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Potential habitats for the European Wildcat (*Felis silvestris silvestris*, SCHREBER 1777) in Austria – a basis for further steps in conservation

Sarah Friembichler & Leopold Slotta-Bachmayr

Abstract

Based on literature research a GIS (geographical information system) model for potential European wildcat habitat in Austria was created. Different environmental parameters, landcover, duration of snow covering and size of appropriate area, were included.

The results demonstrate that there exists sufficient potential habitat. 44 % of Austria is suitable for the wildcat. The most adequate areas for the wildcat are situated in the east and northeast of Austria. Large, connected and appropriate patches are to be found in the southeast of Styria, Burgenland and Lower Austria. Due to the long duration and height of snow cover, the Alps are unsuitable for the wildcat.

Comparing potential habitats for whole Austria and around observation sites, wildcats are significantly observed more often in suitable and optimal habitats. These results suggest that the model describes wildcat habitat appropriately. The results of this study are the basis for further decision according to spatial distribution of populations, monitoring, habitat improvement or possible release sites for supplementation of the wildcat population in Austria.

Keywords

conservation, decision making, *Felis silvestris silvestris*, Geographic Information System, potential habitat, European Wildcat

Introduction

Formerly the European wildcat was spread across large parts of the Austria, concentrating in the east of Austria, where the climate is more continental and milder. Due to increasing hunting pressure and the loss of adequate habitat the autochthon wildcat population disappeared in the fifties of the last century (BAUER 2001). SPITZENBERGER (2005) published that the wildcat is nowadays considered to be extinct and little is known about the existence and spreading of this shy carnivore in Austria.

In 2007 the team of the Thayatal national park newly discovered the European wildcat by using lure sticks to get hair sampling (MÖLICH 2007). Based on this new data and the whole lack of information an Austria-wide operating coordination and reporting office was founded, which collects all Austrian wildcat data. Till the year 2012, 128 wildcat indications across whole Austria were documented (FRIEMBICHLER et al. 2012).

Furthermore an action plan for the conservation of the European wildcat in Austria was formulated (SLOTTA-BACHMAYR et al. 2012). Basis of the action plan is the evaluation of wildcat habitat in Austria, a GIS Model.

The aim of this GIS Model is the identification of potential wildcat habitat in Austria. The obtained model forms the foundation for further measures concerning the conservation of the wildcat in Austria. The results are the basis for decisions about locations for further population monitoring, habitat improvement or population supplementation.

Material and Methods

Environmental parameters

Landcover

"*Felis silvestris silvestris* is primarily associated with natural forests. Large wildcat densities are reached in broad-leaved or mixed forests with low densities of humans (IUCN 2008). Coniferous forests are avoided. Old deciduous-, oak-, beech and mixed forests with various structures and habitat patches are preferred. In these types of habitat, the wildcats find necessary shelter, a home range with sufficient prey and other resources for raising their kittens (HEMMER 1993; RAIMER 2001; HOFRICHTER 2005).

Corine Land Cover data from the year 2000 are available for whole Austria (1:100.000, smallest unit 25 ha). Because the wildcat depends mostly on woodland habitats and due to the fact that the distance to the nearest woodland is crucial for wildcat suitability, categories take type and distance to woodland into account.

Depending on the suitability values vary between zero (unsuitable for wildcats) and four (very appropriate for wildcats) (Table. 1)

Table 1: Classification of different land covering categories (CORINE Landcover) as suitable habitats for wildcats

Landcover categories			**score**
Artificial surface	all categories		**0**
Agricultural areas	arable land	non-irrigated arable land	
		less than 200 m from woodland	**3**
		200 m – 500 m from woodland	**2**
		500 m- 2500 m from woodland	**1**
		more than 2500 m from woodland	**0**
	permanent crops	vineyards	**3**
	pastures	pastures	
		less than 200 from woodland	**4**
		200 m- 500 m from woodland	**3**
		500 m – 2500 m from woodland	**2**
		2500m- 5000 m from woodland	**1**
		more than 5000 m from woodland	**0**
	heterogeneous agricultural areas	complex cultivation patterns	
		less than 200 m from woodland	**3**
		200 m – 500 m from woodland	**2**
		500 m- 2500 m from woodland	**1**
		more than 2500 m from woodland	**0**
		land principally occupied by agriculture, with significant areas of natural vegetation	
		less than 200 from woodland	**4**
		200 m- 500 m from woodland	**3**
		500 m – 2500 m from woodland	**2**
		2500m- 5000 m from woodland	**1**
		more than 5000 m from woodland	**0**
Forests and seminatural areas	forests	broad-leaved forest	**4**
		mixed forest	**4**
		coniferous forest	**3**
	shrub and/or herbaceous vegetation associations	natural grassland	
		less than 200 from woodland	**4**
		200 m- 500 m from woodland	**3**
		500 m – 2500 m from woodland	**2**
		2500m- 5000 m from woodland	**1**
		more than 5000 m from woodland	**0**
		moors and heathland	
		less than 200 from woodland	**4**
		200 m- 500 m from woodland	**3**
		500 m – 2500 m from woodland	**2**
		2500m- 5000 m from woodland	**1**
		more than 5000 m from woodland	**0**
		transitional woodland/shrub	**4**
	open spaces with little or no vegetation	bare rock	**0**
		sparsely vegetated areas	**1**
		glaciers and perpetual snow	**0**
Wetlands	inland wetlands	inland marshes	**0**
		less than 200 m from woodland	**3**
		200 m – 500 m from woodland	**2**
		500 m- 2500 m from woodland	**1**
		more than 2500 m from woodland	**0**
		peatbogs	**4**
		less than 200 m from woodland	**3**
		200 m – 500 m from woodland	**2**
		500 m- 2500 m from woodland	**1**
		more than 2500 m from woodland	**0**
Water bodies	all categories		**0**

Duration of Snow Cover

The European wildcat has a preference for sunny, warm regions with mild climate (PIECHOCKI 1990) and avoids high mountains and regions with long, strong winters (HOFRICHTER 2005). Because the wildcat doesn't hibernate, it depends on hunting the whole year. Snowy winters are problematic, because its main prey (small rodents) can hide easily under the snow. For the European wildcat an average snow covering of less than 100 days are necessary to build up a population surviving over a longer period (HEPTNER & SLUDSKIJ 1980; PIECHOCKI 1990; RAIMER 1991; LINN 1992; HEMMER 1993; MÖLICH & KLAUS 2003; BAUER 2001; MERMOD & LIBEREK 2002; HOFRICHTER 2005).

The data of snow covering were obtained from the Central Austrian Institute for Meteorology and Geodynamics in the period between 1961 and 2007 (raster data, 250 m by 250 m). The snow data are divided into three categories:

- snow covering less than 50 days a year = 4
- snow covering 51-100 days a year = 2
- snow covering more than 100 days a year = 0

Patch size

The size of the appropriate areas is important because isolated families cannot survive on a long run. At least 50 adult and unrelated animals are necessary to allow a population to survive. Even under favourable conditions 50 wildcats need about 20.000 hectares un-fragmented habitat (RAIMER 2001). To withstand most of the fluctuations in biotic and abiotic factors 500 individuals are required. Therefore the space requirements of an intact wildcat population are approximately 165.000 hectares of appropriate habitat (RAIMER 2001).

Due to land cover and duration of snow covering as adequate classified habitats patches are rated depending on their size:

- patches > 100 000 ha - 4
- patches 10 000 – 100.000 ha - 3
- patches 1 000 – 10.000 ha – 2
- patches < 1 000 ha and inappropriate habitat – 1

Model building

The overall suitability of the habitat is given as product of all factors. Variable land- and snow covering are essential for wildcat occurrence. Patch size is non-essential. Essential variables may reduce to 0 and will then lead to a zero overall score. Non-essential variables enhance the value of a habitat and they are never rated with 0. In order to identify potential wildcat habitats the calculated values are reclassified into three new categories:

- inappropriate habitats
- subotimal suitable habitats
- suitable habitats

Model evaluation

The model was evaluated by combination of the habitat model with the sites of wildcat observations since 1955. Therefore a circle with a radius of 1865 m was placed around each point of discovery. Such a circle has the size of an average home range (KLAR 2007). Within each circle the suitability of the habitat for wildcats was calculated. A Chi^2 test was carried out to prove the significant differences of the habitats surrounding wildcat observations and the available potential habitats all over Austria.

Software

For analysis a geographic information system (GIS) software was used (ESRI ArcGIS 9.1).

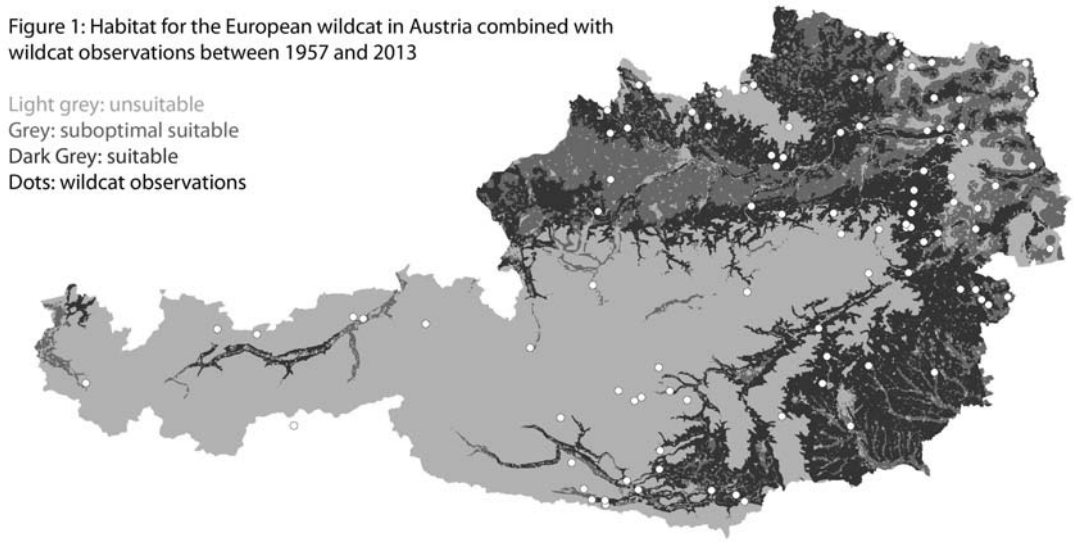


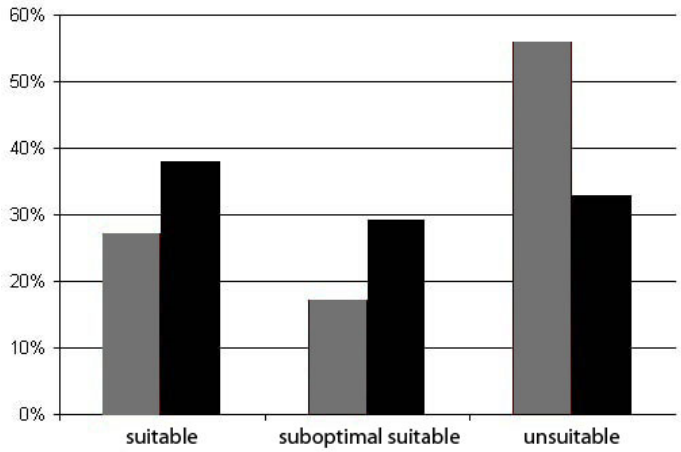
Figure 1: Habitat for the European wildcat in Austria combined with wildcat observations between 1957 and 2013

Results

The results show 36.749 ha of suitable habitats all over Austria. This means that 44 % of the whole country is suitable for the European wildcat (Fig. 1). Due to the long duration and height of snow covering, the Alps in the centre of Austria provide unsuitable habitat. Only small parts of the valley bottoms of the river Inn and Rhine are at least suitable for the wildcat. On the northern, eastern and southern edge of the Alps huge suitable areas are found. 17% of whole Austria are suboptimal suitable and 27% are optimal suitable wildcat habitat. (Fig. 2) The most adequate areas for the wildcat are predominantly situated on the northern edge of the alps, along the river Danube, in the northern parts of Lower Austria, Burgenland and south-eastern Styria and some parts of Carinthia.(Fig.1).

The combination of potential habitat and observations since 1950 shows that about 60% of all observations are found in suitable habitats. 45 % of the observations are connected to suitable and 15 % to optimal habitats. The comparison of habitats available for whole Austria and around wildcat observation points shows a significant difference (Chi²-test, $p<0,005$, Fig. 2). These results suggest that the presented model gives a realistic picture of potential wildcat habitats for the whole of Austria.

Figure 2: Distribution of suitable, suboptimal suitable and unsuitable habitat in the whole of Austria (grey) and observation sites around (black)



Discussion

The result of this study demonstrates that there is sufficient suitable habitat for the European wildcat in Austria. A habitat model for the wildcat in Austria was already developed by DIEBERGER (1994). His model was based on altitude, snow depth, precipitation, forest covering and the acceptance by hunters. DIEBERGERS models, as well as the one presented above, use forest covering as an important factor and also include altitude, snow depth and precipitation. We think that from these parameters duration of snow covering describes the suitability of wildcat habitat best. Duration of snow covering also correlates with altitude, and therefore altitude weren't included separately. There is no hint from literature that precipitation may be an important habitat parameter for European wildcat. DIEBERGER (1994) also uses acceptance by humans as a variable. Acceptance by humans may decide about recovery or extinction of different carnivore species all over the world. Therefore it is quite important to consider such a factor in a habitat model. The factor acceptance unfortunately couldn't be included in our model because we hadn't the appropriate data.

In the current model also habitat size is used. The parameter is not essential for wildcat occurrence, but for the long term stability of populations.

Considering the results of the presented model, the most adequate areas for the wildcat are predominantly situated in the east and northeast of Austria. The Alps are unsuitable because of long snow covering, as DIEZEL & MÜLLER – USIN (1962) already recognized. These results were also supported by DIEBERGER (1994), He considered the east and northeast of Austria as suitable habitats and the optimal areas are situated in the forest areas of the Weinviertel district.

Comparing the results of the habitat model with wildcat observation of the last 60 years, about 60 % of the observations are found in suitable habitats. Wildcats are hardly to differ from domestic cats (PIECHOCKI 1990). Therefore we have to consider that observations of domestic cats will also be included in this data set. In some observations the exact location is not available and the coordinates of the nearest community were included on the map. The model also describes the habitat suitability for the whole year. During summer, without snow covering, much larger amounts may be available for migratory wild cats as described above.

So it turns out that the presented model makes appropriate statements about suitable habitats for the European wildcat in Austria. Therefore it is an important basis for further management decisions like the location of the European wildcat populations. With the aid of the habitat model it's possible to focus on the most suitable areas, searching for wildcats. Furthermore communication programs to inform hunters and other stakeholders about the wildcat and improve the acceptance and habitat improvement measures are necessary. Therefore the habitat model gives a hint, where to start first.

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Contact

Sarah Friembichler
sarah.friembichler@hotmail.com

Naturschutzbund Österreich
Museumsplatz 3
A-5020 Salzburg
Austria

Leopold Slotta- Bachmayr
leo@dogteam.at

Tiergarten Wels
Maria-Theresia-Str. 33
A-4600 Wels
Austria