The changes of distribution and population density of wildcats *Felis silvestris* Schreber, 1775 in Hungary between 1987-2001

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Abstract

The wildcat is one of the most endangered carnivore species in Europe. The population density declined and the distribution area became fragmented over the last century due to the hybridisation, loss of habitat, illegal hunting and road kills (Stahl and Artois 1994). However, a slight increase in the population density could be found in Belgium, France, Germany and Slovenia over the last few decades due to the recolonisation and reintroductions (Stahl and Artois 1994). Wildcats have been protected in Hungary since 1973, but the situation of this species was not been investigated until 1987. Mail questionnaire surveys were conducted between 1987 and 2001 to evaluate the changes of population density and distribution. Clear decrease of the wildcat population distribution range, constant and serious decrease in the population density could be found in Hungary between 1987 and 2001. The stable areas of the species’ occurrence are the Transdanubian and the Northern Middle Altitude Mountains, the Dráva plain, the Meesek and the Villányi Mountains and the forests of floodplains in the Great Plain. The protection of this species have to be intensified with a species protection plan, which contains the wildcat reserve areas with strict protective management measures.

Key words

*Felis silvestris*, distribution, population density.

Introduction

According to the Atlas of European Mammals (Mitchell-Jones et al. 1999) formerly wildcats population range covered all of Europe, with the exception of Scandinavia and north-eastern Europe. Recently the wildcat populations are sparsely distributed due to the fierce decline in population density. It reached a low in the first half of the XXth century. Recolonisations could be found in few areas in the last decade and also reintroductions were carried out to increase the population number. Healthy populations can be found in France, Germany, Italy, the Iberian Peninsula and in the Carpathians.

The fragmentation of the populations is due to the loss of habitats and hunting. Wildcats prefer deciduous or mixed forests with dense undergrowth, especially oak and beech woods with neighbouring open fields (Artois 1985; Stahl et al. 1988; Liberek 1996; Biró et al. 2004). The diet of wildcats consists mainly of small rodents and rabbits.

The threatened situation of wildcat has been proven by the report of Council of Europe (Stahl and Artois 1994). This statement was the base of the future tasks concerning wildcats formulated in the action plan of Felids by the IUCN (Nowell and Jackson 1996). The Hungarian situation in the report of Council of Europe was based on the data of the Department of Wildlife Biology and Management (Szemethy 1989; Szemethy et al. 1991; Szemethy et al. 1994).

The aims and priorities of the long-term and effective conservation and management of this species, pointed by Stahl and Artois (1994) were the following:

- regular monitoring of the population density and distribution;
- investigation of the hybridisation and its effect;
- studies on the loss and destruction of habitats;
- studies on the mortality due to the illegal hunting and to the road kills;
- the remarkable difficulties of the reintroduction programs;

The wildcat is listed in the Hungarian Red Data Book (Bankovics and Nechay 1989) in Hungary, species has been under protection since 1973, and the penalty value for an illegal killed wildcat individual is 200 €. Despite the fact that the wildcat is one of the most endangered...
carnivores in Europe and in Hungary, its situation in Hungary was not investigated from the declaration of protected status to 1987.

Wildcat population in Hungary can be divided into three major parts: the large and stable populations in the Transdanubian and the Northern Middle Altitude Mountains, the populations in the forests of floodplains in the Great Plain and population along the Dráva river. Some uncertain occurrences are noted in the hilly regions of Somogy and Zala counties. The population density decreases slightly, but continuously.

According to the studies carried on since late 1980s (Szemethy 1989; Szemethy et al. 1991; Stahl and Artois 1994; Szemethy et al. 1994; Szemethy and Heltai 1996) the most serious threats to the wildcat populations in Hungary are:

- destruction of the habitats (large clear-cuts and monocultural aforestations)
- illegal hunting
- the competition with domestic cats
- the hybridisation.

Studies undertaken by the Department of Wildlife Biology and Management of the St Stephen University aimed to investigate the occurrence and the trend of population density of the wildcat in Hungary during the period 1987-2001.

### Material and methods

#### Mail questionnaire survey

Data on the distribution and population density were collected by mail questionnaire surveys sent to each game management unit (hunting area). This method allowed to gain a large amount of data in a relatively simple way; on the other hand, no suitable alternative techniques were available.

An address list was first established based on the registration list of Hungarian Hunters Association, then from 1997 on the list was compiled based on the National Game Management Database. Questionnaires were sent to the presidents, head keepers and masters of the hunting areas. Respondents were given 1-1.5 months to reply. From 1994 a reminder was also sent after the deadline had passed.

We have processed data from eight surveys between 1987 and 2001. In the first period surveys were conducted in:

**Table 1. Yearly characteristics of the questionnaire surveys.**

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<td>48</td>
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<td>Covering rate (%)</td>
<td>80</td>
<td>50</td>
<td>36</td>
<td>43</td>
<td>40</td>
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**Table 2. Significant differences in the population densities of wildcat among years. X – significant results, p < 0.05.**

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Fig. 1. Changes in the population density (mean ± SD) of wildcat in Hungary. There is an estimated trend line of the changes: $y = -0.024x + 0.738$, $R^2 = 0.9$. The linear regression was significant (ANOVA: $F_{1,6} = 53.7$, $p < 0.001$; t-test for the regression coefficient: $t = -7.3$, $df = 6$, $p < 0.001$).
under different ongoing research programs, and no uniform questionnaires were used. A unified survey was developed only in 1997. Table 1 shows the statistics for the responses in different years.

Two questions concerned distribution and population density:

1) Does the wildcat occur in your hunting area (stable or occasional presence/absence)?

2) Estimated number of wildcat individuals?

Obviously, the responses to the question about the population number are less reliable because they are based on assumptions, and it is also more difficult to check the data. However, significant changes between one survey and another will suggest processes actually occurring.

Data processing

The data received were recorded in Paradox and Quattro Pro (Corel Corporation) database programs, linking the official code of the hunting area to every respondent, which made it possible to geographically localise data later. Every Hungarian hunting area has an individual code, which is necessary for official national registration. Responses that were unidentified in this respect were omitted from the data processing. The answer and the area coverage rate were calculated based on identified, coded areas. Statistical analyses were performed by the software SPSS 7.0 (SPSS, Inc.), while map views were generated by ArcInfo 3.0 and ArcView GIS 3.1 (Environmental Systems Research Institute, USA).

The estimated population density was calculated for 1000 ha and one-way ANOVA with Duncan-Range post-hoc tests was used to make comparisons between years. We analysed groups of density data separately for areas where the wildcat is considered as stable present, i.e. supposed to reproduce. The time series of the density were analysed by Pearson correlation and linear regression. Furthermore, data on presence/absence were analysed by χ²-test for all years and Bonferroni-intervals (Byers et al. 1984) were used to show a significant difference in these data in each year.

Map were prepared using digital maps of Hungarian hunting areas as well as on the Hungarian part of the map by Universal Transverse Mercator (UTM), with grid cells of 10×10 km. UTM-based distribution maps show the maximum distribution area of the species in the study period similar to European Mammal Mapping (Mitchell-Jones et al. 1999), but we applied much more severe criteria. Wildcats were considered as present in a quadrate if we had information on at least 6.25% of this area. We counted the given marginal value to exclude the least possible information. Thus, we supposed the worst scenario, where a hunting area with an area smaller (2500 ha) than determined by the Game Management Act (3000 ha) covers four equal 625 ha parts in four UTM cells; therefore, we have information on 6.25% of a cell of 10 000 ha. A combined map from the yearly answers was prepared for the entire study period.

Table 3. Variation of wildcat occurrence in the hunting estates between 1994 and 2001. n: the number of hunting estates responded the given occurrence class.

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<td>absence</td>
<td>135</td>
<td>46.1</td>
<td>153</td>
<td>39.6</td>
<td>215</td>
<td>50.4</td>
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<tr>
<td>occasionally</td>
<td>51</td>
<td>17.4</td>
<td>85</td>
<td>22.0</td>
<td>95</td>
<td>22.2</td>
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<tr>
<td>stable</td>
<td>106</td>
<td>36.2</td>
<td>141</td>
<td>36.5</td>
<td>113</td>
<td>26.5</td>
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<tr>
<td>regular occurrence</td>
<td>1</td>
<td>0.3</td>
<td>7</td>
<td>1.8</td>
<td>4</td>
<td>9</td>
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Fig. 2. Changes in the population density (mean ± SD) of wildcat in the area of stable occurrences. There is an estimated trend line of changes: y = −0.014x + 1.476, R² = 0.17. The regression is not significant (ANOVA: F₁,₆ = 0.95, NS; t-test for the regression coefficient: t = −0.97, df = 6, NS).
The change of the distribution area was analysed from the negative answers of the hunting grounds and the estimated number of the wildcats of the hunting estates. The number of the specimen (dots) was the first layer and the absence data was the second one on the map. Thus the dots inside the absence area show the decline of the species distribution area.

Results

Significant differences could be found among the yearly population densities of the wildcat during the study period in Hungary ($F_{7,3166} = 4.867, p < 0.001$). Duncan range post-hoc test was used to detect the differences among years (Table 2.). The decline was constant, as the trend line shows, and significant (Pearson correlation: $R = -0.95$, $n = 8$; Fig. 1).

The population density of wildcat also decreased in those areas, where the occurrence is stable (i.e. stable occurrence was reported in every year), however the decline was not continuous or significant (Pearson correlation: $R = -0.37$, $n = 8$; Fig. 2).

The area of the species appeared to narrow. The frequency distribution of stable-regular and the absence-occasional occurrence are significantly different from the expected value between 1994-2001 ($\chi^2 = 14.65$, $df = 5$, $p < 0.05$; Table 3). This change was due only to the significantly smaller proportion of absence and the larger proportion of the stable occurrence in 1995 (Bonferroni-intervals).

However, the spatial analysis of the data shows a decline of the area and the population density in the last decade.

Figure 3 shows the core areas of the wildcat population. The species disappeared from the north-western and from the central parts of Hungary. There are just few parts of the country, where the occurrence of the wildcat is stable. Stable populations are in the Dráva-plain, in the Mecek and in the Villányi Mountains, in the Transdanubian and in the Northern Middle Altitude Mountains, and in the forests of floodplains in the Great Plain.
Discussion

According to the investigations of Heltai (2002), among our carnivores it was only the wildcat, whose situation has clearly become worse in the 90s. Its range area and density have decreased, species has disappeared from many parts of the country, and its remaining populations are probably fragmented.

Protection plan to save the wildcat and stabilise its populations is urgently needed. The species protection plan has to contain the wildcat reserve areas, where the population density could increase through very strict protective management, e.g. the old, cuttable forests should be maintained, the domestic cats should be eradicated from those areas by any controlling methods, because the domestic cat is an invasive species (Orueta and Ramos 2001) and also the immigration of domestic cats should be hampered.

According to the proposal of Stahl and Artois (1994), the hybridisation and the loss of habitats have to be prevented, and the mortality due to the illegal hunting and road kills should be reduced for the effective protection of wildcats. The main problems in Hungary are the huge road kills should be reduced for the effective protection of the hybridisation and the loss of habitats have to be eradicated from those areas by any controlling methods, because the domestic cat is an invasive species (Orueta and Ramos 2001) and also the immigration of domestic cats should be hampered.

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REFERENCES


