A SURVEY OF AMERICAN MINK (*Mustela vison*) ON HIIUMAA ISLAND, ESTONIA

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INTRODUCTION

Background

The objective of this survey was to provide an estimate of the total number of American mink (*Mustela vison*) living on the island of Hiiumaa, in the Baltic sea, 22 km off the Estonian mainland. The island forms part of the West-Estonian Archipelago Biosphere Reserve, of UNESCO's Biosphere Reserve Network. The surveyors, Adam Grogan and Cengiz Philcox from Oxford University's Wildlife Conservation Research Unit (WildCRU) both have experience of surveying mink in southern Britain.

The fieldwork was conducted from 18 July to 4 August 1997. Weather conditions were mostly dry, with clear skies, except for a period of showery weather during the middle third and at the end of the period. We do not feel that this rain affected the results of the survey significantly.

The island (and islets) has an area of about 1000 km^2, and mostly comprises freely draining sandy soils. Relief is generally very flat, the highest point on the island being 68 m above sea level. Approximately 60% of the land-cover is coniferous forest (pine, spruce and juniper scrub); most of the remaining area is arable or pastoral agriculture. The total population of the island is about 12,000 of which approximately one third live in the principal town, Kardla.

Drainage

An extensive network of straight-cut drainage ditches exists in much of the forested areas, particularly in the northern and central areas where bog predominates (see Map1). As well as these extensive networks, surface drainage ditches occur along roadsides and bordering agricultural fields. Besides these drainage ditches, many of the island's rivers have been canalised and straightened to carry large volumes of water during peak flows. A substantial length of inland watercourse exists on the island providing localised surface water over a wide area between Spring and Autumn. However, as became evident during the survey, the majority of the watercourses had dried out due to the exceptional weather. During this time it seems likely that availability of water may become an influential factor in the distribution of certain animals.

Surveying

The large body of literature detailing the ecology and behaviour of American mink as describe it as being strongly associated to water, seldom being found more than 100-200 m from a water-body (Marshall, 1936; Gerell, 1970; Linn and Birks, 1981; see also references in Allen, 1983). We have assumed during this survey that mink will be accurately recorded by surveying watercourses (dry or wet) and water-bodies, as mink will congregate in these areas, especially in the Summer when surface water seems to be very scarce. The calculation of mink numbers on Hiiumaa assumes mink living in proximity to dry or wet watercourses and water-bodies only.

METHODS

Sampling strategy

The objective of the survey was to derive an estimate of the number of animals present on the island. The Hiiumaa Biosphere Reserve staff have prepared a detailed vegetation classification based on soil types. However, the complexity and level of detail presented by this scheme was not suited to a stratified sampling technique. As a result a completely random sampling scheme was chosen targeting habitat rather than targeting specific vegetation types. In this way, the vegetation types and habitats would automatically be sampled according to their abundance, yielding a representative estimate of mink numbers without the need for further calculation.

The random sampling strategy was restricted to water-bodies indicated on the 1:100 000 scale AS TS Ltd. map. Fifteen days were devoted to surveying randomly chosen sites, generating 75 site visits. These were stratified into three groups of equal size:

1. Coastal sites. Thirty-three sites were initially anticipated for survey. These were selected by measuring the coastline using a "mapometer , selecting a random start point and distributing 33 points equidistantly around the coast. It later became evident that the total number of sites we could achieve would be 75. Therefore 25 of these 33 sites were chosen for survey, such that they were fairly evenly distributed around the coastline (see Map 1).
2. River sites. Rivers were identified on the map as those longer, wider water-bodies whether canalised or not, which were of a different character to the network of straight drainage ditches shown in the forest of the central region. The total combined length of all rivers was measured using a "mapometer , and 33 points were distributed equidistantly along the total length of rivers on the island. From these, 25 well-distributed points were selected for survey.
3. Ditch sites. A 1 km grid was drawn on the 1:100 000 scale map. Using a scientific calculator's random number generator, Easting and Northing co-ordinates were derived, rejecting those which fell in the sea. A ditch site was selected as being the nearest perpendicular distance from a ditch to the random point generated. This was repeated until 33 points were produced. From these, 25 well-distributed sites were chosen for survey.

In addition to the 75 randomly chosen sites, 2 further areas were examined:

4. Lake sites. One day was spent examining lake shores. Apart from Kajumeri lake, which appeared to have a character of a coastal site, the other lakes surveyed were either surrounded by dense *Phragmites* beds, or had no properly defined edge. Instead the ground formed a gradient from dry to saturated bog progressively covered by deeper surface water. This made conventional surveying impractical, and lake surveys were more of a "spot check at a particular accessible location. No mink density estimates are therefore possible for these sites.
5. Islets. One day was spent visiting the islets of Saarnaki and Hanikatsi. At each of these, stretches of coastline and inland paths were examined for scats and other signs, giving an indication of which species might be present.

Survey method

Two-hundred and fifty metres on each side of the randomly chosen survey point (estimated by pacing) were examined in detail by both surveyors. On rivers and ditches this usually meant that one bank was checked by each person. Coastal sites tended to be characterised by wide, sandy beaches, bordered by rough grassland or *Phragmites* beds, which could be up to C.70m thick, and backed by woodland or pine forest. In these locations, one surveyor examined the beach area from the water's edge to an agreed zone, whereupon the other surveyor would examine the remaining area to the tree-line or where this was impractical, to the landward border of the *Phragmites*. The number of tracks and scats of mink in and alongside the water-course or on the coastal zone was recorded as well as the presence of other animals. A colour-slide was taken at some point along the surveyed stretch, to demonstrate the character of the vegetation. The standard WildCRU mink/water vole recording sheet was used to collect other information on aspects of shore/bank substrate and profile, bordering land-use, vegetation cover as measured on the DAFORN scale (see Table 1 for an explanation), stream width and current speed. An example of the recording sheet is shown in Appendix 1.

Table 1. The DAFORN scale of vegetation cover used in the survey.

Abbreviation	Description	Vegetation % cover
D	Dominant	81-100
A	Abundant	61-80
F	Frequent	41-60
O	Occasional	21-40
R	Rare	1-20
N	None	0

Samples of all mustelid scats were collected for verification of species by Tiit Maran at Tallinn Zoo, and Rob Strachan at WildCRU and a number of fox and other animal's faeces were deposited with T. Maran.

Calculation of mink numbers

Rationale

The method used to estimate the number of mink on the island based on the results of the survey was as follows:

Using the proportion of surveyed sites found to be positive in each habitat (rivers, ditches, coast), we assume this proportion of the total length of each habitat to be occupied by mink at the time of survey. Using values of mink densities derived from previous studies in a variety of habitats, we multiply the inhabited proportion of the total habitat length by an appropriate value of mink density to give a total number of individuals.

The total length of rivers, ditches was measures from the 1:100 000 scale AS TS Ltd. map using a "mapometer . The length of coastline was taken from Kokovkin (1995). The extent of lake-shores was measured as the edge of the forest cover shown on the 1:50,000 scale Russian maps. This area was chosen because while the area of surface water is quite variable throughout the year, the Habitat Suitability Index model for American mink (Allen, 1983) suggests that the extent of emergent vegetation cover on the shore is likely to be the limiting factor in herbaceous wetland habitat suitability. The majority of lake sites on Hiiumaa are surrounded by dense *Phragmites* stands which extended from the forest edge towards the lake boundary. It is this area that has been used to define the extent of the lake habitat. The large lagoon at Kaina appears to resemble a lake on Hiiumaa in many ways, particularly in terms of abundant *Phragmites* cover and waterfowl as potential prey. The shoreline of this lagoon has been included in the lake-shore length for Hiiumaa. Table 2 shows the length of each type of habitat used in the analysis.

Table 2. The total length of each habitat used in calculations of number of mink present.

Habitat	Length (km)
Rivers	295
Ditches	309
Lacustrine/herb. wetland	62
Coastal	325

The range of figures for mink home ranges and densities are shown in Table 3. Pikulik and Sidorovich show a range of densities given for mink living on streams, ditches and canals in Belarus of 0.18 - 0.33 per km. Conditions occurring in this study are most likely to best characterise the conditions on Hiiumaa, though unfortunately, it is difficult to assess the comparability of both areas, since the reference is not available in English. For the purposes of estimating mink density on rivers and ditches on Hiiumaa, these figures have been adopted, based on the results of the Pikulik and Sidorovitch (1991) study.

In comparing lacustrine with acid river habitats in the UK (Dunstone and Birks, 1983, 1985), and marshlands with canals and ditches in Belarus (Pikulik and Sidorovitch, 1991), it appears that the small lakes on Hiiumaa might support 125%-400% more mink than the rivers and ditches. As sources of surface water in summer to be very important to mink on Hiiumaa, it is likely that the density of mink around the lakes tends towards the higher end of this range. A value of 1.1 mink/km (4x0.275) has been adopted as the density of mink around the lakes on Hiiumaa.

Table 3. Comparison of American mink home range size (km) and density on water bodies from other studies.

Source	Country	Habitat	Adult Male	Range	Adult Female	Range	Juvenile Male	Juvenile Female	Mink/km
Dunstone & Birks (1983, 1985)	UK	Acid river	2.53		2.16				0.86*
		Lacustrine	1.90		1.46				1.21*
		Coastal	1.50	1.35-1.80	1.09	1.55-0.75		1.05-1.80	1.58* 1.88
Gerell (1970, 1971??)	Sweden	River	2.00 ^{t} 1.35 ^{rt}		2.00 ^{t} 1.15 ^{rt}		2.0,1.0 ^{t} 0.73 ^{rt}		1.25 ^{t} 1.61* ^{rt}
Halliwell & Macdonald (1996)	UK	River							0.246* (1.43-10.0)
Mitchell (1961)	US	River	<4.50		<4.50			<0.80	
Novikov *et al* (1970)	USSR	Ditch, stream							0.10
		River							0.30
Pikulik & Sidorovich (1991)	Belarus	Large/ Average river							0.91, 1.38 (0.39-2.34)
		Slow current rivers in marshy areas							0.44, 1.09
		Average / rapid currents, moderate marshy or dry bank zone							0.29, 0.43 (0.23-0.63)
		Canals & ditches of forest/ agric drainage							0.29, 0.26 (0.18-0.33)

^{t} data from trapping

^{rt} data from radio-telemetry

* calculated from data available

Deriving a range of total population estimate

A complicating factor is the level of certainty with which recovered scats can be positively identified to species. Because of the relatively large number of mustelids present, only a small number of scats could be attributed definitely to mink. A larger number were only identified tentatively as mink, while others were identified as belonging to one of two possible species, e.g. mink or marten. These three groups represent different levels of confidence in correctly interpreting the species.

Most surveys to assess the status of a species will use only data of the highest level of certainty i.e., the number of positive occurrences of the species is a minimum estimate, and a high level of confidence can be placed in these results. However, in the case of this feasibility study relying only on such data would present a serious risk of underestimating the potential cost of the project. With this in mind, two levels of confidence of the data are provided to give a maximum and minimum estimate of positive occurrences of the species. The number of scats which were identified definitely as mink is likely to be an underestimate of the true figure, while the number of scats identified tentatively as mink is likely to be an overestimate. Thus the true figure would be expected to lie within the range of these minimum and maximum estimates. Records of footprints are included as constituting a tentative mink identification.

RESULTS

Table 4. Estimated numbers of mink for all sites by habitat.

	All sites	Lakes	River	Ditch	Coast
Total Sites	75	3	25	25	25
Confirmed mink sites	19	3	8	6	2
Min no. per km		1.1	0.18*	0.18*	0.275
Min. No. estimate	105	68	17	13	7
Max no. per km		1.1	0.33*	0.33*	0.275
Max. No. estimate	131	68	31	25	7
Possible mink sites	18	0	8	9	1
Min no. per km		1.1	0.18*	0.18*	0.275
Min. No. estimate	41	0	17	20	4
Max no. per km		1.1	0.33*	0.33*	0.275
Max. No. estimate	72	0	31	37	4

* from Pikulik and Sidorovich, 1991.

These results show that there could be between 105 and 131 mink using the confirmed positive sites. If we include the possible mink sites, this number could rise to 203 (131 + 72). Therefore the total number of mink that could be present on the island is between 105 and 203 individuals. Possible mink sites are sites where scats and/or footprints were found that could be mink, but cannot be positively identified.

Habitat summary.

As noted earlier, the surveyors also collected information on the habitat of the area being surveyed. This helps to identify particular habitat details that may favour the mink. This can be summarised as follows:

Presence of water: Out of a total of 37 sites with possible or definite mink sign, water was present at 12 (32%) of the confirmed mink sites and 4 (11%) of the possible sites. 12 of these 16 sites were rivers over 1 metre wide, but with poor currents. Only 1 ditch with possible mink sign held water, with the other 3 sites where water was present being lakes. Only 25 (47%) of the 53 non coastal sites surveyed had water.

Vegetation: Of the sites surveyed, many reflected the degree of tree cover on the island. Of the 37 total sites 25 sites (68%) had greater than 40% tree cover. Of the remaining 12 sites, 17 (46%) had in excess of 20% cover from shrubs. 14 sites (38%) had greater that 40% emergent vegetation in the form of reed beds.

Bordering land use. The surrounding land use can also determine the levels of mink populations in the area. Of the 37 sites, 22 (59%) bordered on conifer woodland, 23 (62%) bordered on a mix of conifer and broadleaved woodland and 12 (32%) sites bordered on permanent or temporary grassland. No other land use figured significantly, reflecting the land use of the island as a whole.

No evidence of mink were found on the islets of Saarnaki and Hanikatsi.

CONCLUSIONS

Mink population estimate.

The numbers of mink present on the island of Hiiumaa has been calculated to between 105 and 203. This is a large range, but this estimate is complicated by the age and condition of many scats, making positive identification difficult. However the maximum numbers of animals that has been derived from the survey should not make the removal from the island too difficult an obstacle too overcome.

Factors affecting the mink population on Hiiumaa

Allen (1983), used the results of previous population studies to put together a model which gives a Habitat Suitability Index (HSI). The purpose of this model is to define the relative quality of different habitats in supporting mink, and applies to inland wetland areas. While we are not aware of the results of putting this model to the test, it does highlight some of the habitat factors which may effect the number of mink on Hiiumaa.

For riverine habitats, Allen identifies the key attributes of habitat suitability to be: The percentage of persistent canopy closure, within 100m of the water's/wetland's edge. In his model, habitat suitability rises from zero to optimum as canopy closure rises from zero to 75%, and remains optimum from 75-100% closure. Secondly, Allen stipulates that to provide optimum habitat, surface water must be present for a minimum of 9 months of the year. Habitat suitability then falls progressively, until when surface water exists for less than 3 months of the year, the habitat has a suitability of zero.

For herbaceous wetlands, which seems to best characterise the small inland lakes on Hiiumaa, the same factors apply as above, with the additional relationship of the suitability of habitat rising from near-zero to optimum as percentage of the wetland basin covered by persistent emergent herbaceous vegetation (such as *Phragmites*) rises from zero to 50%. Suitability remains optimum between percentage cover values of 50-75%, and falls slightly as cover rises to 100%.

In deriving our population estimate, we have used the proportion of positive sites in a particular habitat to indicate the extent of suitable habitat for mink. This was then multiplied by the density values given in the literature. It was assumed that availability of surface water does not limit the density of mink below the figures given in the literature. However, it might be felt that a more accurate appraisal of suitable habitat could be made in the future, if the duration of the presence of surface water in the rivers and ditches was known. At present, this information is not available.

The timing of a trapping program

Our results indicate that mink show a strong preference to those sites with surface water present in summer. We expect their distribution to be relatively restricted during this time, whereas in winter they might be distributed much more widely. Trapping in summer might therefore minimise transport and other logistical costs, although it is accepted that many of the trappers that would be employed will prefer to work during the winter. The costs of a trapping program may depend heavily on the time of year it is conducted. Subsequent re-survey would be necessary to assess the effectiveness of a trapping program. Results from this may reveal ways in which improvements could be made.

The feasibility of a trapping program

Trapping out the number of American mink estimated to exist on Hiiumaa should be achievable with the appropriate effort and resources. However, the feasibility of the eradication program is more likely to depend on the rate of re-colonisation of American mink from the nearby inhabited islands and islets in the region. Without continuing control of immigrants, we must anticipate the likely outcome of an as yet unknown number of American mink arriving on the island as the European mink are attempting to establish.

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