detailed scheme of the locations of works is presented in Annex 11.

3.2.1.2.5 Preservation of the forming riparian stands in core habitats (on banks of dredged rivers and streams and recipients of drainage systems)

Protection objective 3.1.1.2, 3.1.1.3
Risk factors 2.3.2, incl. 2.3.2.3; 2.3.3 incl., 2.3.3.1, 2.3.3.2 (2.3.3.2.3)
Priority: I

Preservation of the forming riparian stands is necessary primarily on dredged rivers and recipients of drainage systems that flow in agricultural landscapes, but also on rivers canalised during forest drainage and belonging to the core habitats of the European mink (see Figure 19, Annex 11). Constructed shelters (see pp. 65-66) will improve habitat conditions but they will decay with years and the formation of riparian stands / groups of trees in the riparian zone is still necessary. More attention should be paid to water bodies where the tree species growing on banks could form a stand (alder, birch, aspen, ash, pine, spruce). According to the plan for restoration of fish spawning grounds drawn up by AS Maa ja Vesi, strip of trees should cover at least 50% of bank line, which is optimal also for the European mink. Thus, the riparian stands in stretches indicated in Figure 19 should be created on at least 50% of the bank line and, naturally, it is necessary to preserve also the forests in those areas where the water course runs in forest land (pursuant to the Act on the Protection of Marine and Freshwater Coasts, Shores and Banks). The forming riparian stands / groups of trees will enrich the riparian biotope both through raising the quality of habitats (formation of root hollows decreases the risk of minks getting killed) and through increasing food resources, but they will also improve the amenity of the landscape (see pp. 65) and the general condition of water bodies (incl. the condition of fish and crayfish populations – see pp. 18–20).

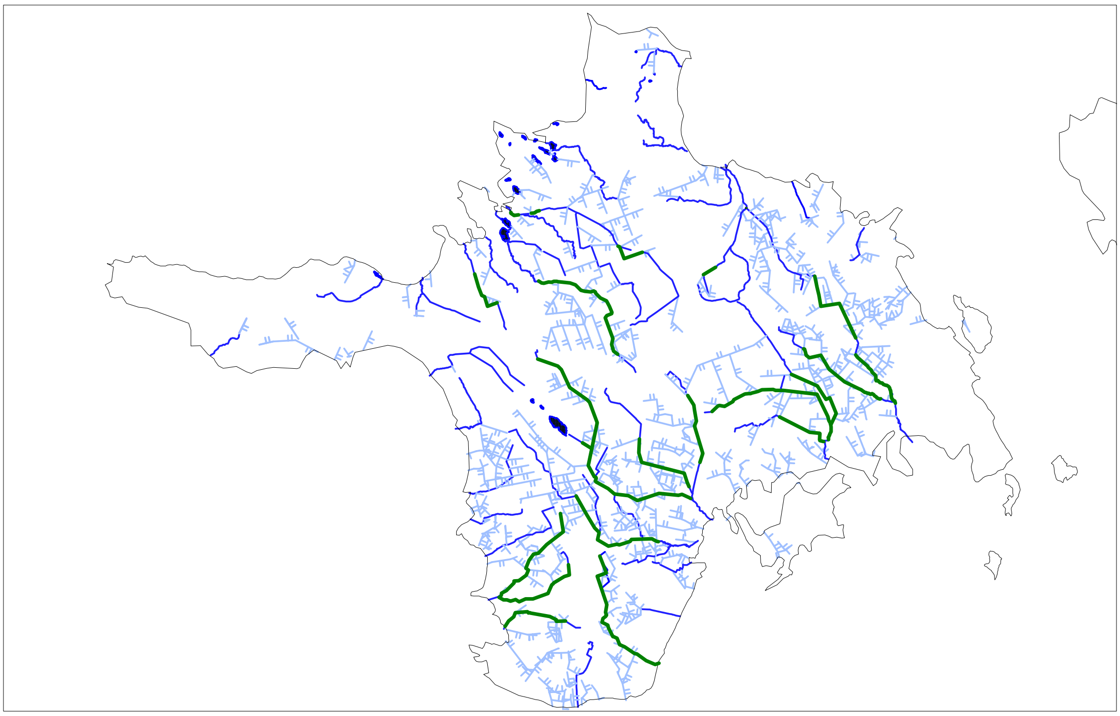


Figure 19. Banks of water courses where the forming riparian stand (▬) needs to be preserved.

A more detailed scheme of locations of water bodies where riparian stands need to be preserved is presented in Annex 11.

The works done to ensure a sufficient quantity of habitats and food resources will decrease the variation of food resources due to changes in environmental conditions and increase the capacity of habitats. It is realistic to achieve that restoration works will increase the population density to a level characteristic of slow-flowing natural rivers or

streams – restoration of 102.7 m of main ditches would lead to the increase of the population by at least 13–25 individuals, that is, to 63–117 individuals. Later, when the natural condition of water bodies has further recovered, also the European mink population is likely to further increase.

3.2.1.2.6 Organisation of water monitoring in Hiiumaa

Protection objective 3.1.1.2
Risk factor 2.4.4.2
Priority: II

Water quality is assessed regularly (on a monthly basis) on three water bodies of Hiiumaa in the frames of the B7 (*Baltic Seven Islands*) – rivers Nuutri, Suuremoisa and Luguse. In order to avoid agricultural pollution, one of the biggest producers of Hiiumaa, OU Ari Kaup, is required to organise water monitoring in the area of crop fields where pig farm slurry is spread (a requirement set out by user permit). Due to the risk of forestry pollution from the Laasimetsa drainage system, the institution responsible for the works (Kardla forest district) is required to organise water monitoring. Water monitoring is implemented by the Administration of Hiiumaa Protected Areas.

From the point of view of the European mink, there is no need for organising additional water monitoring on the water courses of Hiiumaa. The current monitoring provides sufficient information on the condition of water bodies.

*3.2.1.2.7 Establishment of protection regime in core habitats – designation of protection areas (*hoiualad*) and permanent habitats*

Protection objective 3.1.1.2
Risk factors 2.3.2; 2.4.1; 2.4.2; 2.4.3; 2.4.4
Priority: I

VERSION A – Additions to new Nature Conservation Act

Under the new nature conservation act the selected core areas will be protected as special conservation areas (*hoiualad*) or species protections sites (*pusielupaigad*). The protections rules must incorporate the following restrictions:

- Forestry:
  - regeneration cutting is prohibited in riparian zone of 10 meters,
  - within 10-50-meter riparian zone the regeneration cutting is allowed only as the shalterwood and clearcutting. The width of the cutting area must not extend over 30 meters, the lank must me directed perpendicular with the watercourse and the distance between cutting ares shall not be less than 100 meters.
- Drainage:
  - The construction of drainage systems is prohibited
  - The renovation of already existing drainage systems is permitted with exclusion of renovation of ditches to their initial form. Recipient areas of drainage system can partially be renovated with respective permission of the administrator/manager of special conservation area/species protection site provided that the undertaken renovation will not have longterm and substantial negative effect to European mink habitats.
  - In the course of renovation or management of drainage system a partial removal of trees is permitted only from one bank; single trees or groups of trees shall be maintained with interval of maximum 50 meters.
  - The establishement of small drainage system can be permitted by the administrator/manager of special conservation area/species protection site

provided that this will not have a longterm and substantial negative effect to European mink habitats.

VERSION B – Changes in the Act on the Protection of Marine and Freshwater Coasts, Shores and Banks.

The following amendments will be made to the Act on the Protection of Marine and Freshwater Coasts, Shores and Banks **(RT I 1995, 31, 382;** 1999, 95, 843; 2001, 50, 290; 2002, 61, 375; 63, 387; 99, 579):

§ 1. Subsection 5 of section 8 is repealed.

§ 2. § 9^1 is added to the Act in the following wording:

” § 9^1 Special requirements for the protection of banks of water body that are habitats of protected species.

(1) The list of water bodies or stretches thereof that are habitats of protected species shall be established by the Minister of Environment.

(2) On the banks of water bodies listed according to subsection 1 of this section, the following activities are prohibited, except in cases listed in subsection 4 of this section:

1) altering of stream bed or lake bank;
2) extraction of mineral resources or earth material;
3) establishment or expansion of enterprises and storage facilities where dangerous goods are used, generated or stored;
4) regeneration cutting of forest in the form of clear cutting;
5) construction of land improvement systems as defined in the Land Improvement Act (RT I 2003, 15, 84).

(3) The restrictions referred to in subsection 2 of this section shall apply to:

1) 200 m from the mean water level line on the banks of water bodies designated as the habitats of salmonids;
2) 50 m from the mean water level line on the banks of water bodies designated as European mink habitats;
3) .... other species.

(4) The restrictions referred to in subsection 2 of this section shall not apply if environmental impact assessment does not ascertain a negative impact on the water regime, water quality or condition of bottom or bank of water body to an extent that endangers the survival of the species referred to in subsection 3 in the water body concerned.

§ 3. Subsection 3 of section 11 is amended to read as follows:

„(3) Cutting of woody vegetation in a water protection zone is prohibited except where necessary for maintenance of water conduits or reservoirs, or for maintenance or regeneration of woody vegetation by sanitary or shelterwood cutting and for preservation or restoration of a habitat of a protected species in accordance with a management plan.“

Motivation: incorporation of the aspect of species protection into the Act on the Protection of Marine and Freshwater Coasts, Shores and Banks is essential for the protection of habitats of endangered or economically important species, such as the European mink and salmonids. In particular, the negative impact of land improvement and forestry (clear cutting) in fluvial habitats has to be prevented. In addition, the Act should allow implementation of works necessary for the improvement of conservation status. Amendments to the Act on the Protection of Marine and Freshwater Coasts, Shores and Banks are formulated on the basis of these principles.

3.2.2 Decreasing of the impact of carnivores

Decreasing of the impact of carnivores is essential mainly during the period of establishing the population, but to some extent also in the established population. This means more effective regulation of the numbers of carnivores in particular in the coming few years. Later, once the population has formed, wild-born minks will be better adapted to the surrounding conditions, including carnivores. The possibility of minks getting killed will be decreased also by the improvement of habitat quality as an outcome of other activities (shelters, etc.).

3.2.2.1.1 Creation of shelters

Protection objective: 3.1.1.3
Risk factors 2.2.1, incl. 2.2.1.1; 2.2.1.2.3; 2.3.2, incl. 2.3.2.3; 2.3.3, incl., 2.3.3.1, 2.3.3.2. (2.3.3.2.3)
Priority: I

See pp. 65-66, activity 3.2.1.2.4.

3.2.2.1.2 Improvement of the ecological condition of water courses by means of hydraulic structures

Protection objective: 3.1.1.2, 3.1.1.3
Risk factors 2.4.1, incl. 2.4.1.1, 2.4.1.2, 2.4.1.3; 2.4.3; 2.2.1 incl. 2.2.1.1; 2.3.3, incl. 2.3.3.1; 2.3.3.2.3;
Priority: I

See pp. 57–63, activity 3.2.1.2.2.

3.2.2.1.3 Preservation of the forming riparian stands in core habitats (on the banks of dredged rivers and streams and recipients of drainage systems)

Protection objective 3.1.1.2, 3.1.1.3
Risk factors 2.3.2, incl. 2.3.2.3; 2.3.3 incl. 2.3.3.1, 2.3.3.2 (2.3.3.2.3)
Priority: I

See p. 67, activity 3.2.1.2.5

3.2.2.1.4 Intensification of fox, raccoon dog and pine marten hunt during the period of establishing the European mink population

Protection objective: 3.1.1.3

Risk factor 2.2.1, incl. 2.2.1.1
Priority: I

In order to regulate the numbers of medium-size carnivores in Hiiumaa, the ongoing hunting competition should be intensified and extended. In addition to the first prize (big game hunting licence), prizes should be awarded also to a certain number of other more active hunters. The duration of the pilot project is three years.

3.2.3 Avoidance of the impact of American mink

Avoidance of the impact of the American mink is of vital importance for the preservation of the European mink population in Hiiumaa. As the likelihood of formation of American mink population through invasion of the species from the mainland is very small due to natural conditions, it is more important to avoid the re-establishment of mink farming on the island: the escaped specimens would form a solid basis for the formation of a feral population of the American mink on the island. This situation would destroy the possibility of forming a wild population of the European mink on the island. In this case all the time, energy and money invested so far into achieving the objective would be in vain.

3.2.3.1.1 Monitoring in Hiiumaa and its vicinity (Vormsi)

Protection objective 3.1.1.4

Risk factor 2.3.1.1
Priority: II

Monitoring of the American mink (*Mustela vison*) in Hiiumaa can be organised in parallel with monitoring of the European mink, using the same methodology (see p. 74).

Organisation of monitoring of the American mink in the vicinity of Hiiumaa concerns mostly the island of Vormsi, as it lies close enough to the mainland for the American mink to reach the island. Also, the habitats available in Vormsi could make it possible for single specimens to survive and reach Hiiumaa. The monitoring is basically similar to that in Hiiumaa (track census and trapping) but it is less work consuming – as there are very few suitable habitats in Vormsi, minks will be easier to find, especially in the case of their high abundance, when there is also bigger likelihood of some specimens moving to Hiiumaa. There is certainly no need for organising annual monitoring in Vormsi, a three-year interval will be sufficient.

3.2.3.1.2 Legal regulation of farming of American mink

Protection objective 3.1.1.4
Risk factor 2.3.1.2
Priority: I

Proposals for amending the draft Nature Conservation Act

1) Subsection 6 of § 53 of the draft Act should be amended to read as follows:
„ (6) (in the draft: 185) Captive breeding of non-native species endangering the ecological balance is prohibited.“

Motivation: There are essentially no isolated ecosystems in Estonia. Although islands can be conditionally regarded as isolated ecosystems, in our natural conditions they are accessible to most of the free-living wild animals.

2) Clause 7 should be added to subsection 1 of §68 of the draft Act (in the draft: 232) in the following wording:
„7) specimen of a non-native species that endangers the ecological balance was bred in captivity in a manner that allowed the specimen to escape into the wild.“

Motivation: biological contamination is, in essence, comparable with or even more dangerous than pollution or contamination of a territory.

3) Subsections 5 and 6 are added to §77 of the draft Act in the following wording:
„(5) Animal farms established prior to the date of effect of this Act and raising specimens of non-native species that endanger ecological balance must be closed, or the animal species endangering the ecological balance should be replaced, within 20 years of the date of effect of this Act.

(6) If an animal farm referred to in subsection 5 of this section continues to raise specimens of non-native species endangering ecological balance during the term established in the same subsection, it must, within five years from entry into force of this Act,:
1) mark all specimens of the non-native species endangering ecological balance;
2) supply the enclosure of the animal farm with devices that exclude the escape of animals under, over or through the barrier.“

Motivation: sufficient time must be allowed for final prohibition of captive breeding of specimens of non-native species endangering ecological balance, and it is expedient to apply stricter measures for preventing the escape of animals also during the interim period.

3.2.4 Avoidance of development of negative public attitude

The main reason for development of negative attitude is the damage that European minks may cause by killing domestic animals. Positive attitude could thus be maintained in a situation where European minks do not get to human settlements at all. As this is impossible to ensure, the damage caused must be compensated with a fair price and with no delay. In order to avoid negative attitude caused by misconceptions or lack of information, it is necessary to inform the public of the serious need for restoring the European mink population in Hiiumaa, of the course of activities, etc.

3.2.4.1.1 Compensation for damage that European minks cause by killing domestic animals on farms.

Protection objective 3.1.1.5
Risk factors 2.2.2, incl. 2.2.2.1; 2.3.5, incl. 2.3.5.1
Priority: III

Damage caused by protected animals and migrating birds is compensated for in accordance with regulation No. 21 of 10 March 2003 of the Minister of Environment "Methodology and procedure for assessment of and compensation for damage caused by protected animals and migrating birds". According to subsection 3 of § 3 of this regulation, a committee shall assess the damage caused by the species not listed in the regulation upon receipt of an opinion of an expert of the biology of this species. The expert shall be selected by the environmental department of the location concerned. The opinion must specify the extent and financial estimates of material damage probably caused by the species.

During the process of restoring the European mink in Hiiumaa, most of the victims of conflicts between minks and domestic animals have been domestic birds. Economic damage caused by a mink killing a chicken is bigger than just the market value of a new chicken due to the loss of profit in the form of eggs, and due to the fact that purchasing of a new chicken is associated with additional costs (e.g. cost of time and transport). It is not always possible to buy egg-laying chicken and, instead, one has to buy pullets, which begin to lay eggs only some time later. In the conditions of Hiiumaa it also matters that chicken cannot be bought all the year round and bringing them from the mainland is very expensive. Thus, the chicken killed in autumn can usually be replaced only next spring. Therefore the damage to be compensated for in the case of killed chicken is roughly the average market price of one and a half egg-laying chicken in the nearest point of selling. On the basis of prices in 2003, the compensation would equal 70*1.5=105 kroons per specimen.

Paying of higher prices is not recommendable because it may cause vain calls or even attempts of fraud, e.g. where chicken are killed by pine marten.

3.2.4.1.2 Regular updating of Web page

Protection objective 3.1.1.5
Risk factors 2.2.2 incl. 2.2.2.2; 2.3.5 incl. 2.3.5.2
Priority: III

Creation of the European mink population in Hiiumaa is a unique activity. Therefore the results of and experience from this activity are important not only in the context of this species and geographic location but also in a much broader context. This is why the activities have raised great interest both in Estonia and abroad. In order for an overview and results of activities to be operationally available for conservation experts, media workers, but also for any other interested persons, it is necessary to collect and regularly update material for the relevant Web page. The best suitable site for this information is the home page of foundation "Lutreola" – www.lutreola.ee, which is already providing information on the protection of the species both in Estonian and in English.

3.2.4.1.3 Publication of a brochure on the protection and biology of the European mink

Protection objective 3.1.1.5
Risk factor 2.2.2 incl. 2.2.2.2; 2.3.5 incl. 2.3.5.2
Priority: III

Currently there are no publications in the Estonian language introducing the European mink and its protection in more detail. A lot of important biological and management information has been gathered in the course of the activities carried out so far, especially various reports, which have mostly remained in the form of manuscripts. It would be relatively easy to draw up an overview brochure on the biology and protection of the European mink. This brochure could be published in the series "Game of Estonia".

3.2.4.1.4 Preparation of a Multimedia programme on CDs.

Protection objective 3.1.1.5
Risk factor 2.2.2 incl. 2.2.2.2; 2.3.5 incl. 2.3.5.2
Priority: III

Schools, environmental organisations and interested people often lack good visual material when it comes to introducing a species conservation project such as the establishment of a European mink population in Hiiumaa. The situation could be improved by preparing a Powerpoint slide programme that gives an overview of the biology of the species, its current state and restoration activities. This slide programme could be distributed on CDs, and also single slides could be used when there is a need to introduce the activities related to the European mink in some broader context, e.g. that of nature conservation in Estonia. The programme will be prepared in Estonian but it would require relatively few additional resources to translate it e.g. into English. The number of copies could be 150.

3.2.4.1.5 Preparation and publication of a leaflet

Protection objective 3.1.1.5
Risk factor 2.2.2 incl. 2.2.2.2; 2.3.5 incl. 2.3.5.2
Priority: II

The aim is to introduce the conservation activities of the European mink in Estonia in a popular form and in two languages to the following target groups:

- In Hiiumaa: schools, tourism companies (information centre), NGOs involved in nature conservation, municipalities, governmental offices.
- In Estonia: firms of nature tourism and NGOs involved in nature conservation, Ministry of the Environment and its divisions, etc.
- Abroad: international conferences and other meetings.

The brochure would be distributed by hand mail and through central organisations, to some extent also by mail

Number of copies: 7000.

3.2.5 Obtaining a consistent overview of the establishment and state of the European mink population

In order to make the establishment and further management of the European mink population more effective, it is necessary to carry out consistent monitoring and additional research. There exist no good examples of restoration of European mink populations, and activities concerning other species can be taken as a model on only a very general level. The need for studying the established population derives from the difference between the natural conditions in Hiiumaa (food resources, quantity and quality of habitats, etc.) and those in other regions where the biology of the species has been thoroughly studied.

3.2.5.1.1 Monitoring of the European mink in Hiiumaa

Protection objective 3.1.1.6
Risk factors 2.3.6; 2.3.1 incl. 2.3.1.1
Priority: I

To get an overview of the progress of release of European minks and of the condition of the population during its establishment, it is necessary to carry out continuous (annual) monitoring. The best time for monitoring is the period of snow cover. The methodology is based on track census combined with live trapping. In the period covered by this management plan, monitoring will produce data on absolute numbers of minks in Hiiumaa, on the sex and age structure of the population and on the condition of specimens.

3.2.5.1.2 Additional research

Protection objective 3.1.1.6
Risk factors 2.3.6; 2.3.5.
Priority: II

In order to manage a population of an endangered species on an at least satisfactory level, it is important to have an overview of different aspects of the ecology of the species. The knowledge required is partly available in the existing literature. In the case of such a rare species as the European mink the existing data are relatively inadequate but competent management decisions often require information on namely the population concerned. Therefore it is necessary to carry out applied studies on the conservation of the European mink in Hiiumaa. It is particularly important to study the diet, habitat use and breeding of the species.

3.2.6 Institutional arrangement of long-term management and protection of the established population.

The aim of the ongoing conservation activities of the European mink in Hiiumaa is to establish a self-sustaining population but it will be necessary to deal with conservation management issues also in future. In order to implement the management plan and organise long-term management of the population, the relevant institutional assumptions have to be met and there has tobe cooperation and exchange of information with many parties. It is not possible to fulfil the future tasks through a project-based approach: it is essential to ensure continuity of the activities.

3.2.6.1.1 Creation of a job for species conservation expert at the Administration of Hiiumaa Protected Areas for research and management of the European mink population.

Protection objective 3.1.1.6
Risk factors 2.2.1-2.3.3; 2.3.5–2.4.4
Priority: I

Implementation of the management plan both in the stage of establishing the population and in the course of its further management requires continuous activities in Hiiumaa. In the first stage the activities are related mainly to the release of animals and monitoring of their state, while in later stages the activities will focus on coordination of conservation measures, monitoring and gathering of applied scientific information. Therefore it is necessary to create a job for the relevant expert at the Administration of Hiiumaa Protected Areas. This is of particular importance because the European mink is endangered on the European level and Estonia has an international obligation to take care of the well-being of the species.

In the first stage the expert could work half-time and switch to full-time work once the population is established. Full-time work is estimated to cover also the probable need to continue conservation management in Saaremaa.

In addition to creating the job, the expert needs to be supplied with work equipment.

3.2.6.1.2 Establishment of the Coordination Committee for European Mink Conservation (NKKN).

Protection objective 3.1.1.6
Risk factors 2.2.1-2.3.3; 2.3.5–2.4.4
Priority I

Establishment of the European mink population in Hiiumaa and further management of the population fall in the sphere of interest of many stakeholders. Without the involvement of the various stakeholders and opinion leaders in decision-making concerning the management of the population, and without keeping them informed of the course of activities, there is a great danger of negative myths appearing around the activities and stakeholders may even lose interest. Involvement of different stakeholders is of particular importance because part of the activities have a significantly broader outcome for nature conservation and improvement of the living environment than just maintenance of the European mink population.

The NKKN is a voluntary body which will meet once a year on a regular basis and also at other times if necessary. The NKKN comprises the representatives of the following stakeholders: Environmental Department of Hiiumaa, Administration of Hiiumaa Protected Areas, private and public foresters, Land Improvement Office, hunting tenants, county government, foundation Lutreola, etc. Meetings of the NKKN will be convened and prepared by the species conservation expert at the Administration of Hiiumaa Protected Areas.

The NKKN will inform the stakeholders of progress achieved and of the planned activities, search for compromises in possible conflicts between different interests, and constitute a forum for finding new solutions that satisfy all parties.

3.3 Prioritisation of activities

Activities are ranked into three classes of priority based on the following considerations:

1. activities inevitable for the formation and long-term survival of the population;
2. activities important for successful establishment and further strengthening of the population;
3. activities supporting the formation and further management of the population.

The priority ranking based on these considerations is presented in Table 12.

Table 12. Activities necessary for ensuring the formation and survival of a viable population of the European mink (*Mustela lutreola*)[1].

ACTIVITY	PROTECTION OBJECTIVE	RISK FACTOR	PRIORITY
3.2.1.1.1. Keeping of a captive population of the European mink at Tallinn Zoo in the framework of the European mink EEP programme	3.1.1.1	2.2.1, incl. 2.2.1.1, 2.2.1.2 (2.2.1.2.1–2.1.1.2.5)	I
3.2.1.1.2. Strengthening of the Hiiumaa population with captive-bred specimens	3.1.1.1	2.2.1, incl. 2.2.1.1, 2.2.1.2 (2.2.1.2.1–2.1.1.2.5)	I
3.2.1.1.3. Improvement and application of the methodology for adapting European minks to the wild	3.1.1.1	2.2.1, incl. 2.2.1.1, 2.2.1.2 (2.2.1.2.1–2.1.1.2.5)	I
3.2.1.2.1. Restoration of frog spawning sites	3.1.1.2	2.4.1.1	I
3.2.1.2.2. Improvement of the ecological state of water courses by means of hydraulic structures	3.1.1.2, 3.1.1.3	2.4.1, incl. 2.4.1.1, 2.4.1.2, 2.4.1.3; 2.4.3; 2.3.3.1; 2.3.3, incl. 2.3.3.1, 2.3.3.2.3; 2.2.1 incl. 2.2.1.1;	I
3.2.1.2.3. Re-stocking of crayfish in suitable water courses	3.1.1.1	2.4.1 incl. 2.4.1.3	III
3.2.1.2.4. Creation of shelters	3.1.1.2, 3.1.1.3	2.2.1, incl. 2.2.1.1, 2.2.1.2.3; 2.3.2, incl.. 2.3.2.3; 2.3.3, incl. 2.3.3.1, 2.3.3.2 (2.3.3.2.3)	I
3.2.1.2.5. Preservation of the developing riparian stands in core habitats (on the banks of dredged rivers and streams and recipients of drainage systems)	3.1.1.2, 3.1.1.3	2.3.2, incl. 2.3.2.3; 2.3.3, incl. 2.3.3.1, 2.3.3.2 (2.3.3.2.3)	I
3.2.1.2.7. Establishment of protection regime in core habitats – designation of protection areas or permanent habitats	3.1.1.2	2.3.2; 2.4.1; 2.4.2; 2.4.3; 2.4.4;	I

[1] Activities that have no direct conneciton with conservation management of the European mink are not included (e.g. water monitoring)

3.2.1.2.8. Ensuring of the preservation of habitats of protected species on banks of water bodies: amendments to the Act on the Protection of Marine and Freshwater Coasts, Shores and Banks	3.1.1.2	2.3.2; 2.4.1; 2.4.2; 2.4.3; 2.4.4;	I
3.2.2.1.4. Intensification of fox, raccoon dog and marten hunt during the period of establishing the population	3.1.1.3	2.2.1, incl. 2.2.1.1	I
3.2.3.1.1. Monitoring in Hiiumaa and the vicinity (Vormsi)	3.1.1.4	2.3.1.1	II
3.2.3.1.2. Legal regulation of farming of American mink	3.1.1.4	2.3.1.2	I
3.2.4.1.1. Compensation for damage that European minks cause by killing domestic animals on farms	3.1.1.5	2.2.2, incl. 2.2.2.1; 2.3.5, incl. 2.3.5.1	III
3.2.4.1.2. Regular updating of Web page	3.1.1.5	2.2.2, incl. 2.2.2.2; 2.3.5, incl. 2.3.5.2	III
3.2.4.1.3. Publication of a brochure on the protection and biology of the European mink	3.1.1.5	2.2.2, incl. 2.2.2.2; 2.3.5, incl. 2.3.5.2	III
3.2.4.1.4. Preparation of a Powerpoint programme on CD-s	3.1.1.5	2.2.2, incl. 2.2.2.2; 2.3.5, incl. 2.3.5.2	III
3.2.4.1.5. Preparation and publication of a leaflet	3.1.1.5	2.2.2, incl. 2.2.2.2; 2.3.5, incl. 2.3.5.2	II
3.2.5.1.1 Monitoring of the European mink population in Hiiumaa	3.1.1.6	2.3.6; 2.3.1, incl. 2.3.1.1	I
3.2.5.1.2. Additional applied scientific studies	3.1.1.6	2.3.6; 2.3.5	II
3.2.6.1.1. Creation of a job for a species conservation expert at the Administration of Hiiumaa Protected Areas for management and research of the mink population.	3.1.1.1–3.1.1.6	2.2.1-2.3.3; 2.3.5–2.4.4	I
3.2.6.1.2. Establishment of the Coordination Committee for European Mink Conservation (NKKN)	3.1.1.1–3.1.1.6	2.2.1–2.3.3; 2.3.5–2.4.4	I

3.4 Time table and budget of activities

Table 13. Time table and budget of activities necessary for conservation management of the European mink (*Mustela lutreola*) (ranked by priority)

Activity	Priority	Cost						Possible source	Responsible body
		2004	2005	2006	2007	2008	Total		
3.2.1.1.1 Keeping of a captive population of the Eurpean mink at Tallinn Zoo in the framework of the European mink EEP programme	I	350 000	350 000	350 000	350 000	350 000	1 750 000	Foreign aid, Tallinn city government	Tallinn Zoo, foundation Lutreola
3.2.1.1.2 Strengthening of the Hiiumaa population with captive-bred specimens	I	15 000	15 000	15 000	15 000	15 000	75 000	SB[1], foreign aid	Foundation Lutreola, Hiiumaa KA[2]
3.2.1.1.3 Improvement and application of the methodology for adapting European minks to the wild	I	35 000	35 000?	–	–	–	70 000	Foreign aid, LIFE CO-OP[3]	Foundation Lutreola (Hiiumaa KA?)
3.2.1.2.1 Restoration of frog spawning sites	I	–	115 500	115 500	–	–	231 000[4]	EIC[5], foreign aid	Foundation Lutreola, Hiiumaa KA

[1] State budget

[2] Administration of Hiiumaa Protected Areas

[3] EU LIFE programme project

[4] The average price of restoration or creation of one spawning site is estimated at 7000 EEK (incl. VAT, based on pilot work by OU Kemehh), the total of 33 sites need to be restored/created.

[5] Environmental Investment Centre

Activity	Priority	Cost						Possible source	Responsible body
		2004	2005	2006	2007	2008	Total		
3.2.1.2.2 Improvement of the ecological state of water courses by means of hydraulic structures	I	–	300 000	339 000	339 000	339 000	1 317 000[5]	Foreign aid, EIC	Foundation Lutreola, Hiiumaa KA, Hiiumaa Envir. Dept.
3.2.1.2.4. Creation of shelters	I	–	21 200	–	–	–	21 200	EIC, Foreign aid	Foundation Lutreola, Hiiumaa KA
3.2.1.2.5. Preservation of the developing riparian stands in core habitats (on the banks of dredged rivers and streams and recipients of drainage systems)	I	–	–	–	–	–	–	–	Hiiumaa KA, Hiiumaa Envir. Dept.
3.2.1.2.7. Establishment of protection regime in core habitats – designation of protection areas or permanent habitats	I	–	–	–	–	–	–	–	Ministry of Environment
3.2.1.2.8. Ensuring of the preservation of habitats of protected species on banks of water bodies: amendments to the Act on the Protection of Marine and Freshwater Coasts, Shores and Banks	I	–	–	–	–	–	–	–	Ministry of Environment
3.2.2.1.4. Intensification of fox, raccoon dog and	I	40 000	40 000	40 000	–	–	120 000[6]	EIC	Hunters' Society of Hiiumaa, Tahkuna Hunters' Society,

[5] Activity includes project preparation in 2005 (EEK 200 000) and environmental impact assessment (EEK 100 000), practical implementation of works in 2006–2008 (EEK 886 600) and hiring of an expert for 2006–2008 (EEK 130 000, i.e. EEK 70 /h+33%).

Activity	Priority	Cost						Possible source	Responsible body
		2004	2005	2006	2007	2008	Total		
marten hunt during the period of establishing the population									Leluselja state hunting district
3.2.3.1.2. Legal regulation of farming of American mink	I	–	–	–	–	–	–	–	Ministry of Environment
3.2.5.1.1 Monitoring of the European mink population in Hiiumaa	I	20 000	20 000	20 000	20 000	20 000	100 000	SB	Foundation Lutreola, Hiiumaa KA
3.2.6.1.1. Creation of a job for a species conservation expert at the Administration of Hiiumaa Protected Areas for management and research of the mink population.	I	–	60 000	60 000	60 000	60 000	240 000	SB	Hiumaa KA
3.2.6.1.2 Establishment of Coordination Committee for European Mink Conservation (NKKN)	I	–	–	–	–	–	–	–	Hiiumaa KA
3.2.3.1.1 Monitoring in Hiiumaa and neighbouring areas (Vormsi)	II	22 000	20 000	20 000	22 000	20 000	104 000[7]	SB	Foundation Lutreola, Hiiumaa KA
3.2.4.1.5 Preparation and publication of a brochure	II	–	70 000	–	–	–	70 000	Foreign aid, EIC	Foundation Lutreola

[6] Estimated prizes: EEK 5000 for I prize, EEK 3000 for II prize, EEK 2000 for III prize and EEK 1000 for the next best 30 hunters who have hunted foxes, raccoon dogs and martens in Hiiumaa.

[7] Costs of American mink monitoring in Hiiumaa will be covered by European mink monitoring (EEK 20 000/yr) because the works will be conducted simultaneously. Additional American mink monitoring will be carried out in 2004 and 2007 in Vormsil (EEK 2000 /yr).

Activity	Priority	Cost						Possible source	Responsible body
		2004	2005	2006	2007	2008	Total		
3.2.4.1.2 Additional applied scientific studies	II	20 000	20 000	20 000	20 000	20 000	100 000	SB, Science Fund, foreign aid, LIFE CO-OP	Foundation Lutreola, Hiiumaa KA, Tallinn Pedagogical University
3.2.1.2.3 Re-stocking of crayfish in suitable water courses	III	–	4000	4000	4000	4000	16 000	EIC, foreign aid	Hiiumaa KA, OU Lutra, foundation Lutreola
3.2.4.1.1 Compensation for damage that minks cause by killing domestic animals on farms	III	3000	3000	3000	3000	3000	15 000[8]	EIC	Hiiumaa Envir. Dept. /Hiiumaa KA
3.2.4.1.2 Regular updating of Web page	III	–	–	–	–	–	–	–	Foundation Lutreola, Hiiumaa KA
3.2.4.1.3 Publication of a brochure on the protection and biology of the European mink	III	–	–	60 000	–	–	60 000	EIC	Foundation Lutreola
3.2.4.1.4. Preparation of Powerpoint programme on CDs	III	–	25 000	–	–	–	25 000	EIC, foreign aid	Foundation Lutreola

Table 14. Summary budget by years

[8] Prognosticated rough estimate made on the basis of killing cases in 2003.

Cost breakdown by years (EEK)					Total cost
2004	2005	2006	2007	2008	
501 000.-	1 098 700.-	1 046 500.-	837 000.-	831 000.-	4 214 200.-

Table 15. Summary budget by priorities

Cost breakdown by priorities (EEK)			Total cost
I	II	III	
3924200.-	174000.-	116000.-	4214200.-

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ANNEXES

Annex 1.

List of mammal species of Hiiumaa (Jeeser, 1974; Ernits a.o. 1984; Klein, 1992; Maran, 2000; Masing, 2001)

	Insectivores *(Insectivora)*:
1.	Western hedgehog *(Erinaceus europaeus)*
2.	Common shrew *(Sorex araneus)*
3.	Water shrew *(Neomys fodiens)*
	Bats *(Chiroptera)*:
4.	Northern bat *(Eptesicus nilssonii)*
5.	Brown long-eared bat *(Plecotus auritus)*
6.	Daubenton's bat *(Myotis daubentonii)*
7.	Whiskered bat *(Myotis mystacinus)*
	Rodents *(Rodentia)*:
8.	Red squirrel *(Sciurus vulgaris)*
9.	Brown rat *(Rattus norvegicus)*
10.	House mouse *(Mus musculus)*
11.	Yellow-necked mouse *(Apodemus flavicollis)*
12.	Bank vole *(Clethrionomys glareolus)*
13.	Northern water vole *(Arvicola terrestris)*
14.	Common vole *(Microtus arvalis)*
15.	Field vole *(Microtus agrestis)*
16.	Beaver *(Castor fiber)*
	Rabbits and hares *(Lagomorpha)*:
17.	Brown hare *(Lepus europaeus)*
18.	Mountain hare (*Lepus timidus)*
	Carnivores *(Carnivora)*:
19.	Pine marten *(Martes martes)*
20.	European mink *(Mustela lutreola)*
21.	Stoat (*Mustela erminea)*
22.	Weasel *(Mustela nivalis)*
23.	Lynx *(Felis lynx)*
24.	Red fox *(Vulpes vulpes)*
25.	Raccoon dog *(Nyctereutes procyonoides)*
26.	Wolf *(Canis lupus)*
27.	Otter *(Lutra lutra)*
	Seals *(Pinnipedia)* :
28.	Ringed seal *(Pusa hispida)*
29.	Grey seal *(Halichoerus grypus)*
 30.	**Hoofed animals *(Artiodactyla)*:** Wild boar *(Sus scrofa)*
31.	Roe deer *(Capreolus capreolus)*
32.	Elk *(Alces alces)*

33.	Red deer *(Cervus elaphus)*
	Animal species that have formerly occurred or whose occurrence is possible/probable
1.	Brown bear *(Ursus arctos)*
2.	American mink *(Mustela vison)*
3.	Western polecat *(Mustela putorius)*
4.	Pygmy shrew *(Sorex minutus)*
5.	Common pipistrelle *(Pipistrellus pipistrellus)*
6.	Striped field mouse *(Apodemus agrarius)*
7.	Harvest mouse *(Micromys minutus)*

Annex 2.

Land improvement works in 1966–1992 that have affected the water course network of Hiiumaa (Kaskor, 2003)

Land improvement system	Municipality	Year	Area	Recipient
Allika	Puhalepa	1976	56.2	Partsi m.d.
Eessoo	Puhalepa	1980	107.2	
Haavamae	Puhalepa	1990	284.6	Suuremoisa river
Harju	Puhalepa	1981	124.4	Partsi stream
Keskuse	Puhalepa	1986	140.6	Ala ditch
Keskuse	Puhalepa	1982	30.0	
Kurgesoo	Puhalepa	1977	142.9	Suuremoisa river
Korve	Puhalepa	1989	7.4	
Loja	Puhalepa	1978	163.0	Suuremoisa river
Nomba	Puhalepa	1992	92.8	Vilivalla m.d.
Palukula	Puhalepa	1988	265.9	Nuutri river
Partsi	Puhalepa	1983	287.7	Suuremoisa river
Sakla	Puhalepa	1979	187.2	Suuremoisa river
Sarvesoo	Puhalepa	1988	183.9	Vilivalla m.d.
Soopollu	Puhalepa	1990	220.2	Vilivalla m.d.
Soopollu	Puhalepa	1990	212.5	Suuremoisa river
Suuremoisa	Puhalepa	1982	109.6	Suuremoisa river
Tempa	Puhalepa	1970	143.6	
Tubala I	Puhalepa	1990	212.4	Ala ditch
Tubala II	Puhalepa	1978	198.3	Ala ditch
Ussisoo	Puhalepa	1976	99.1	
Varesepollu	Puhalepa	1984	142.2	Vilivalla m.d.
Vilivalla	Puhalepa	1963	44.2	
Aadma	Kaina	1975	58.0	
Aadma-Jausa	Kaina	1980	100.2	
Jaagu-Valja	Kaina	1971	158.2	Tulimurru m.d.
Joe	Kaina	1986	109.9	River Vaemla l
Kaasiku	Kaina	1968	136.7	River Vaemla r
Kaigutsi	Kaina	1969	189.5	
Kakumaa I	Kaina	1973	84.8	Tulimurru m.d.
Kakumaa II	Kaina	1971	167.5	Tulimurru m.d.
Kaupsi RM	Kaina	1981	132.1	Rebasselja m.d.
Kaupsi- Baas	Kaina	1976	112.8	Vaemla river
Keskuse	Kaina	1970	140.0	
Kleemu I	Kaina	1978	89.4	Orjaku m.d.
Kleemu II	Kaina	1970	101.3	
Kogri-Villemi	Kaina	1985	172.5	Ristivalja m.d.
Kotkasoo	Kaina	?	118.0	River Luguse
Kassarisoo	Kaina	1990	155.5	River Vaemla l
Kaina-Kolga	Kaina	1976	291.6	Ristivalja m.d.
Lelo	Kaina	1970	178.0	Lelu m.d.
Lennuvalja	Kaina	1971	271.4	
Luguse S	Kaina	1980	115.5	River Luguse
Luguse U	Kaina	1977	165.6	
Mustika	Kaina	1981	85.4	Mustika m.d.
Mannamaa	Kaina	1988	205.1	Tulimurru m.d.
Niidikula	Kaina	1967	215.0	Ristivalja m.d.
Parnselja	Kaina	1966	193.7	Parnselja m.d.

Land improvement system	Municipality	Year	Area	Recipient
Rava	Kaina	1989, 1973	219.3	Rebasselja m.d.
Ristivalja	Kaina	1969	241.5	Ristivalja m.d.
Soobe I	Kaina	1981	94.2	Rebasselja m.d.
Soobe II	Kaina	1982	74.1	
Soobe III	Kaina	1985	120.6	
Suurekaevu	Kaina	1975	156.9	Jausa str.
Tagakarjamaa	Kaina	1975	200.0	River Vaemla r
Tiina	Kaina	1973	199.1	River Luguse
Ussikuninga	Kaina	1989	27.2	River Luguse
Utukula	Kaina	1969	98.0	Orjaku m.d.
Uuskula	Kaina	1974	113.2	
Veskimetsa	Kaina	1989	17.0	
Ounaku	Kaina	1989	136.6	
Kaanissoo	Emmaste	1987	203.0	Jausa str.
Rebase	Emmaste	1970	70.4	Jausa str.
Harju	Emmaste	1970	141.9	Prassi m.d.
Vahesoo	Emmaste	1977	117.4	Prassi m.d.
Ulja-Lepiku	Emmaste	1978	246.8	Prassi m.d.
Valgu-Ulja	Emmaste	1967	49.1	
Keskuse	Emmaste	1977, 1968	161.6	
Jausa	Emmaste	1977	229.0	Kaanissoo d.
Kabuna	Emmaste	1983	148.0	Kulama m.d.
Kitsa-Haldi	Emmaste	1985	158.7	
Kurisoo	Emmaste	1979	173.5	Vanamoisa m.d.
Kuusiku	Emmaste	1973	142.3	Leetselja m.d.
Lassi	Emmaste	1970	153.2	Valjasoo m.d.
Leisu	Emmaste	1987	110.2	Leetselja m.d.
Lepametsa	Emmaste	1987	142.0	Vanamoisa m.d.
Metsalauka	Emmaste	1976	50.4	
Ollima	Emmaste	1971	159.9	Ollima m.d.
Pandermaa	Emmaste	1974	191.5	
Prassi	Emmaste	1969	158.5	Prassi m.d.
Prahnu	Emmaste	1992	44.7	
Tilga-Tagametsa	Emmaste	1975	155.2	Prassi m.d.
Ranna Tilu	Emmaste	1988	165.1	Ollima d.
Tarkma	Emmaste	1975	65.0	Ollima d.
Vanamoisa	Emmaste	1977	155.7	Valjasoo m.d.
Viiri	Emmaste	1968	140.7	
Valjasoo	Emmaste	1991	154.8	Valjasoo m.d.
Ongu	Emmaste	1989	62.6	
Armioja	Korgessaare	1974	136.8	Armioja str.
Heiste	Korgessaare	1986	26.4	
Huti	Korgessaare	1975	34.3	Paope str.
Isabella	Korgessaare	1967	76.9	Jaanigu d.
Kopa	Korgessaare	1989	11.7	
Laasma	Korgessaare	1980	59.5	
Lauka	Korgessaare	1983	125.6	Jaanigu d.
Leigri I	Korgessaare	1987	76.2	River Luguse
Leigri II	Korgessaare	1979	91.8	River Luguse
Metsapollu	Korgessaare	1972	117.2	(into Kajumeri)
Paope	Korgessaare	1980	58.2	Paope str.
Pihla	Korgessaare	1978	47.1	Pihla str.

Land improvement system	Municipality	Year	Area	Recipient
Poama	Korgessaare	1986	42.7	Poama str.
Villama	Korgessaare	1984	36.2	Luidja str.
Total			**13402.4**	

Annex 3.

The fish in Hiiumaa water bodies according to undertaken studies (Kangur, 2002; Jarvekulg, 2001; Laanetu, 1998;)

Fish in River Vaemla

Time	Sampling site	Species	AVG. length, Max/min mm		Density		No of Ind.
				Ind/100m²	Ind. per 10 m	Grams per 10 m	
1995. 06	Middle course	Roach		xxxxx			
		Pike		xxxx			
		Nine-spined stickleback		xx			
	Lower course	Roach		xxx			
		Perch		xxx			
		Pike		xxx			
		Three-spined stickleback		xxx			
1996, 98		Pike					+
		Roach					+
		Nine-spined Stickleback					+
		Perch					
		Three-spined Stickleback					+ +
2002 01.08	Upstream from bridge in Suuremoisa-Kaina road	1)					-
02.08	Tammela main ditch at mouth	2)	254	2,3	0,2	18,2	1
	Kaina-Kardla road 1 km up	3)					-

Tammela main ditch

1996, 98		Roach					+
		Pike					+
2002 04.08	3 km from river mouth to River Vaemla	Roach	238(225-252)	2,7	0,3	9,1	3
		4)					-

x - single individuals, xx - low abundance, xxx - middle abundance, xxxx - abundant , xxxxx – very abundant, + - present;
1) 1 0+ pike and 2 crayfish was detected
2) 1 pike was detected
3) 1 0+ and 3 pikes with length L ~15 -25 cm
4) 2 pikes of L ~30- 35 cm was observed

Fish in River Luguse

Time	Sampling site	Species	AVG. length, Max/min mm		Density		No of Ind.
				Ind/100m2	Ind. per 10 m	Grams per 10 m	
1995. 06	Kaina-Emmaste road. at bridge	Pike Three-spined Stickleback			xxx xx		
1996, 98		Pike Roach			x x		
2002							
30.07	Lower course, Kleemu	Roach Crayfish	199(173-240) 79(40 – 115)	1,3 10,9	0,6 4,9	56	3 25
31.07	Uhtri-Lelu road, upstream from bridge	Modersieschen Pike	46(40 – 55) 244(69-428)	9,3 8,1	1,1 1,0	0,7 159	8 7
31.07	Huti-Manna-maa road, upstream	-					
		Rebasselja main ditch					
1996, 98		Pike Roach Nine-spined Stickleback Crayfish					+ + + +
2002							
30.07	~2 km upstream from River Luguse	Roach	196(158-168)	0,7	0,2	16	2
		Tulimurru main ditch.					
1996, 98		Nine-spined Stickleback Crayfish					+ +
2002							
31.07	0,5 km upstream from Rebasselja main ditch.	Roach Crayfish	163(158-168) 75(60-95)	5,3 7,1	0,9 1,2	41	3 4

Fish in Jausa stream

Time	Sample site	Species	AVG. length, Max/min mm	Ind/100m²	Density Ind. per 10 m	Grams per 10 m	No of Ind.
1995. 06	Kaina-Emmaste Road at bridge	Three-spined Stickleback		x			
		Pike 1+		xx			
	Ligema	Three-spined Stickleback		xx			
1996, 98	Lower course	Nine-spined Stickleback		x			
2002 03.08	Mudaoja stream at river mouth	Pike [1]	261(202-352)	2,1	0,6	77	6
		Roach	232(225-240)	1,4	0,4	48	4
03.08	Ligema	-					
Prassi main ditch							
1996, 98		Nine-spined Stickleback					+
2002 05.08	0,5 km from river mouth	Three-spined Stickleback	52(40-70)	3,8	0,9	0,9	7
		Nine-spined Stickleback	42(32-48)	2,7	0,6	0,5	5
		Pike	255	0,5	0,1	13	1
05.08	2 km from river mouth	Pike [2]	245(92-440)	1,0	0,6	143	3
Mudaoja stream							
2002 03.08	River mouth	-					

[1] 4 pikes L ~10, 25, 30, 35 cm was detected
[2] 2 pikes - 0+, L ~30 cm was detected

Fish in Ongu stream and River Vanajogi

Time	Sampling site	Species	AVG. length, Max/min mm	Ind/100m^2	Density Ind. per 10 m	Grams per 10 m	No of Ind.
			Ongu stream				
1988 04.10		Trout 0+ Trout >		22,4 4,8			37 8
1996, 98	Lower courses	Trout			1-2		24
2002 05.08	Lower course ~1km upstream from pod ~1km from start	Trout Nine-spined Stickleback -	133(91-260) 58	13,1 0,6	1,8 0,3	31 0,5	11 1

1980	~1,5km from rivermouth	Trout 0+ja>		15,4 29,8			42 81
1984 04.10	~1,5km from rivermouth	Trout 0+ Trout>	75(45-95) 181(98-535)	25,5 30,7			54 65
1988 04.10	~1,5km from rivermouth	Trout 0+ Trout >	51(48-59) 184(97-478)	38,7 30,1			72 56
1995. 06	0,5 km from Luidja-Nurste road to the west	Trout 0+&>		xxxxx			
1996, 98	Lower course: West from road East from road Middle course Upper course	 Trout 0+&> “ “ “			 15-20 1-2 (2-5) <1 0		 51
2002 05.08	~1,5km from river mouth ~2,5 km from river mouth	Trout 0+ [1)] Trout > Trout 0+ Trout>	83(50-108) 183(110-610) 54 174(104-255)	25,7 18,8 0,8 4,9	5,8 4,2 0,2 1,1	38 265 0,4 84	26 19 1 6

1) ~30% of 0+trouts were not caught

Fish in Poama stream

Time	Sampling site	Species	AVG. length, Max/min mm	Ind/100m^2	Density Ind. per 10 m	Grams per 10 m	No of Ind.

Time	Sampling site	Species	AVG. length,		Density		No of Ind.
			Max/min mm	Ind/100m²	Ind. per 10 m	Grams per 10 m	
1980	Downstream from Palli-Luidja road	Trout 0+ja>		52,5			94
1984 03.10	Downstream from Palli-Luidja road	Trout 0+ja> Brook lamprey	126(53-231)	56,7			97 +
1985 10.09	Downstream from Palli-Luidja road	Trout 0+ja> Flounder Lamprey Pike	133(62-281) 107(65-130) 122(112-130)	38,9 2,7 2,7	0,6 0,4 0,4		43 3 3 +
1995. 06	Palli-Luidja road, at bridge	Pike		xx			
1996, 98		Trout Roach Pike		x x x			
2002 05.08	Downstream from Palli-Luidja road	Pike Three-spined Stickleback	140(115-198) 62	6,2 1,0	1,0 0,2	23 0,2	6 1

Fish in Luidja, Paope and Joeranna stream

Time	Sampling site	Species	AVG. length,		Density		No of Ind.
			Max/min mm	Ind/100m²	Ind. per 10 m	Grams per 10 m	
			Luidja stream				
1996, 98		Nine-spined Stickleback					+
2002 05.08	Downstream form Luidja-Korgessaare road	Nine-spined Stickleback Three-spined Stickleback Trout 0+	56(47-61) 64(61-71) 71	5,3 2,0 0,6	0,7 0,3 0,1	1,1 0,5 0,4	8 3 1
			Paope stream				
1996, 98		Trout Nine-spined Stickleback		x xxxxx			

Time	Sampling site	Species	AVG. length, Max/min mm	Density			No of Ind.
				Ind/100m²	Ind. per 10 m	Grams per 10 m	
2002 06.08	Downstream from Luidja-Korgessaare road	Nine-spined Stickleback	50(40-61)	34,6	4,1	7,5	11
		Lamprey	103(40-135)	28,3	3,4	9,4	9
		Three-spined Stickleback	26(19-61)	25,1	3,0	0,5	8

Joeranna stream

Time	Sampling site	Species	AVG. length, Max/min mm	Ind/100m²	Ind. per 10 m	Grams per 10 m	No of Ind.
1996, 98		Nine-spined Sticklebacks		xxxx			
2002 06.08	Upstream from Luidja—Kor-gessaare road	Nine-spined Sticklebacks	20(19-22)	2,1	1,5	0,3	4
		Burbot	250	0,5	0,4	36	1

Fish of Armioja stream

Time	Sampling site	Species	AVG. length, Max/min mm	Density			No of Ind.
				Ind/100m²	Ind. per 10 m	Grams per 10 m	
1995. 06	Korgessaare-Kardla road; at bridge	Pike			xxxxx		
		Roach			xxxx		
		Perch			xxxx		
		Burbot			xxxx		
1996, 98		Nine-spined Stickleback			xxx		
		Perch			xxx		
		Trout			xx		
		Pike			xx		
		Roach			xx		
		Nine-spined Stickleback			xx		
		Burbot			xx		

Time	Sampling site	Species	AVG. length, Max/min mm	Density Ind/100m²	Density Ind. per 10 m	Density Grams per 10 m	No of Ind.
2002 06.08	Korgessaare-Kardla road; upstream from bridge	Pike Perch Burbot Roach	288(85-430) 129(73-240) 213(73-240)	7,6 1,5 1,0	2,0 0,4 0,3	394 25 19	15 3 2 +
02.08	Heiste-Isabella Road; ~300 m downstream	Burbot	239(225-260)	1,1	0,5	34	3

Fish in Pihla stream

Time	Sampling site	Species	AVG. length, Max/min mm	Density Ind/100m²	Density Ind. per 10 m	Density Grams per 10 m	No of Ind.
1995. 06	At Reigi-Luidja road	Pike Perch Ruff		xxxx xxx xx			
1996, 98	Lower course	Perch Nine-spined Stickleback Pike Roach Nine-spined Stickleback		xxx xxx xx xx xx			
	Middle course	Perch Nine-spined Stickleback Burbot Pike		xxx xxx xx xx			
2002 30.07	At Otste-Pihla bridge	Burbot Roach Pike	302(154-420) 25(21-30) 111	1,4 1,4 0,2	0,5 0,5 0,1	93 0,1 0,8	6 6 1
02.08	Metsakula-Koidma road; upstream	-					

Fish in Kidaste stream

Time	Sampling site	Species	AVG. length, Max/min mm	Density			No of Ind.
				Ind/100m²	Ind. per 10 m	Grams per 10 m	
1995. 06	Sigaste-Tahkuna road; at bridge	-					
1996, 98		Nine-spined Stickleback					+
2002		1)					
31.07	Upstream from Mailahte	Pike Burbot	123(88-158) 230(150-310)	0,7 0,7	0,3 0,3	5 30	2 2
31.07	~200m upstream from latter	Burbot Pike	164(138-208) 105(90-115)	10,1 7,6	1,0 0,7	62 12	4 3
31.07	Korgessaare-Kardla road; downstream	-					

1) number of fish is 1/3 higher

Fish in River Nuutri

Time	Sampling site	Species	AVG. length, Max/min mm	Density			No of Ind.
				Ind/100m²	Ind. per 10 m	Grams per 10 m	
1980	Heltermaa-Kard-la road between bridge and dam	Pike Burbot	232(98-363) 112				3 1
1984	Heltermaa - Kardla road; at bridge	Trout 0+ Trout >		0,6 5,7			1 10
1995. 06	Prahla Kardla park at seacoast	Trout 0+&> Three-spined Stickleback Nine-spined Stickleback			xxx xxxxx xxxx		

Time	Sampling site	Species	AVG. length, Max/min mm	Ind/100m²	Density Ind. per 10 m	Grams per 10 m	No of Ind.
1996, 98		Lamprey			xxx		
		Trout			xxx		
		Nine-spined Stickleback			xxx		
		Pike			xx		
		Roach			xx		
		Three-spined Stickleback			xx		
		Burbot			x		
2002							
01.08	At Prahla	Trout>	263(228-298)	2,3	0,6	108	5
		Lamprey	135	0,4	0,1	0,8	1
02.08	Maavli mire	Trout>	220(128-430)	6,0	0,8	144	9
		Pike	195	0,7	0,1	4	1

Fish in River Suuremoisa

Time	Sampling site	Species	AVG. length, Max/min mm	Ind/100m²	Density Ind. per 10 m	Grams per 10 m	No of Ind.
1995. 06	Hellamaa-Vilivalla road; at bridge	Pike		x			
	Heltermaa-Kaina road;at bridge	Pike		xxx			
		Perch		xxx			
		Burbot		x			

Time	Sampling site	Species	AVG. length, Max/min mm	Density			No of Ind.
				Ind/100m²	Ind. per 10 m	Grams per 10 m	
1996, 98	Middle course	Pike					+
		Roach					+
		Perch					+
	Lower course	Roach					+
		Perch					+
		Pike					+
		Burbot					+
		Nine-spined Stickleback					+
		Three-spined Stickleback					+
2002							
03.08	In Park Suuremoisa	Burbot	197(154-268)	1,0	0,5	28	6
		Three-spined Stickleback	41(18-56)	0,8	0,4	0,3	5
04.08		Pike	103	0,2	0,1	0,6	1
		Perch	160	0,2	0,1	4	1
04.08							
	6,8km from rivermouth	Pike	360	1,4	0,2	71	1
		Pike	327(171-484)	0,6	0,2	78	2
	Upper cource 8 km from river mouth	Burbot	402	0,3	0,1	36	1
		Roach	220	0,3	0,1	12	1

Annex 4.

Distribution of crayfish and state of its population on the water courses of Hiiumaa in 2002: assessment and recommendations for improvement of ecological conditions of water bodies (Laanetu, 2002).

Water body	**State of water body**	**Distribution of crayfish**	**Assessment and recommendations**
Armioja stream	Forest drainage on upper course, water-scarce, big sediment load up until the lakes. Lower course with stony bottom, in good state. Forest drainage decreases the stability of hydrological regime of drainage area and the water quality.	No crayfish.	Crayfish has been repeatedly introduced in the middle and lower course. Crayfish occurred earlier in the middle course but has disappeared by now. Water body in poor state, restoration of crayfish possible after renovation of water body. Excavation of several sedimentation pools necessary to decrease the impact of the ongoing forest drainage.
Pihla stream	Dredged, with stony bottom and clayey-stony banks. Water-scarce, dry at places in upper and middle course.	Single specimens of crayfish in lower course.	High potential as crayfish stream. After restoration (construction of weir rapids) possible to considerably increase the stock of crayfish.
Kidaste stream	Small drainage area, dries up regularly, stony bottom, partly in natural state.	No crayfish.	Low potential but restoration of crayfish population possible in the area of construction of weir rapid.
River Nuutri	Emanates from Pihla bog, partly in natural state. III quality class for crayfish but occurrence of crayfish not recorded.	No crayfish.	No data on earlier occurrence of crayfish, probably acid bog water. A small number of crayfish should be introduced in the area of lower course to test the suitability of water for crayfish.
River Suuremoisa	Entire river dredged. Influence of sea water in lower course. Canalised part has grown over with vegetation, muddy sediments in bottom layers.	Crayfish in the middle and lower course, low abundance.	Low potential for crayfish but the potential may increase after renovation. It is recommended to excavate a sedimentation pool in the middle course to decrease the sediment load associated with land improvement in the middle and lower course.
River Vaemla	Entire river canalised, upper course grown over with vegetation, influence of sea water in lower course. Strongly fluctuating water regime.	Crayfish occurs on a 2-km stretch with high abundance.	After renovation of the river it will be possible to extend the range of crayfish also upstream from the mouth of Tammela ditch. Spreading of crayfish downstream the mouth of Tammela ditch is limited by the influence of sea water.

River Luguse	Entire river dredged. Grown over with vegetation in open places. Lower course partly in natural stream bed but 2 km influenced by sea water (distribution of crayfish inhibited).	Crayfish abundant on 5 km upstream from the mouth of Rebasselja ditch and less abundant on 2 km downstream from the mouth of Rebasselja ditch. No crayfish in lower and upper course.	Renovation of the river can considerably raise the potential for crayfish management and ensure the preservation of stock. It is planned that riffles, pools and stream narrowers will be constructed under the spawning grounds restoration project to improve the hydrological conditions, which will create better living possibilities for both crayfish and fish fauna.
Rebasselja ditch	Tributary of Luguse. Entirely canalised, upper course between fields and forests. Lower course suitable for crayfish. Upper course spring-fed, area with regulated ditches in middle course.	Medium abundance on a short stretch of lower course.	Construction of weir rapids and riffles in lower course recommended. In order to ensure sufficient water quality, water protection requirements need to be strictly followed in fertilising the fields in the upper course. Crayfish is especially endangered by pig farm slurry containing humic substances.
Tulimurru ditch	Tributary of Luguse. Whole ditch canalised, upper course between fields and forests. Only 2 km of lower course suitable for crayfish.	Medium abundance on a short (2 km) stretch of lower course.	It is recommended to construct weir rapids and riffles in lower course and to strictly follow water protection requirements in the area of fields in upper course and during ditch maintenance.
River Jausa	Whole river dredged. Water-scarce, water level strongly fluctuating. Several lock regulators constructed for irrigation purposes are out of order. Lower course influenced by sea water.	Crayfish occurred on a short stretch of middle course but all died in summer.	Drying of water body caused death of crayfish. Water level needs to be regulated by weir rapids and it is recommended to introduce crayfish in suitable places in middle course and also in lower course, in the area of road bridge.
Prassi canal	Grown over with vegetation. Flow ceased fully in 2002.	No crayfish.	Low potential as crayfish habitat also after the completion of hydrotechnical works.
Prassi quarry	Gravel quarries filled with water. Water quality suitable, water heats up in summer in open places.	Crayfish occurs. Mortality similar to that caused by crayfish plaque in summer 2002.	Crayfish population survived, probably some other disease than crayfish plague was concerned. It is recommended to develop crayfish management and design the quarries in accordance with the requirements for crayfish breeding.
Valjasoo-Vanamoisa ditch	Land improvement ditches. Lower course dammed by lock regulator. Flow ceased in summer 2002 and the ditch dried up both in upper and lower course.	No crayfish was found.	Low potential. Restoration of crayfish possible only in dammed area and downstream of it in case weir overflow is regulated according to the principles of sustainable draining. Cessation of flow in draught years inevitable.

Ongu stream	Spring-fed, sandy bottom downstream the mill dam, banks sodded with roots. Bank profile suitable for crayfish but water level low.	No crayfish, in 2001 some specimens were found immediately under the dam.	Low potential for crayfish. It is recommended to introduce smaller quantities of crayfish and to establish some low (20–25 cm) weir rapids to stabilise the water level downstream from the road.
River Vanajogi	Lower course suitable for crayfish, upstream from the road with sandy bottom and less suitable for crayfish. Suitability of water quality not investigated.	No crayfish in sample catches.	In 2001, 160 crayfish were introduced in the area of lower course. No crayfish was caught during catch sampling. Possibilities of increasing the ecological diversity and fish and crayfish stock in the lower course of the river need to be investigated.
Poama stream	Only a short stretch of lower course suitable for crayfish.	Crayfish occurs. In 2002, 1 specimen was caught.	Single specimens (introduced earlier) were found in 2000. Lower course suitable as the habitat of trout, lamprey and crayfish if some weir rapids are constructed. Construction of three spawning pads and reconstruction of river mouth planned under the fish spawning sites restoration project.
Luidja stream	Only a short stretch of lower course suitable for crayfish.	No crayfish was found.	Low potential because the stream dries up partly every year and completely in draught years.
Paope stream	Only a short stretch of lower course suitable for crayfish.	No crayfish was found.	Low potential because the stream dries up partly every year and completely in draught years.
River Joeranna	Only a short stretch of lower course suitable for crayfish.	No crayfish was found.	Low potential because the stream dries up partly every year and completely in draught years.

Annex 5.

Occurrence of habitats suitable for crayfish on different water bodies of Hiiumaa (on the basis of data from quality assessment; Laanetu, 2002).

Water body or stretch thereof	Extent of habitats of different quality (length of bank km)					
	I	II	III	IV	V	TOTAL
River Luguse with tributaries	1.0	2.3	13	6.3	17.5	40.1
River Jausa	0	0	4.2	7.4	10.4	22.0
River Vaemla, Tammela	0	1.2	1.0	3.3	17.5	23.0
River Suuremoisa	0	0	4.3	4.2	19.0	27.5
River Nuutri	0	0	1.8	10.2	3.5	15.5
Pihla stream	0	0	6.2	5.4	10.4	22.0
Armioja stream	0	0	8.0	5.5	3.0	16.5
River Vanajogi	0	0	4.6	2.4	2.0	9.0
River Ongu	0	0	2.5	0.5	2.0	5.0
Other small rivers	0	0	2.0	13.0	26.0	41.0
TOTAL	1.0	1.2	34.6	51.9	93.8	182.5
Optimum population density (based on quality class) per 1-m-stretch of water body	>10	5	1	0.1	0.001–0	
Planned optimum stock of crayfish on water bodies of Hiiumaa	>1000	6000	34600	5190	<100	46 890 **45 000–50 000**

Annex 6.

Overview of shelters of the European mink (*Mustela lutreola*) on different water courses of Hiiumaa:

Water course	Length of studied stretch (km)	Density of shelters per km			Notes
		high	medium	low	
River Nuutri together with Tubala stream	8.4	4.5	3.9	–	Natural-looking or dredged long ago (in the middle course)
River Suuremoisa	14	1	1.6	11.4	Lower course has natural banks with old trees. Middle and upper course dredged.
Villivalla main ditch	7.6	–	1.7	5.9	Whole ditch dredged, shelters more abundant in the upper course due to beaver activities.
River Vaemla	12.3	–	1.2	11.1	Shelter possibilities medium in the lower course due to beaver activities and low elsewhere.
Tammela stream	11.2	1.2	6	4	In middle and lower course stream bed natural, with old trees, in lower course – dredged, shelters scarce.
River Luguse	17.6	2	0.7	14.9	Shelter possibilities better in the natural part of lower course, poor in the dredged stretch running between fields.
Rebasselja stream	9.7	1.8	0.8	7.1	Shelter possibilities better in lower course, old trees on banks. Elsewhere: shelters scarce, stream dredged recently.
Tulimurru main ditch	8.1	–	3.9	4.4	Banks of lower and upper course wooded, middle course between fields and recently dredged.
Jausa stream	13.5	–	8.3	5.2	Lower course natural, upper course with wooded banks. Middle course between fields, shelters scarce.
Lelu main ditch	3.3	–	–	3.3	Dredged recently, banks covered with brushwood.
Tihu ditch	2.1	–	1.4	0.7	Banks covered with brushwood in the lower course (between fields) and with forest in the area of lakes.
Prassi stream	9.6	–	4.7	4.9	Whole stream dredged. Old trees in the middle and lower course, shelter possibilities medium.
Kulama main ditch	5.6	–	1	4.6	Middle and lower course recently dredged. Upper course runs in forest, shelter possibilities better.
Vanamoisa main ditch	4.1	–	1.5	2.6	Shelter possibilities medium in lower course and low elsewhere due to recent dredging.
Valjasoo main ditch	8.3	–	3	5.3	Whole ditch dredged, old trees on banks at places.

Leetselja main ditch	5.9	–	1.1	4.8	Whole ditch dredged, old trees on the bank in middle and lower course at places.
Ongu stream	5.7	3.8	1.9	–	Wooded, natural banks in upper and middle course. Lower course runs in a village, shelter possibilities medium.
River Vanajogi	7.6	2.5	5.1	–	Lower course natural, elsewhere dredged some time ago, shelters more scarce.
Poama stream	2.4	0.6	0.8	1	Shelters more abundant in lower and upper course, banks wooded. Middle course poor in shelters due to open banks and recent dredging.
Luidja stream	4.9	1.4	3.5	–	Lower course natural, wooded. Elsewhere shelters more scarce due to drainage.
Paope stream	5.1	–	1.5	3.6	Lower course with wooded banks and medium shelter possibilities. Elsewhere shelters scarce (dredged).
Joeranna stream	3.9	2.4	1.2	0.3	Natural, shelters abundant in the wooded part of lower course but scarcer elsewhere.
Armioja stream	13	3.6	2.3	7.1	Lower course natural, shelters abundant, except in the area of coastal lakes. Shelters scarce elsewhere due to dredging.
Pihla stream	14.3	–	10.5	3.8	Middle course mostly wooded, shelter density medium, except on the side of a recently constructed road. Lower course dredged, bank low, shelters scarce.
Kidaste stream	6.1	0.8	4.9	0.4	Natural at places, shelter density high or medium, except in the quagmire of old lake.
Tareste stream	4	–	3.6	0.4	Natural and wooded at places, shelter density medium in such places and low elsewhere.
Lehtma stream	5.6	–	5.6	–	Mostly natural, with wooded banks.

Annex 7.

Access of the European mink (*Mustela lutreola*) to water in winter on the water courses of Hiiumaa.

Water body	Assessment of winter access to water on the stretch observed (km)	
	good	bad
River Nuutri (with Tubala)	7.1	2.1
River Suuremoisa	1	10.9
Villivalla main ditch		7.5
River Vaemla	1.3	10.9
Tammela stream	4.3	7.7
River Luguse	2	16.9
Rebasselja stream	2.7	7.1
Tulimurru main ditch	0.5	7.7
Jausa stream	3.6	9.3
Lelu main ditch		3.3
Prassi stream	0.7	9.2
Kulama main ditch		5.7
Valjasoo main ditch		8.4
Vanamoisa main ditch		4.2
Leetselja main ditch		6
Ongu stream	5.6	0.4
River Vanajogi	2.9	5.9
Poama stream	0.7	1.7
Luidja steam	1.1	3.1
Paope steam	1.3	4.4
Armioja stream	5.3	7.8
Pihla stream	12.7	1.7
Kidaste stream	2.3	3.5

Annex 8.

Structures requiring the permit for special use of water planned to be created in Hiiumaa in the course of restoring fish spawning sites (Maa ja Vesi, 2002).

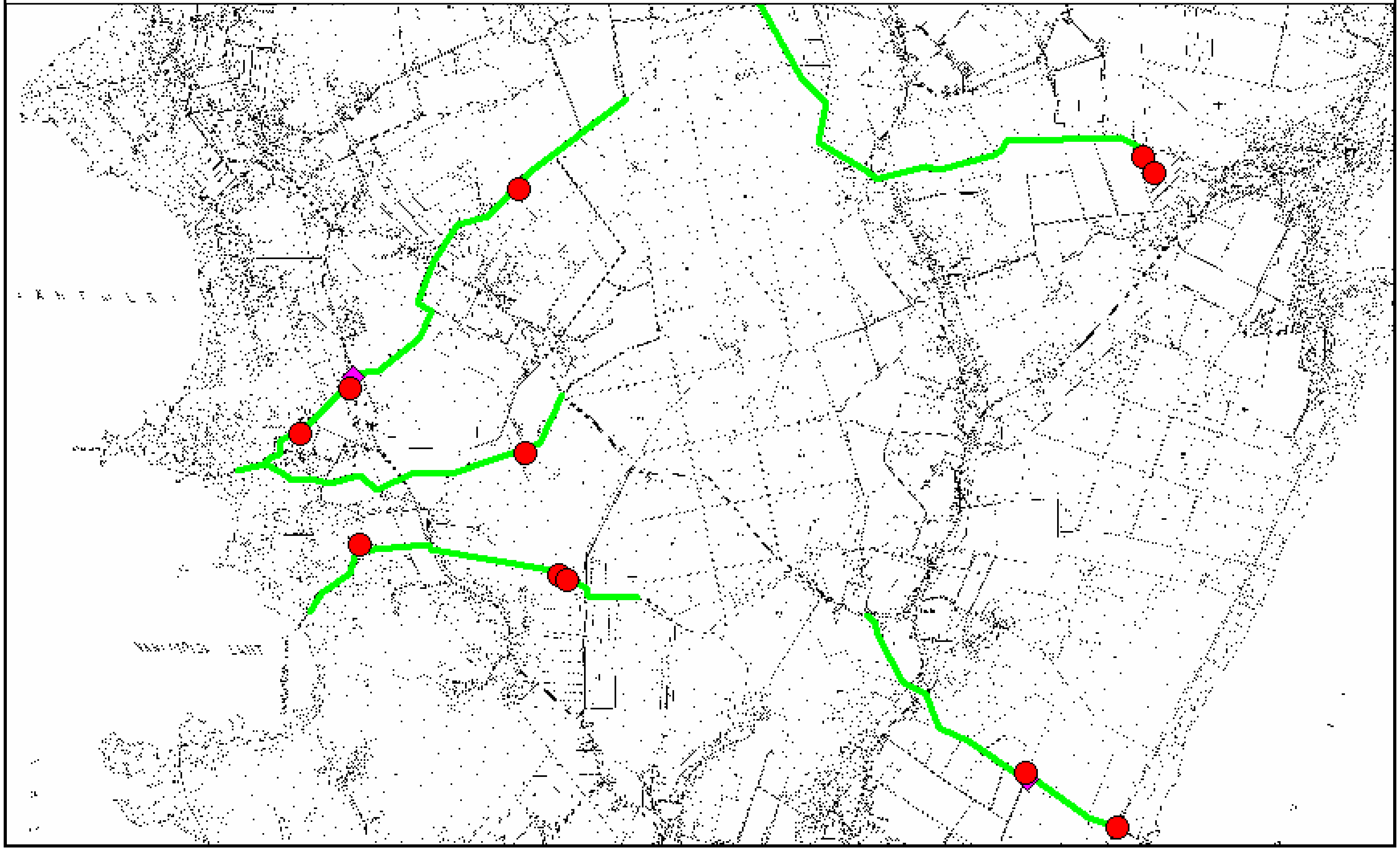
No.	Name of water body	Designed hydraulic structures	Operations requiring a permit for special use of water
1.	Poama stream	Extension of mole, weir rapids, cleaning of lakelet, three spawning pads	• Blockstone rapid on the bank line of Poama stream. Damming height depends on sea water level, 0–0.5 m • Dredging of two lakelets on Poama stream, 1.8 thous. m^3
2.	Kirikulaht together with Kunaauk	Reconstruction of stream bed in Raudsilma, excavation of pool in Kirikulaht. Renovation of lock between Kunaauk and Kirikulaht, closure of one lock, design of stepped rapid in the area of one lock	• Blockstone rapid in Raudsilma. Damming height depends on the water level, 0–0.3 m • Raising of water level in Kunaauk with riffles, 0.3 m • Design of blockstone rapid in front of lock regulator. Damming height 0.4 m. • Excavation of edge canal and pools 1.1 thous. m^3
3.	Pihla stream	9 riffles, hand dredging of mouth area	• Damming of each riffle by 0.25 m
4.	Coastal lakelets of Allika and Mai	Reconstruction of stream bed of Sigala inlet, construction of riffle. Blockstone rapid at Allikalaht. Reconstruction of outflow from Allikalaht and Mailaht to Sigala inlet.	• Blockstone rapid at the outflow of Mailaht-Sigala. Damming height up to 0.45 m • Excavation of narrow pool and dredging of Allika-Mailaht, 545 m^3
5.	Kura relic lake	Reconstruction of the mouth of Hiiesaare stream, cleaning of Kura relic lake	• Excavation in the mouth area of Hiiesaare stream, 500 m^3 • Weir rapid at the outflow of Kura relic lake H=0.45 m • Dredging of Kura relic lake, 37 thous. m^3
6.	River Suuremoisa	Hand cleaning of mouth area	Lacking
7.	River Vaemla	Construction of 11 riffles and renovation of culvert regulator	• Damming of each riffle by 0.25 m

8.	River Luguse with Rebasselja main ditch	9 riffles, 4 weir rapids, placement of single stones in steam bed, renovation of culvert regulator, 1 sedimentation pool	• 21 riffles h=0.2–0.3m • 6 weir rapids, damming height h=0.4–0.5m • excavation of sedimentation pool, 13 thous. m^3
9.	Lake Tihu	Blockstone rapid	• Damming of overflow of lake H=0.5 m
10.	Jausa stream	Dredging of mouth	• Cleaning of mouth, the water conduit is not dredged. 1.4 thous. m^3
11.	Nuutri river	Spawning pads in Tubala area, weir rapid and culvert regulator	• 1 weir rapid, damming height h=0.5 m
12.	Ongu stream	Bank protection, construction of spawning pads	• Dredging of mouth area, 150 m^3
13.	River Vanajogi	Protection of mouth area	• Dredging of mouth area, 285 m^3

Annex 9.

Locations of restoration of spawning sites of frogs and reconstruction of water courses

● – spawning sites of frogs to be restored/created; ● – restored/created spawning sites; ◆ – reconstruction of regulator; ◆ – construction of dam; ◆ - construction of spawning pad ● – installation of culvert together with construction of dam; stretch of river to be reconstructed



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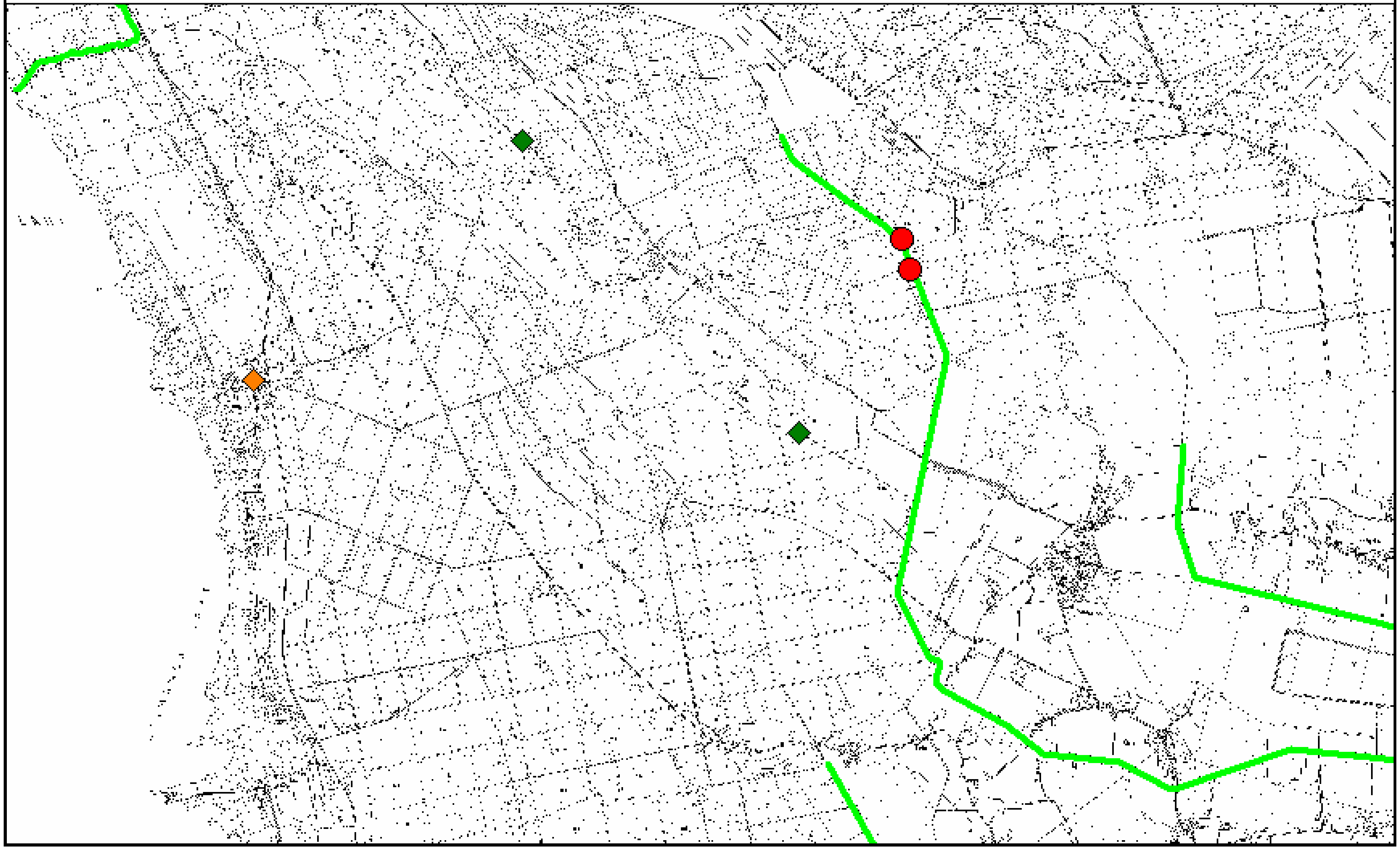

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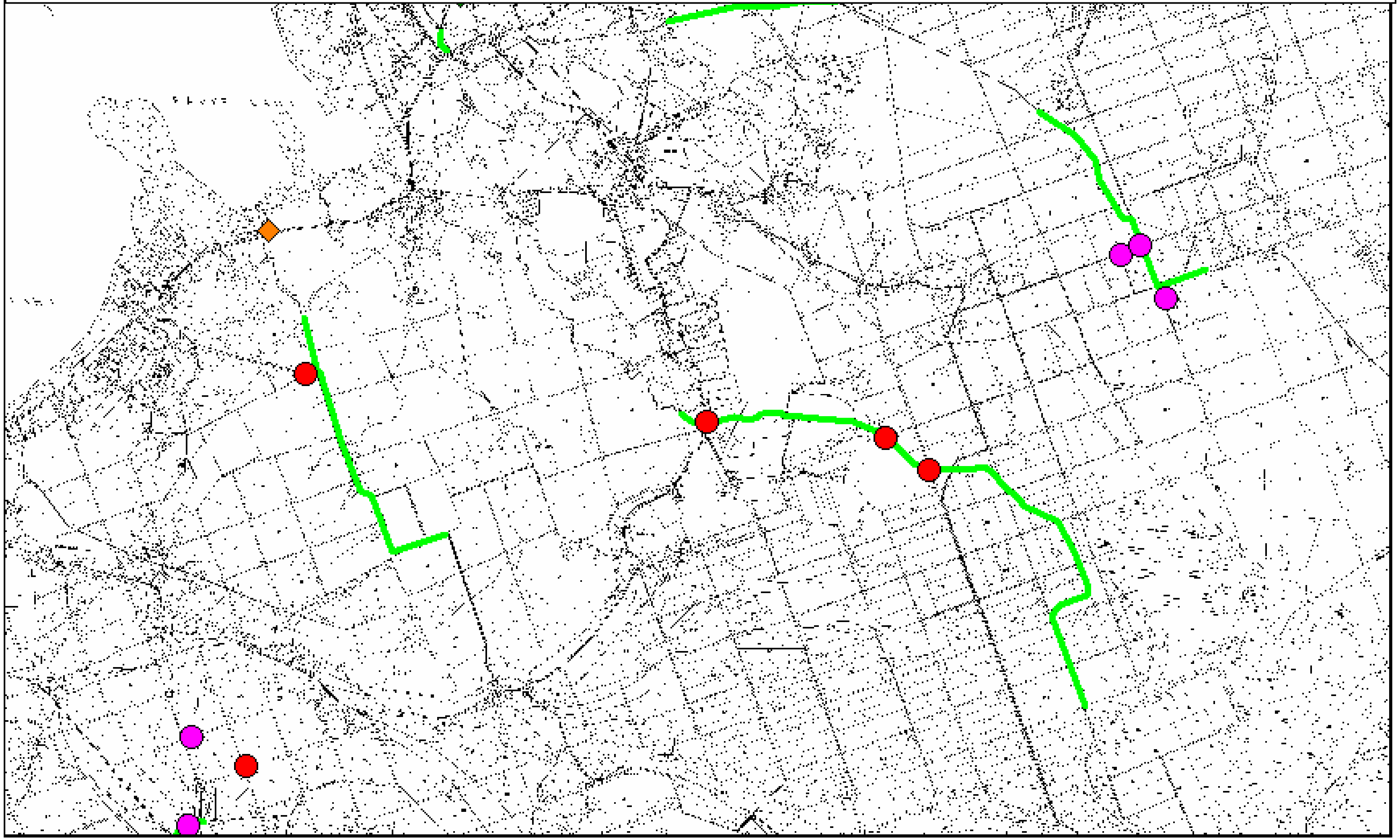

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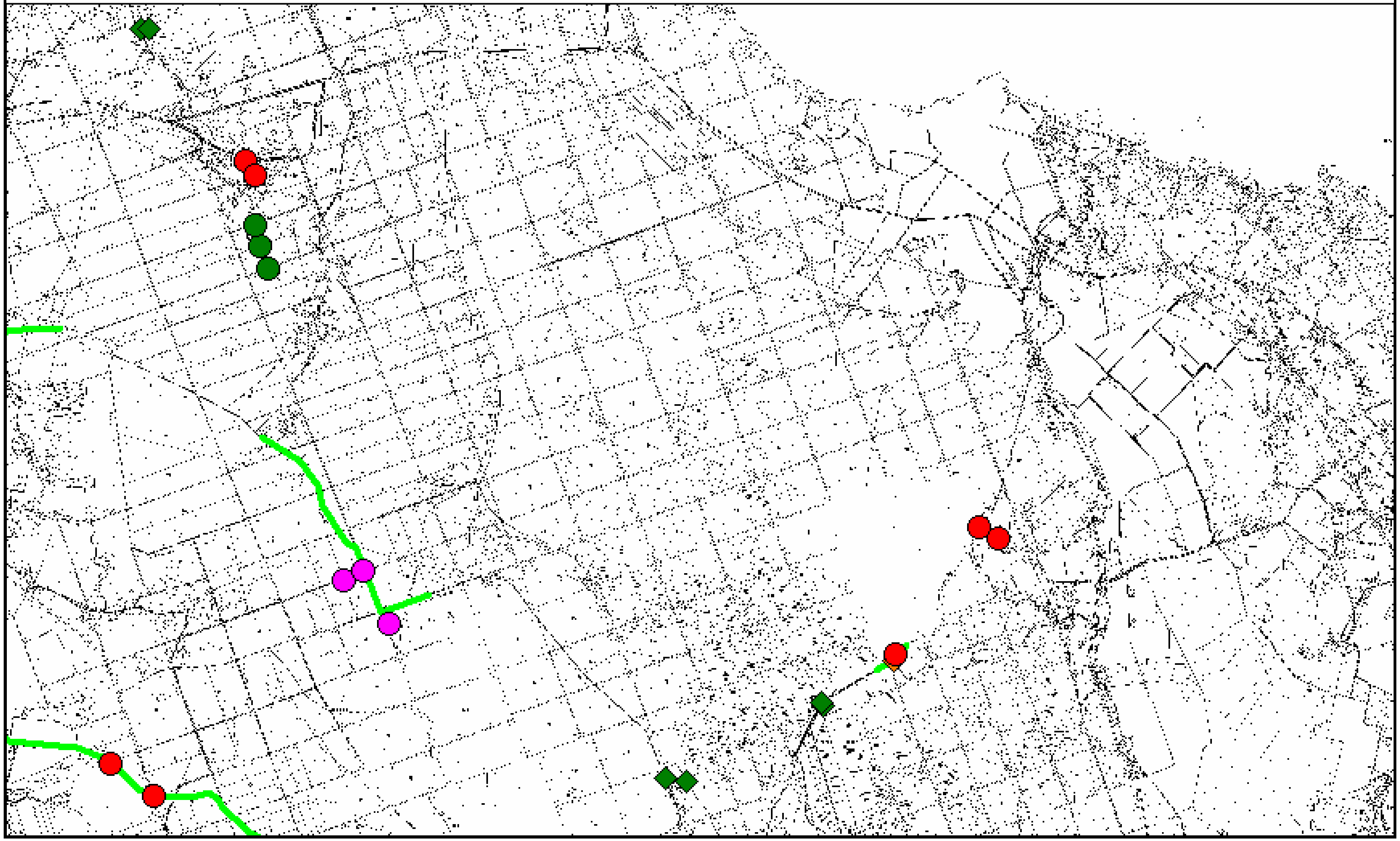

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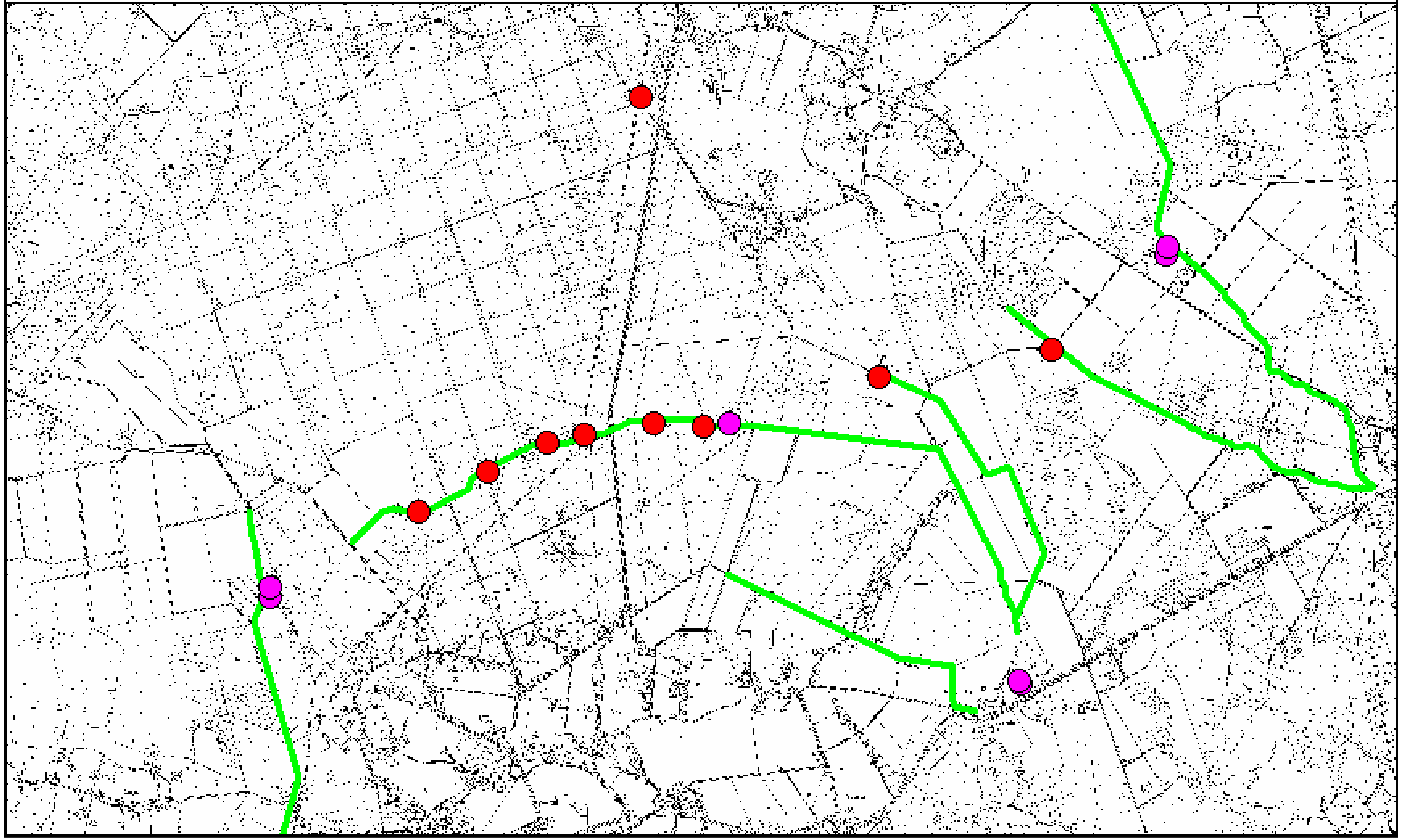


Annex 10.

Types of restoration works on water courses, their volume and locations according to longitudinal profiles of water courses (Jarvekulg, 2001; data from Hiiumaa Dept. of the Land Improvement Office of Laane county – longitudinal profiles of main ditches)

Water course	End points of stretch km		Length of stretch, km	Height of bottom m		Average gradient m/km	Gradient per stretch m/km	No. of weir rapids and riffles per stretch[1]	No of weir rapids and riffles per river	Dams for raising the water level
	l.course	u.course		l.course	u.course					
Paope str.	1.6	5.2	3.6	5.61	9.75	1.15	4.14	16	16	
Villivalla m.d.	0	4.9	4.9	-0.46	0.27	0.15	0.74	3	3	
Tammela str.	0	4	4	-0.2	0.62[2]	0.3	1.2	4	4	
Ristivalja m.d.	0	3.6	3.6	-0.11	4.09	1.17	4.2	16	16	
Rebasselja str.	0	2.7	2.7					14[3]	21	
	2.7	4.7	2	5	6.12	0.56	1.12	4		
	4.7	6	1.3	6.95	7.8	0.65	0.85	3		
Tulimurru m.d.	0	5.9	5.9	4.28	10.44	1.21[4]	7.1	28	28	
Prassi m.d.	0.4	4.4	4	0.12	5.32	1.3	5.2	20	20	
Kulama m.d.	0.3	4.7	4.4	0	2.9	0.66	2.64	10	10	
Vanamoisa m.d.	0	4	4	0.05	0.98	0.49[5]	1.96	7	7	
Valjasoo m.d.	0.3	7.1	6.8	0.47	2.1	1.48[6]	10.1	30	30[7]	
Pihla str.			5.1			1.05[8]	5.36	21	21	2 (u. course, in Pihla bog)
Armioja str.			7.4			1.1[9]	8.14	32	32	3 (outflow of Kunaauk lakelet)

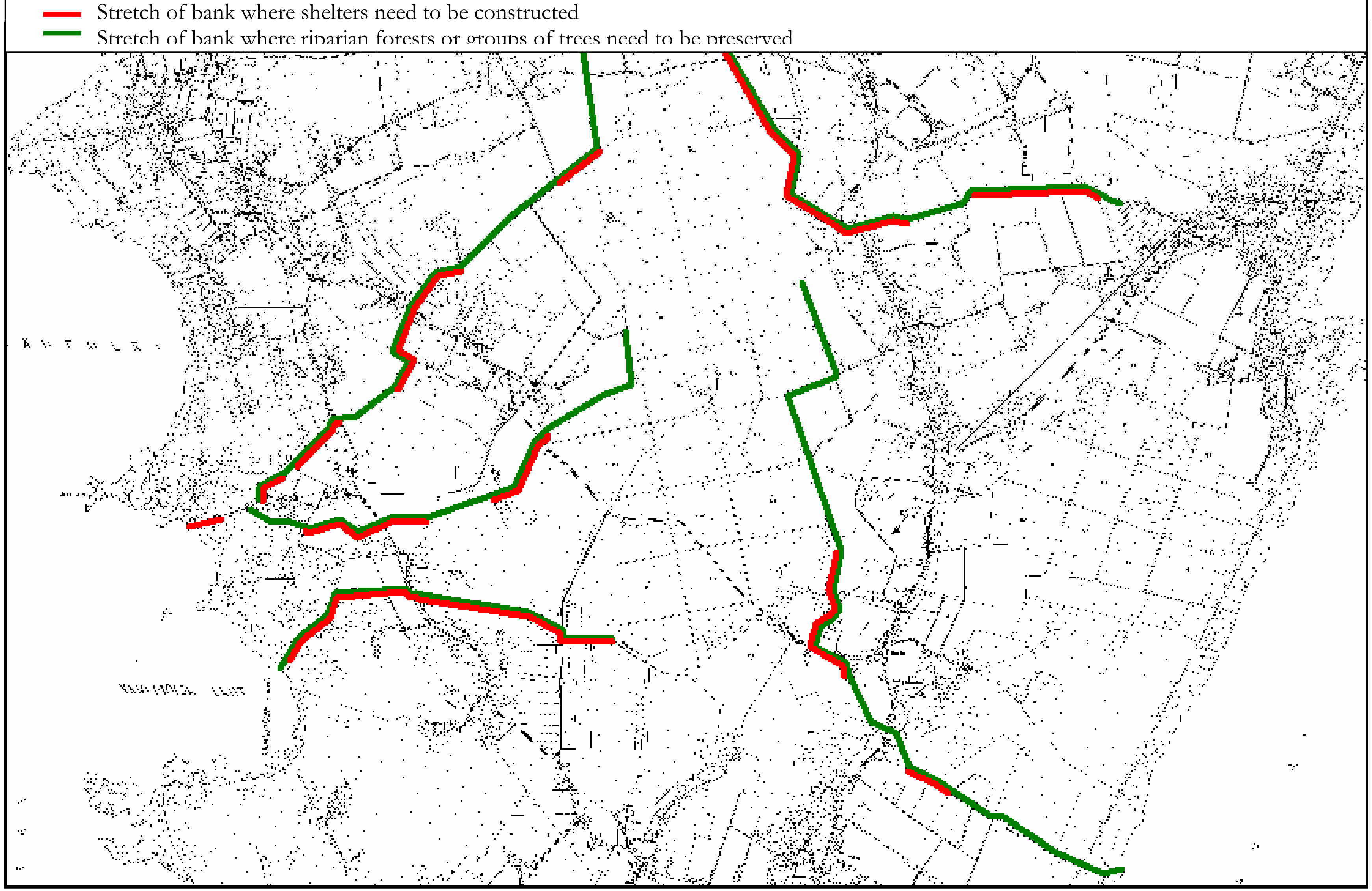
[1] Estimated height of dam 20–30 cm (~25 cm)
[2] Average gradient of the stretch of Tammela stream concernted is estimated after a 2,7 km stretch in lower course
[3] No. of weir rapids in the lower course of Rebasselja stream has been taken from the project by "Maa ja vesi (2002)"
[4] Average gradient of Tulimurru main ditch is estimated after a 5,1 km stretch, 0,8 km in lower course has probably a higher gradient
[5] Average gradient of Vanamoisa main ditch has been estimated after a 1,9 km stretch in lower course
[6] Average gradient of Valjasoo main ditch has been estimated after a 1,1 km stretch
[7] The No. of weir rapids and riffles in Valjasoo main ditch has been decreased because the gradient is probably higher in lower course than in upper course
[8] Average gradient of Pihla stream is taken from the book "Eesti joed (2001)" by A. Jarvekulg

Suuremoisa river	3 8.4	8.4 10.6	5.4 2.2	-0.5 0.3	0.3 2	0.15 0.77	0.81 1.69	3 5	8	
Vaemla river	2.7 4.4 7.2	4.4 7.2 14	1.7 2.8 6.8	-0.2 1.27 2.9	1.27 2.9 8	0.87 0.58 0.75	1.48 1.62 5.1	5 5 20	30	
Luguse river	2.6 4.6 8.9 12.8	4.6 8.9 12.8 16.4	2 4.3 3.9 3.6	3.28 4.88 10.57 12.21	4.88 10.57 12.21 14.48	0.8 1.32 0.42 0.63	1.6 5.68 1.64 2.27	5 22 5 9	43	
Jausa stream	3.9 7.3	7.3 11.4	3.4 4.1	3.83 8.65	8.65 10.2	1.42 0.39	4.83 1.6	19 6	25	
Vanajogi river			2.9					20	20[10]	1 (u. course in Tihu bog)
Kidaste str.										5 (u. course drainage ditches)
Nuutri river										2 (u. course in Maavli bog)

[9] Average gradient of Armioja is taken from the book "Eesti joed (2001)" by A. Jarvekulg.
[10] Average gradient of the river Vanajogi is taken from the book "Eesti joed (2001)" by A. Jarvekulg.

Annex 11.

Locations of construction of shelters and preservation of riparian forests on the inland water bodies of Hiiumaa



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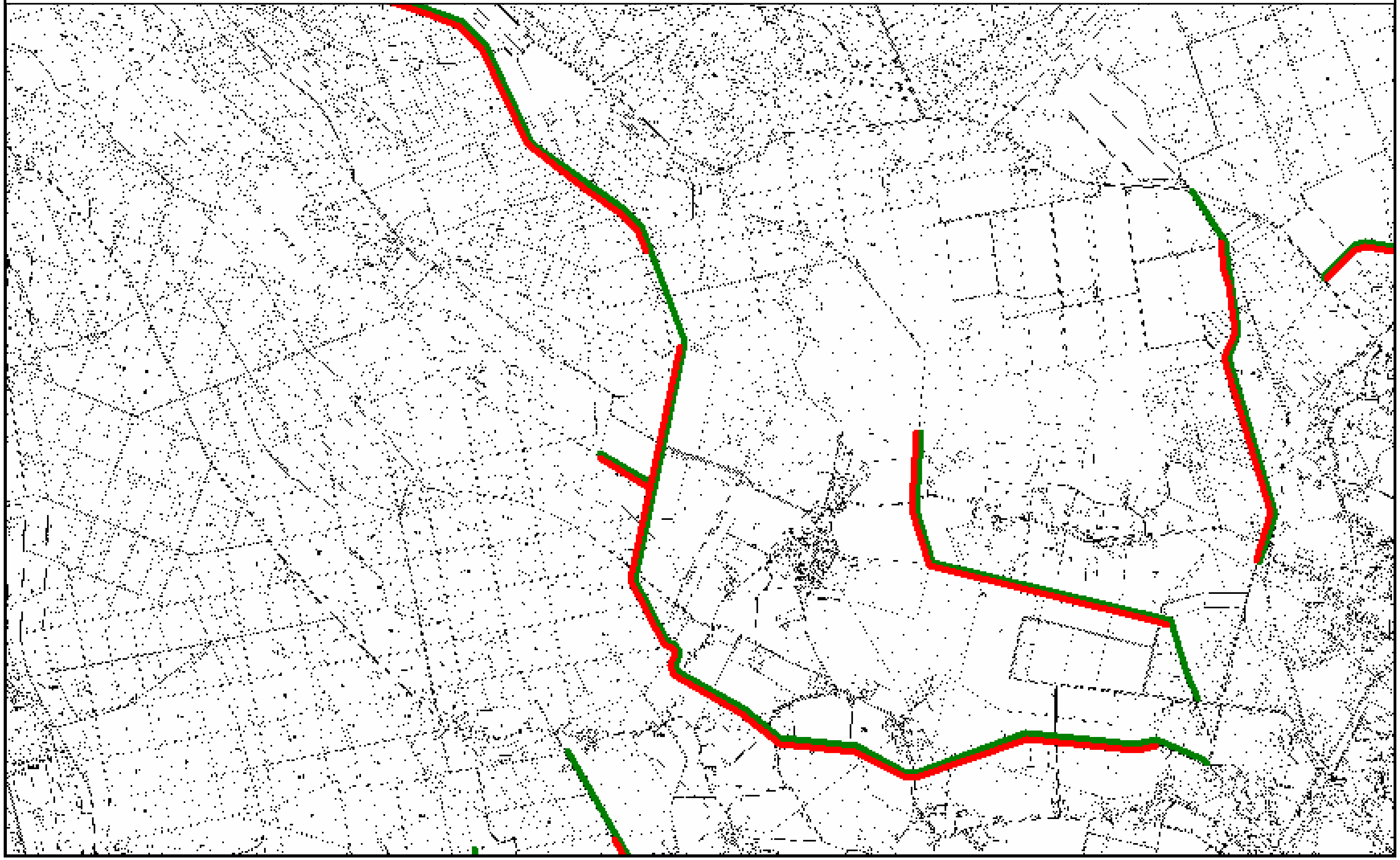
Locations of construction of shelters and preservation of riparian forests on the inland water bodies of Hiiumaa

Stretch of bank where shelters need to be constructed

Stretch of bank where riparian forests or groups of trees need to be preserved



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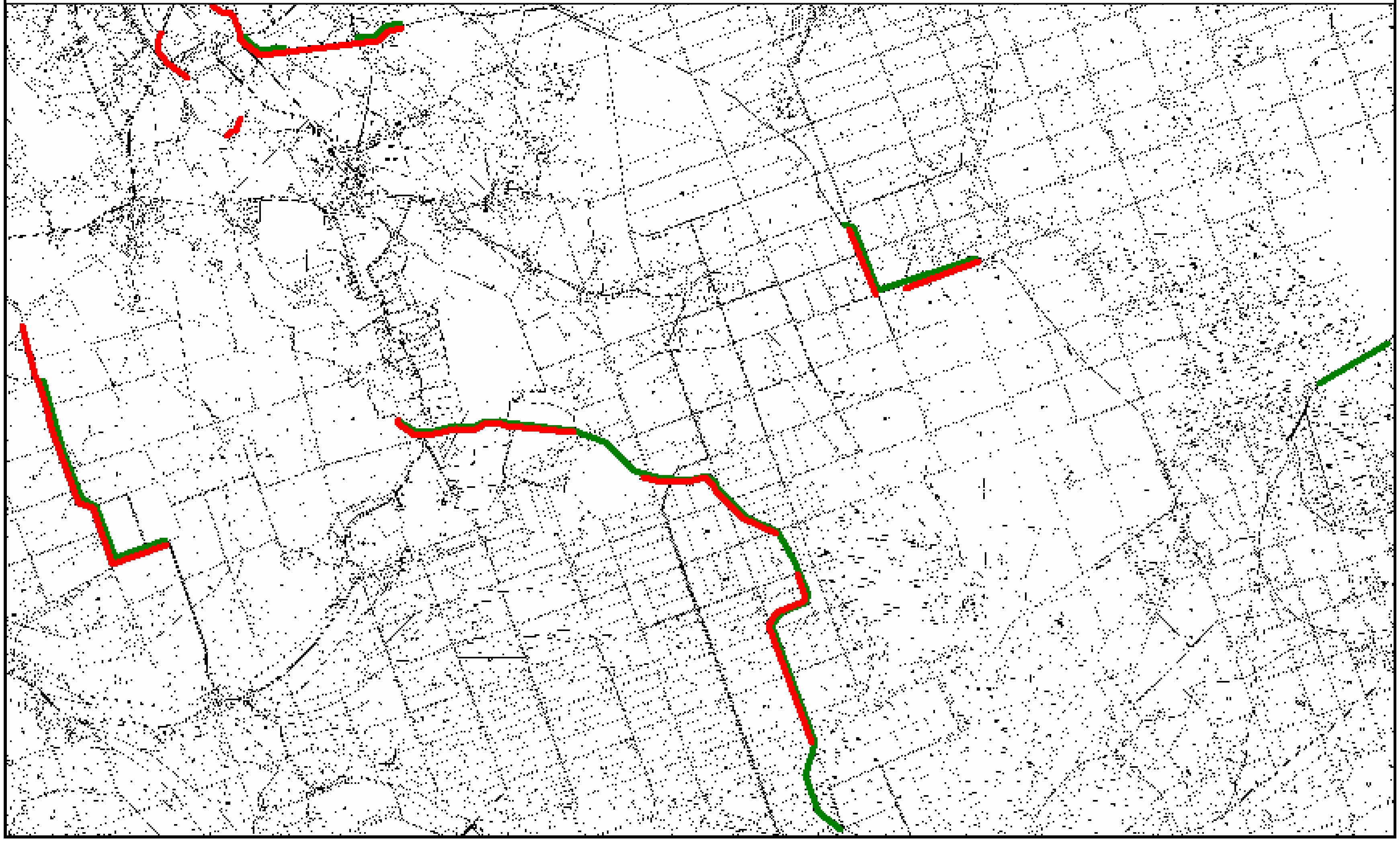

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