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Verified occurrence of *Felis silvestris* in Bohemia (Czech Republic) in 2010–2021 (Carnivora: Felidae)

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Abstract. In total, 616 reliable records (C1, C2 category *sensu* SCALP) of wildcat occurrence in Bohemia were collected and analysed in 11 monitoring seasons, "wildcat years" (WCY), 2010–2021. Camera-trapping data accounted for 95% of the dataset, the rest of the records were verified by the genetic analysis of several hair samples, scats, and tissue samples. The occurrence of the European wildcat was confirmed in eight sub-areas, more continuously in the forested border areas of southern and western Bohemia, and more sparsely in central and northern Bohemia. In total, the wildcat occurred at 73 different sites, in 35 mapping squares: four confirmed as category C1, 31 as category C2. The current occurrence in the western part of the Czech Republic is linked to that in neighbouring Germany. The development of modern non-invasive monitoring methods was crucial for the increase in detection of wildcat presence. However, both reintroduction and population increase in Bavaria and climactic change can also play a role as drivers of the recent spreading of the wildcat to our territory. Reproduction was confirmed in two sub-areas (Český les Mts., WCY 2021; Doupovské hory Mts., WCY 2020) and represents the first documented reproduction of the wildcat in Bohemia since the WWII. In some large areas such as the Šumava Mts., we observed

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a rather wider spatial activity, smaller numbers of individuals and more transient character of occurrence than in other (more restricted) areas, such as the Doupovské hory Mts., where we found higher population density and permanent occurrence with reproduction. Species-specific systematic camera-trapping and genetic monitoring in all areas with confirmed occurrence is highly recommended for the future.

Key words. Wildcat, Czech Republic, monitoring, occurrence, distribution, camera-trapping, genetics.

INTRODUCTION

The knowledge of the occurrence and population dynamics of the European wildcat (*Felis silvestris* Schreber, 1777) is currently much worse compared to other endangered carnivore species. It is believed that the original wildcat population disappeared in Bohemia at the turn of the 18th and 19th centuries (Anděra & Červený 2009). During the 20th century, the wildcat occurred only sporadically and all data on its occurrence in Bohemia stemmed from isolated and hardly verifiable observations until the beginning of the last decade (Anděra & Gaisler 2019). The wildcat is a relatively small, inconspicuous, and elusive species, phenotypically similar to the tabby domestic cat, a species with which it can crossbreed. Only the use of camera traps and genetic methods allows for its effective non-invasive monitoring. Thanks to these methods, the species has been more effectively documented in the western part of the Czech Republic in the last decade. The first reliable data on the re-occurrence of the wildcat in this region date back to the winter 2010–2011 in the Šumava Mts. (Pospíšková et al. 2013). Simultaneously, its presence was confirmed in an adjacent area of the Bavarian Forest National Park (Beutel 2015, Beutel et al. 2017). Gradually, the first records of occurrence were also obtained in the following years from the Český les Mts. and Doupovské hory Mts. (Mináriková et al. 2015, Kutal et al. 2017). A considerable amount of data has subsequently been collected, the summary of which may contribute to a new comprehensive view of the current distribution of this species. Our study summarizes all knowledge on wildcat occurrence in Bohemia (the western part of the Czech Republic) from 2010 till present.

MATERIAL AND METHODS

Study area

In this study, the presence of the wildcat was reported based on the ETRS89 10×10 km grid mapping system (EEA 2017). Our study area included all mapping squares located at least partially in the territory of the Bohemian part of the Czech Republic, including transboundary squares. Data from Moravia and Silesia were not processed, and thus the eastern border of the study area is represented by the geographical border between Bohemia and Moravia.

Overview of monitoring activities

Our data came from specific wildcat monitoring, but also from monitoring aimed at other protected species, especially large carnivores, namely the Eurasian lynx (*Lynx lynx*) and the grey wolf (*Canis lupus*). So far, there has been no continuous and full-scale wildcat monitoring in the Czech Republic. Only rather short-term projects and partial studies targeted on this species and mostly coordinated by the Nature Conservation Agency of the Czech Republic (AOPK ČR) took place during the reporting period 2010–2021. In general, species-specific monitoring has taken place with varying intensity in locations selected on the basis of field monitoring, expert knowledge and habitat suitability model (Pospíšková 2015). This was not a systematic mapping of large areas but rather an expert selection of a limited number of sites that

best corresponded to the appropriate wildcat habitat and thus were considered representative for monitoring of the species occurrence in this area. Such monitoring, coordinated by AOPK ČR, was carried out between 2012 and 2015 in the Ohře river valley, north-eastern part of the Doupovské hory Mts., Smrčiny hills, Aš promontory, Český les Mts., Třeboň region, Podbořany region, Křivoklátsko region, Brdy Mts. (Pospíšková 2019). In 2015–2016, this wildcat monitoring was concentrated on selected SCIs (Sites of Community Importance) within the Doupovské hory Mts., Křivoklátsko region, Český les Mts., eastern part of the Krušné hory Mts., Děčínské stěny rock walls, Švihovské hvozdy forests, the Chejlava forest and other SCIs in Moravia (for details see the final report of the project Monitoring of the large carnivores and the wildcat at the localities within the NATURA 2000 network – Pospíšková 2016). Since 2016, wildcat monitoring has been carried out again as a part of the project coordinated by AOPK ČR in selected PLAs (Protected Landscape Areas), SCIs (Sites of Community Importance) and SPAs (Special Protected Areas) – Blanský les PLA, Boletice SPA, Český les PLA, Brdy PLA, Křivoklátsko PLA, Doupovské hory SPA.

A separate case is represented by a local but intensive monitoring study specifically focused on the wildcat carried out since 2019 using camera-traps and hair-traps in the Doupovské hory Mts. (territory of the Hradiště military training area).

Much of the wildcat occurrence data in the study area, however, come from systematic camera-trapping of the Eurasian lynx. Intensive camera-trapping has been undertaken in the territory of the Šumava NP (and the Bavarian Forest NP) since 2009 (Weingarth et al. 2012). Extensive camera-trapping has taken place in a wider area, covering the whole area of the Šumava Mts. and the Šumava foothills including the Boletice military training area, Blanský les PLA, Novohradské hory Mts., but also the Český les Mts. and adjacent areas such as the Slavkovský les PLA, Brdy Mts., Písecké hory forests and the south-western part of the Javořická vrchovina highlands since 2017 (e. g. Wölfl et al. 2020). Camera-traps were placed along linear structures in the forests like paths, cuts, intersections (mainly within intensive camera-trapping) but also deeper inside forest stands in rugged terrain (rocks, culverts, etc.). Camera-traps installed primarily for lynx monitoring also help to capture other species of large and medium-sized mammals, including the wildcat (e.g., Mináriková et al. 2015, Beutel et al. 2017).

Last but not least, data on wildcat presence also come from camera-trapping aimed at the grey wolf, in the context of spreading of this species in Central Europe (Chapron et al. 2014). Wolf monitoring has been increasing especially since 2015, when it was launched in the Broumov region, Bohemian Switzerland NP, Jizerské hory Mts. as well as in the Kokořínsko-Máchův kraj PLA. Since 2016, camera-trapping has taken place in the Krušné hory Mts., since 2017 in the Lužické hory Mts. and since 2019 in the Šumava Mts.

Data collection

Photographic documentation obtained by camera-traps was the most widely used method of the survey. Basic monitoring was carried out mostly using cameras with white flash and fast triggers. Camera-traps with infrared glow and the possibility of video recording up to 1 minute were also used in some areas (more intensively in the Doupovské hory Mts.). Isolated but valuable accidental observations were included in the data set, with high-quality photo documentation taken by conventional hand cameras.

Another source of information on the occurrence used in this study was obtained by means of genetic analysis of sporadically found dead individuals (road kills), and of non-invasive genetic samples of randomly found scats and systematically collected hairs from hair-traps. Genetic samples were systematically collected exclusively in the Doupovské hory Mts. at several locations, where valerian-treated lure sticks were set simultaneously with camera-traps between WCY 2019 and 2021. Altogether 57 samples were collected in this specific region.

Data processing

The study includes all available data from the period starting in the calendar year 2011, when the first photos of the wildcat were collected, till 30 April 2022. The basic time unit for long-term monitoring was chosen not as a calendar year, but as a reproductive year: WCY = "wildcat year", starting on 1 May of

a given calendar year and continuing till 30 April of the following calendar year. The labelling year means the year of the beginning of this period.

The standard SCALP three-level system (C1, C2, C3) was used to assess data reliability (SCALP criteria – Molinari-Jobin et al. 2003, 2012). Theoretically, hybrids with the domestic cat (*Felis catus* Linnaeus, 1758) can occur (Pierpaoli et al. 2003, Driscoll et al. 2011 Steyer et al. 2013, 2016, 2018, Beutel et al. 2017). These are phenotypically similar to the wild form (Krüger et al. 2009) and difficult to distinguish (Eichholzer 2010). Thus, strictly speaking, in the case of the wildcat, only genetically confirmed data fall into category C1 (Krojerová et al. 2020). Photos of individuals, even if they visually meet identification criteria for the wildcat (e.g., Pospíšková et al. 2013, Anile et al. 2014, Kilshaw et al. 2015, Maronde et al. 2020), have to be included in category C2. Unverifiable data (direct observations of individuals without documentation, finding of tracks, etc.) are classified as C3 data and have not been included in this study. The data were reflected in the grid mapping system of 10×10 km ETRS89 (EEA 2017) to picture the large-scale distribution pattern.

Individual identification

Based on the unique individual coat pattern, it is possible to distinguish each photo-documented wildcat individual reliably (e.g., Eichholzer 2010, Kilshaw & Macdonald 2011, Anile et al. 2012a, b; Fig. 1)

All good-quality photos/videos were compared to each other. The both-sided identification of the individuals was made based on synchronous two-sided photographs of the individual from two opposite camera traps, or the two-sided registration on video recordings. A unique code was assigned to each

Fig. 1. Individual identification based on unique coat pattern: top – the same individual, bottom – different individuals (photo by L. Bufka et al. – camera trapping in the Šumava National Park).

Table 1. Total amount and structure of occurrence data collected during WCYs 2010–2021

WCY	records	photos (cam-traps)	videos (cam-traps)	photos (other)	cadaver / tissue	scats	hair (hair-traps)
2010	3	6	–	–	–	–	–
2011–2013	0	–	–	–	–	–	–
2014	1	1	–	–	–	–	–
2015	5	5	–	–	1	–	–
2016	6	4	2	–	–	–	–
2017	12	10	–	4	1	1	–
2018	17	30	3	–	–	–	–
2019	86	201	86	–	–	–	3
2020	294	701	282	–	1	–	19
2021	192	430	183	–	1	1	8
Σ	616	1388	556	4	4	2	30

identified individual for reliable record keeping and other research (starting with B – both sides identification, L – left side only, R – right side only; followed by a numerical code and the abbreviation of the particular study sub-area).

The minimum number of individuals for the given WCY was determined as the sum of (a) all individuals documented from both sides, and (b) the number of individuals documented either only from the left side or only from the right side (whichever was the highest for the given area and period). In general, reliable sex determination of individuals from photos was possible only in exceptional cases (Fig. 2) and in a higher proportion only in the data from the Doupovské hory Mts., thanks to the higher number of repeated registrations of the same individuals on video recordings available from this region.

For genetic identification of wildcat individuals and the detection of possible hybrids, a set of 24 short tandem repeats (STRs – microsatellites) and one sex marker (partial gene for amelogenin) was used (for details on markers and PCR amplification conditions see Krojerová et al. 2022).

RESULTS

Data quantity and structure

A total of 616 C1 and C2 category records of wildcat occurrence were collected for the WCYs 2010–2021 (Table 1). A smaller part of the total amount consists of findings from the period of WCYs 2010–2016, some of which have already been mentioned individually in earlier publications (Pospíšková et al. 2013, Mináriková et al. 2015), or were used for the overall overview of wildcat occurrence in the Czech Republic (Kutal et al. 2017). New unpublished findings account for the majority of the data used in this study. The amount and structure of data for the whole period are shown in Tables 1 and 2. Most data – 579 events (containing 1388 photos and 556 videos) – were obtained using camera-traps (95%). A smaller part of the collected dataset, but very significant in terms of reliability (C1 category), is made of data with confirmation of wildcat presence by genetic analysis. A total of 57 hair samples from 12 sites were collected in the Doupovské hory Mts. and 30 of them (53%) were successfully genotyped. In addition, the presence of the wildcat was confirmed by analysis of one tissue sample from WCY 2015 and one scat sample from WCY 2021 in this region. In other areas, samples for genetic analysis

were collected only randomly, and such findings were isolated. Specifically, there was one scat sample from the Šumava Mts. in WCY 2017, which confirmed the wildcat, and then samples from two dead individuals hit on the road and found at two nearby sites in central Bohemia (Dobříš region) in the WCYs 2020 and 2021. Finally, the list of data includes the finding of the remains of one wildcat cadaver and one detailed observation with good-quality photo documentation, both from the Šumava Mts. in WCY 2017.

Distribution and area of occurrence

The wildcat presence was confirmed more continuously in the southwestern border regions of the country. Moreover, rather isolated records come from some other areas of western, central and northern Bohemia. The area with obtained C1 and C2 data on occurrence may represent only a part of the real wildcat distribution in Bohemia, as it is undoubtedly influenced by a different level of monitoring effort in different areas and seasons. Up to now, eight separate geographical sub-areas within the whole Bohemia with detected wildcat occurrence can be defined (Figs. 3 and 4, Table 2).

Fig. 2. Rather exceptionally, the sex of an individual can be determined based on a photo or video from a camera-trap (male B004SU, Boletice military training area, 6 December 2018, camera-trap photo by H. Bednářová, Nature Conservation Agency of the Czech Republic).

Table 2. Number of wildcat records and number of occupied grid cells in sub-areas during successive "wildcat years" and during the whole monitoring period; ŠU – Šumava Mts., ČL – Český les Mts., SL – Slavkovský les Mts., DH – Doupovské hory Mts., LH – Lužické hory Mts., ČŠ – České Švýcarsko, DO – Dobříš region, KŘ – Křivoklátsko region

WCY	number of records / occupied grid cells								
	ŠU	ČL	SL	DH	LH	ČŠ	DO	KŘ	total
2010	3 / 2	–	–	–	–	–	–	–	3 / 2
2011–2013	–	–	–	–	–	–	–	–	0
2014	–	1 / 1	–	–	–	–	–	–	1 / 1
2015	3 / 2	1 / 1	–	1 / 1	–	–	–	–	5 / 4
2016	5 / 3	1 / 1	–	–	–	–	–	–	6 / 4
2017	12 / 5	–	–	–	–	–	–	–	12 / 5
2018	7 / 5	10 / 3	–	–	–	–	–	–	17 / 8
2019	9 / 7	7 / 5	2 / 1	68 / 3	–	–	–	–	86 / 16
2020	19 / 6	14 / 3	2 / 1	257 / 4	1 / 1	–	1 / 1	–	294 / 16
2021	11 / 6	4 / 3	2 / 1	169 / 3	2 / 1	1/1	1 / 1	2 / 1	192 / 17
total	69 / 19	38 / 7	6 / 1	495 / 4	3 / 1	1/1	2 / 1	2 / 1	616 / 35

Šumava Mts. – A total of 69 reliable records of wildcat occurrence were collected, mainly by camera-traps, during the wildcat years 2010–2021. In the strict concept of SCALP categorization (see Methods above), the analysed data consisted mainly of C2, only in one case of C1 data (genetically confirmed scat sample). The occurrence was rather rare, but in total, the wildcat was found at 39 different localities in 19 mapping squares, representing a half (53%) of the area covered with systematic camera-trapping. The first findings were made in WCY 2010. No wildcat was detected in the following four WCYs, although systematic camera-trapping of the Eurasian lynx was carried out during this period as well. Since WCY 2015, wildcat presence has been registered annually even though there have been large fluctuations in the number of records in individual WCYs. This is true even for the last five years, when the monitoring effort was most extensive and stayed comparable among seasons (WCY 2017–2021).

Český les Mts. – In total, 38 occurrence records were obtained in this area, documented photographically, almost exclusively from camera-traps (C2). The first credible record of the wildcat presence from the Český les Mts. comes from WCY 2014 and is undoubtedly related to the beginning of camera-trapping for lynx monitoring in this area. Since that, with the exception of WCY 2017, the wildcat has been captured annually there. Numbers of records are rather low and fluctuate widely among WCYs. The observed sparse occurrence within the entire area may be the result of a sparse monitoring network. In total, the occurrence was confirmed at 11 different locations, in seven mapping squares, covering almost the entire mapped area.

Slavkovský les Mts. – A total of 6 occurrence records were collected (two in each of the three WCYs 2019–2021). All data are represented by photos from camera-traps taken at two nearby sites in one mapping square.

Doupovské hory Mts. – In this area, extensive monitoring using camera-trapping and hair-trapping began in WCY 2019. This monitoring was focused specifically on the wildcat. The network of monitoring sites was concentrated in a relatively small area situated in a suitable wildcat

microhabitat (deciduous forests with rugged terrain). As a result, a large number of occurrence events were collected. In total, 459 camera-trapping events and 32 genetic samples were collected in two (C1), respectively four (C1+C2) mapping squares.

Dobříš region – The confirmed occurrence is based on random findings of two dead individuals hit by cars (on the local road at Nový Knín on 7 January 2021 and on the main road between Dobříš and Voznice on 25 November 2021). Both individuals phenotypically matched the wildcat, which was later confirmed by genetic analysis.

Křivoklátsko region – Two camera-trap events took place at one site during WCY 2021 (see also Lankaš in AOPK ČR 2022). The captured individual in both cases corresponded to the wildcat phenotype.

Lužické hory Mts. – There are only three camera-trap records corresponding to the wildcat phenotype from one site in two seasons (WCYs 2020 and 2021).

České Švýcarsko sandstone area – The only finding is one image of an individual corresponding to the wildcat phenotype from a camera-trap set for the monitoring of large carnivores, primarily of the wolf, in WCY 2021.

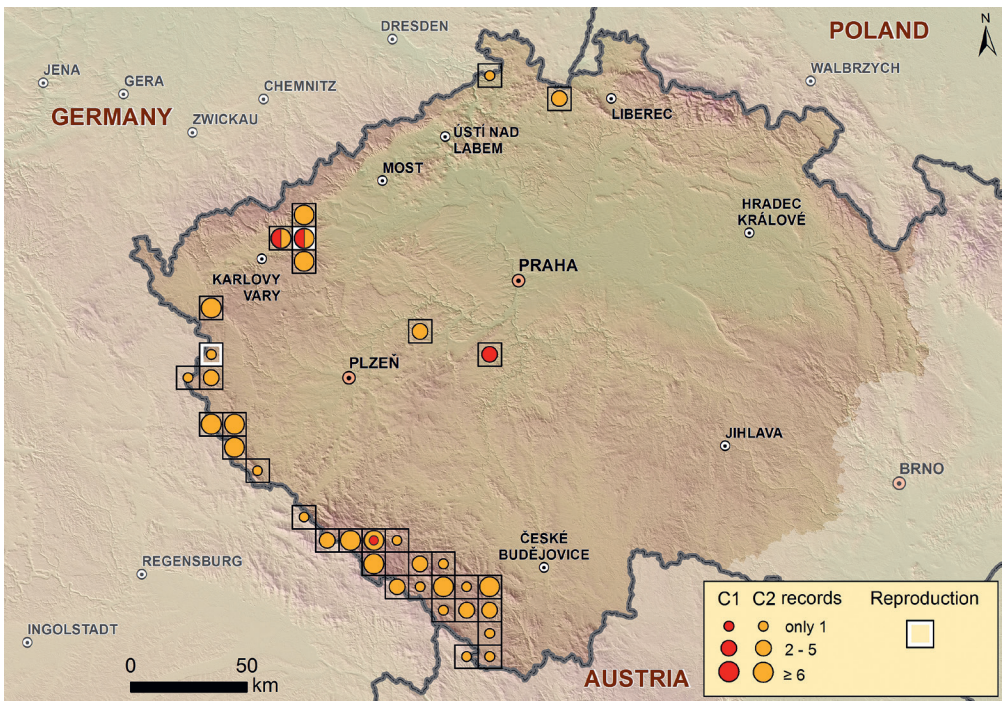

Fig. 3. Wildcat occurrence in the study area based on C1 and C2 data, projected onto the 10×10 km ETRS89 mapping grid system (EEA 2017).

Table 3. Minimum number of wildcat individuals in the four sub-areas with more frequent wildcat occurrence, based on identification from camera-trapping data

WCY	Šumava Mts.	Český les Mts.	Slavkovský les Mts.	Doupovské hory Mts.	total Bohemia
2010	1	–	–	–	1
2011–2013	–	–	–	–	–
2014	–	1	–	–	1
2015	1	1	–	–	2
2016	2	1	–	–	3
2017	3	–	–	–	3
2018	3	3	–	–	6
2019	3	3	2	6	14
2020	4	3	–	13	19
2021	3	1	1	13	19
total inds.	13	9	2	16	37
total cells	19	7	1	4	31

When assessing the entire study area and the whole period of WCYs 2010–2021, the wildcat occurrence was confirmed at 73 different localities in 35 EEA mapping squares – four of them classified in the C1 category, the remaining 31 in the C2 category (Fig. 3).

Reproduction

Two cases of wildcat reproduction were detected in two areas (both documented photographically, i.e., C2 data) during the study period:
(1) A den with two kittens and their mother, which escaped, was found in a large hollow beech tree in the Český les Mts. on 11 May 2021 (grid cell E450N297, Fig. 3).
(2) One juvenile individual, already independently moving, was captured twice by camera-trap at the same site in the Doupovské hory Mts., on 13 and 14 August 2020 (grid cell E454N302, Fig. 3).

Minimum number of individuals – camera–trapping data

The minimum number of individuals determined on the basis of camera-trapping results is available for four sub-areas: the Šumava Mts., Český les Mts., Slavkovský les Mts. and Doupovské hory Mts. Individual identification was not possible for the records from the Křivoklátsko region, Lužické hory Mts. and České Švýcarsko sandstone area due to the lower quality of the photos (Table 3, Fig. 4). The mean proportion of camera-trapping events from which individuals could be identified was 60% of the total sample. The proportion was significantly higher in areas where pictures were taken with a white flash and thus a well-coloured fur pattern prevailed (up to 81% within the data from the Šumava Mts.).

A minimum of 13 different individuals was distinguished over the whole period in the Šumava Mts. The minimum number of different individuals registered per season varied between 0 and 4. Only four individuals were registered in multiple seasons (three in two seasons, one in three seasons).

In the Český les Mts. and Slavkovský les Mts. altogether, at least 11 different individuals were distinguished by photographic identification over the whole period. The minimum number of different individuals per WCY varied between 0 and 5. Only two individuals were registered in multiple seasons (one in two and one in four seasons within the time span of 5 WCYs).

At least 16 different individuals were distinguished by photographic identification over the whole period in the Doupovské hory Mts. The minimum number of different individuals per WCY varied between 0 and 5. Only two individuals were registered in multiple seasons (one in two and one in four seasons within the time span of five WCYs).

Dispersal among the above-mentioned areas is theoretically possible, but no sharing of the same individual identified using both body sides (25) has been detected. However, we have to assume the possibility of dispersion and cannot exclude that more areas would share the same only unilaterally described individual (e.g. in the case that the individual is documented only from one side in a certain area and from the other side in another area). Given the different ratios of left- and right-hand identified individuals in the areas across the entire study area, the total minimum number of individuals within the entire area (Bohemia) is therefore different than a simple sum of the minimum numbers per particular areas. In total, within the entire study

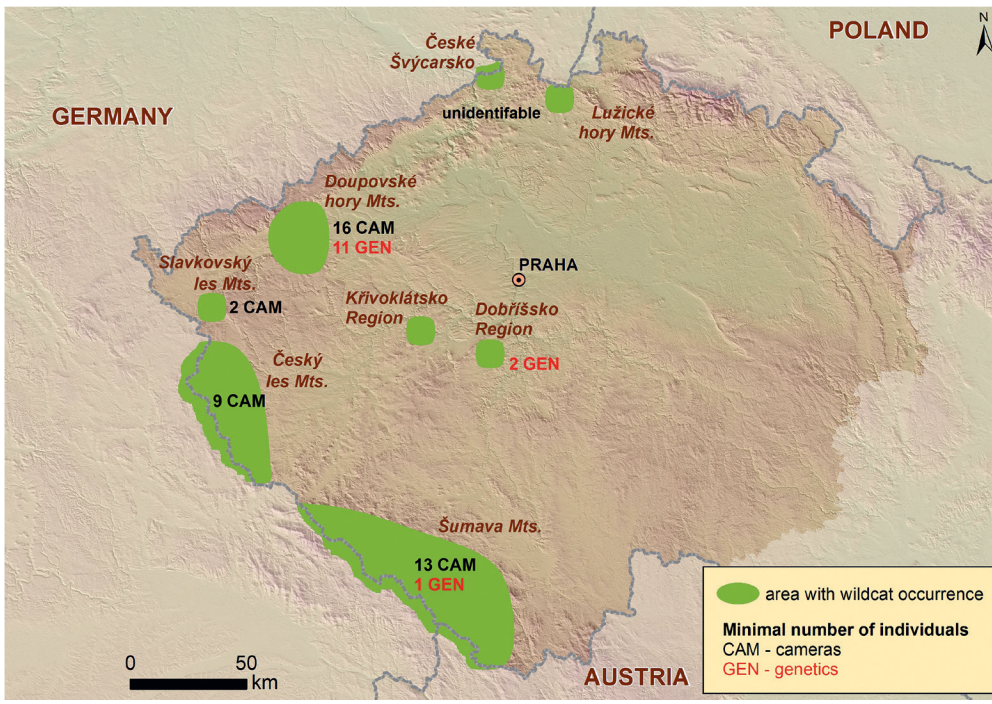

Fig 4. Eight sub-areas with wildcat occurrence and wildcat local minimum numbers estimated by camera-trapping and DNA analysis (samples for genetics were collected systematically only in the Doupovské hory Mts.).

area, 25 individuals were identified bilaterally, another 12 left-flank only and 9 right-flank only. So, in total, at least 37 (25 B, 12 L) wildcat individuals were detected in the entire area during the period of WCYs 2010–2021 (Table 3).

Minimum number of individuals – genetic data

Altogether, 14 wildcat individuals were identified by genetic analysis in the entire area.

So far, 10 different individuals have been identified in the Doupovské hory Mts. based on the non-invasive genetic monitoring in WCYs 2019–2021. Most of the samples come from hair traps, which were installed in suitable microhabitats together with camera-traps. Therefore, some individuals described genetically can be assigned to individuals identified from cameras. This is a part of further research already beyond this paper. Genetically identified individuals probably do not enlarge the number of individuals in the Doupovské hory Mts., except for one individual found as cadaver in WCY 2015. Similarly, one genetically identified individual from the Šumava Mts. (WCY 2017) is probably known from camera-trapping. Thus, the previously mentioned minimum number of individuals for the entire area can be enlarged just by two individuals (cadavers) found in the Dobříš region (WCYs 2020, 2021), to the final number of 39 individuals – Table 3, Fig. 4. Crossbreeds with a domestic cat have not yet been detected in the study area, but cannot be excluded, as very few samples apart from the Doupovské hory Mts. have been analysed so far.

Spatial activity

Repeated occurrence of the same individuals at different sites over time enabled to reconstruct partially their spatial activity. Spatio-temporal information obtained by camera traps cannot substitute data obtained by more precise radio-tracking, as these data are dependent on distribution, intensity and spatial scale of the camera-trapping sites. In our case, camera-traps were set extensively within the Šumava Mts. and Český les Mts, which enabled the eventual re-capture of the same individuals within these large areas. In the Doupovské hory Mts., a relatively small area was studied in detail and its surroundings were left without any camera-traps, not allowing an analysis of spatial activity at a larger scale. However, although the camera trapping was not standardized at a large scale concerning the area and time, the selected partial information detected randomly seems to be interesting and unique for this region (Table 4, Fig. 5).

The maximum distance of re-captures of the same individual was over 20 km, with the largest values being found in the Šumava Mts. and Český les Mts., e.g., the individual B007SU – 24.74 km, R001SU – 23.06 km, B009CL ♂ – 25.04 km. The time intervals between re-captures at different sites are variable and mostly big, so it is not possible to calculate any standard short-term parameters, such as daily linear movement. The only exception is the record of the individual B002SU, which was photo-captured at two rather distant sites separated by rugged terrain in a single day on 19 October 2015 (2:22 a.m. – 9:25 p.m. CET). Linear distance was 5.38 km. The maximum distances recorded for the individuals in the Doupovské hory Mts. were relatively lower. The highest detected movement distance was 9.95 km for the female B014Dou.

We calculated the area of occurrence (100% minimum convex polygon) for individuals observed for at least one season, captured at least 10 times at 5 and more different sites. In the Šumava Mts., the male B003SU was documented in this way. The area on which he was captured during approximately one season (WCY 2017) was 82.67 km^2. The best documented male in the Doupovské hory Mts. – B016Dou – was recorded on an area of 27.26 km^2 during

Table 4. Maximum linear movement distances and space use in selected wildcat individuals; MD – maximum distance, MCP – MCP100%

ID	sex	first registration	last registration	records	localities	MD (km)	MCP (km^2)
B001SU	un	10 Mar 2011	27 Mar 2011	3	2	7.64	
B002SU	un	19 Oct 2015	19 Oct 2015	2	2	5.38	
B003SU	♂	7 Apr 2017	5 May 2018	11	7	17.66	82.67
B004SU	♂	26 Oct 2018	6 Dec 2018	2	2	1.72	
B005SU	un	26 Apr 2020	7 Feb 2021	5	3	7.45	
B006SU	♂	23 Jun 2020	21 Apr 2022	8	4	10.87	
B007SU	un	3 Apr 2018	22 Oct 2019	5	5	24.74	
L010SU	un	1 Jun 2021	7 Jun 2021	2	2	2.83	
R001SU	un	2 May 2018	26 Apr 2019	2	2	23.06	
R002SU	un	23 Oct 2016	2 May 2017	2	2	16.20	
R008SU	un	17 Oct 2021	18 Oct 2021	2	2	3.16	
B009CL	♂	25 Mar 2017	30 Apr 2021	9	6	25.04	
B013Dou	un	22 Apr 2021	10 Aug 2021	7	4	6.75	
B014Dou	♀	8 Apr 2019	25 Feb 2022	33	5	9.95	11.32
B015Dou	♂	11 Feb 2020	13 Jun 2021	37	6	5.32	7.49
B016Dou	♂	27 May 2019	3 Apr 2022	73	7	7.95	27.26
B017Dou	♀	18 Apr 2021	27 Feb 2022	7	3	6.30	
B018Dou	♀	6 Feb 2020	9 Mar 2022	24	4	5.43	
B019Dou	♀	3 Apr 2020	14 Apr 2022	14	2	3.99	
B020Dou	♂	24 Jul 2019	16 Apr 2021	16	3	4.63	
B021Dou	♂	29 Nov 2020	17 Apr 2022	24	6	7.35	15.79
B022Dou	un	28 Feb 2021	17 Oct 2021	7	2	4.72	

WCYs 2019–2021 Among females, B014Dou was recorded during approximately the same period over an area of 11.32 km^2.

DISCUSSION

During the last 11 "wildcat years" (WCYs), we collected quite a lot of data on the wildcat occurrence in Bohemia. Some previous surveys designed specifically to cover suitable wildcat localities within the entire Czech Republic were not very successful (Pospíšková et al. 2016). On the contrary, the first evidence of this species' occurrence was obtained as a by-product of photographic monitoring aimed primarily at the Eurasian lynx (Pospíšková et al. 2013, Jaška 2019). Lynx monitoring is still the most important source of information about the wildcat in Bohemia, except for the Doupovské hory Mts. Lynx monitoring is capable of capturing the wildcat, as camera-traps are exposed over a long period of time in areas and habitats used by both species. The wildcat can move along paths and other line structures in the forests similarly as large carnivores and has daily resting sites in similar microhabitats as the lynx – rugged terrain with rocks, fallen large trees, etc. (e.g., Jerosch et al. 2010, Signer et al. 2019). Both types of camera-trapping sites are used within lynx monitoring. Of course, for a detailed systematic monitoring of the wildcat and the potential capture of all individuals in a particular area/region, it would be necessary to use more intensive monitoring with higher density of

camera-trapping sites, corresponding to the range of spatial activity of this species (Götz et al. 2018, Krojerová et al. 2020).

The wildcat occurrence has been detected in areas and macrohabitats meeting the species' requirements in Central Europe, i.e., forest habitats, in particular with the prevalence of mixed and deciduous woods (Sunquist & Sunquist 2008). This applies especially to the Doupovské hory Mts, big parts of the Český les Mts. as well as some localities at lower altitudes in the Šumava Mts. Interestingly, the wildcat was present also at the high elevations of the Šumava Mts. over 1000 m a. s. l., where spruce forests and peatbogs prevail. However, the individuals detected there could be dispersers crossing the mountain range, as the wildcat was also found at higher altitudes on the Bavarian side of the Šumava Mts, covered by mixed beech forests (Beutel 2015). It is known that the wildcat is to some extent capable of inhabiting highly fragmented landscapes and open habitats (Jerosch & Götz 2011), but the monitoring activities have not been extended to such habitats so far. Moreover, we are aware that also many suitable forest habitats with no proven presence of large carnivores were not covered by any type of monitoring in Bohemia and thus the results presented here can underestimate the real wildcat distribution range in the whole region. For these reasons, it also makes no sense to evaluate differences between seasons, trends in population density and distribution range. However, we assume that a summary of all the data from the past eleven seasons (WCYs) provides an

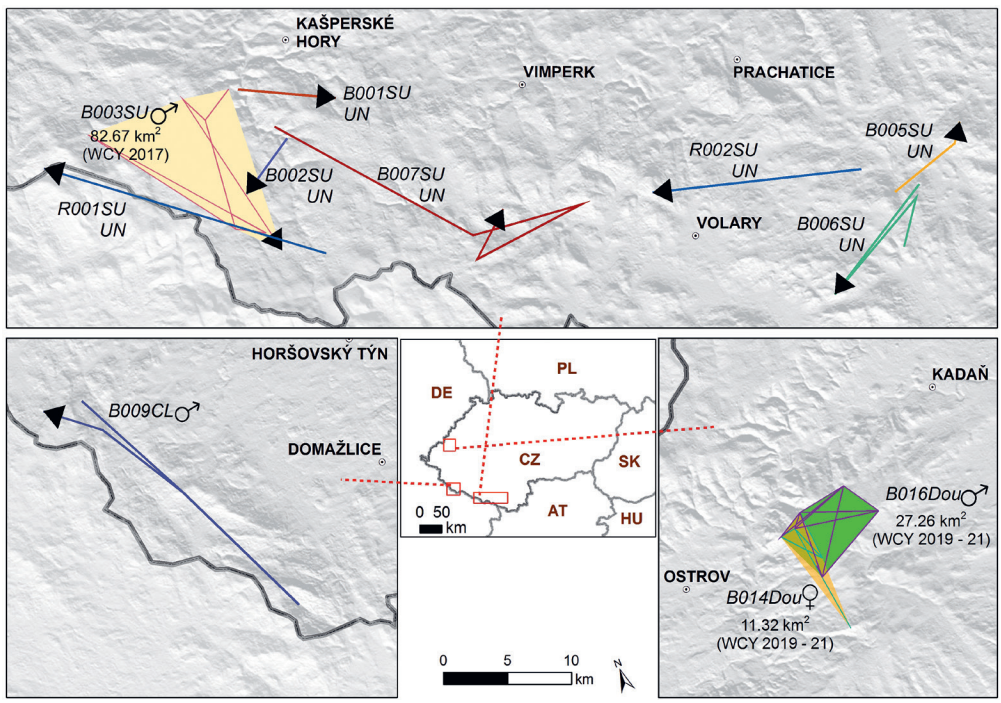

Fig. 5. Long movement distances and space use of wildcat individuals in three different sub-areas.

overall and the most realistic picture of the current occurrence up to date (i.e., till 30 April 2022 – Fig. 3) and should be understood as a snapshot of the beginning of the recent wildcat occurrence in Bohemia. This is supported by the fact that the total area of wildcat occurrence, expressed in terms of the number of grid cells occupied, was nearly the same (16, resp. 17 grid cells) in the last three seasons, when the monitoring effort in the main occurrence areas was comparable (see Methods and Table 2).

The observed modern wildcat presence in the western part of the Czech Republic appears to be directly related to that in neighbouring Germany. The nearest populations, believed to be indigenous, survived during the last century in the Harz Mountains and probably in Thuringia (Röben 1974). Strict protection of the species since the 1990s led to an increase in abundance and spreading to new suitable areas, especially in the last decade (Görner 2012, Stefen 2022). This overall pattern is undoubtedly supported by reintroduction programmes in Bavaria, which have become important stepping stones for the occurrence in western Bohemia. The first individuals were released into the wild in 1984 (Worel 1991, Büttner 1991). In total, 580 wildcat individuals were released in four sub-regions of Bavaria until 2008. Out of this number, 109 individuals were released between 1984 and 1991 in the "Vorderer Bayerischer Wald" [Front Bavarian Forest], the region which is directly adjacent to the Šumava Mts. (Worel 2009). The release of several individuals in the western Šumava Mts. in the 1970s is usually considered to have failed. However, other deliberate or unintentional escapes of wildcats from captivity at certain times cannot be ruled out either (Anděra & Červený 2009).

Data on a larger geographical scale than that of this study showed spreading of the wildcat in some European regions. Nevertheless, the wider use of suitable monitoring methods, such as camera-trapping or hair-trapping with subsequent genetic analysis, could influence the supposed increasing distribution range and population abundance of the wildcat also at this larger scale (Stefen 2022). Moreover, climate change could also have increased the ability of wildcats to move at higher altitudes and probability for the species to cross mountain ranges. It is generally assumed that the wildcat is limited by the extent and height of the snow cover (Sunquist & Sunquist 2008). The warming temperatures and lower snow cover during the last decade in the border mountain range, which, under normal conditions, would likely represent a certain migration barrier for the wildcat, may have facilitated the more frequent dispersion of animals from Bavaria into Bohemia. The relatively abundant occurrence recorded in the Doupovské hory Mts. undoubtedly correlates with the abundance of suitable habitats and the questions are whether there is a link to other areas of occurrence and how this still relatively small population was established. Rare records from central and northern Bohemia (Fig. 4) also suggest that the real occurrence of the wildcat may be more continuous than known so far, especially considering that some of these findings come from sites surrounded by large suitable habitats (Křivoklátsko region). However, the other available recent data, without documentation and/or the possibility of verification (category C3) and not included in this study, almost all came from areas where the wildcat was also/already detected by automatic cameras or confirmed genetically.

The presence of kittens in two sub-areas of occurrence represents the first documented information on the reproduction of the wildcat in Bohemia after several decades. The dates of these findings and the degree of development of the kittens correspond roughly to the most usual timing of birth in central European conditions – the end of April and the beginning of May (Hemmer 1993).

The minimum numbers of individuals detected in our study varied among areas and seasons and are undoubtedly dependent on intensity and settings of the different monitoring studies,

which were not designed for the wildcat, and the estimation of its population size and density. Therefore, unfortunately, it is not yet possible to compare our results with studies from other regions that dealt with wildcat population density in a standard way. Moreover, there still are relatively little data on wildcat numbers in forest habitats of Central Europe (e.g., Steyer et al. 2013). More studies have been carried out in the Mediterranean and Southern Europe (Anile et al. 2012a, b, 2014, Matias et al. 2021), northern Italy (Fonda et al. 2021) and Scotland (Kilshaw et al. 2015). Our data should be understood as the first ever quantitative information about this species in Bohemia, which will help to direct further research. Nevertheless, we presume that, to a certain extent, the minimum numbers of individuals found may indicate actual differences in abundance between areas where the wildcat presence has been documented. From this perspective, the Doupovské hory Mts. seems to be an exceptional area, where at least 13 different individuals were registered in WCY 2020 as well as in 2021, within a relatively small area of 4 mapping squares, i.e., 400 km^2. It appears that the wildcat occurs permanently at a relatively high density and reproduces there. In contrast, in the Šumava Mts., where extensive camera-trapping was carried out over a much larger area of approximately 3,600 km^2, max. four different individuals were detected in one season (WCY 2020). Up to now, the Šumava Mts. and Český les Mts. seem to be areas with less frequent occurrence, used by dispersers (probably from Bavaria) as evidenced by the large-scale spatial activity found in these areas (Fig. 5). However, the finding of kittens in the northern part of the Český les Mts. urges us to be cautious in this conclusion. Perhaps the wildcat occurs permanently and in higher numbers (at least locally) in these areas as well, but this has not yet been detected by the existing systems of monitoring. Similarly, there is a gap in knowledge about population size and status of the wildcat in other areas of central and northern Bohemia with confirmed occurrence (namely the Dobříš region, Křivoklátsko region, Lužické hory Mts., České Švýcarsko sandstone area).

The home range size of the wildcat varies in similar habitat conditions from about 10 to 20 km^2 (Stefen & Görner 2009). Long-term range sizes of several individuals in the Doupovské hory Mts. (Table 4, Fig. 5) correspond, in general terms, to these data. It must be remembered, however, that in our case we did not calculate a home range *sensu stricto* – the data were collected only from a certain number of fixed camera-trapping sites and the wider surrounding territory was not monitored, thus the total area actually used by individuals (i.e. their actual home range) may be larger. The large area used by an adult male during approximately one season (WCY 2017) in the Šumava Mts. together with the observed long linear movement distances, can support the above-mentioned hypothesis of more or less transient type of occurrence with a rather unstable socio-spatial structure in this region.

CONCLUSIONS

The above-described distribution pattern of the recent wildcat occurrence in Bohemia is probably highly dependent on uneven monitoring effort within the whole area. However, at least in areas covered with extensive large-scale camera-trapping carried out in the last ten years, such distribution pattern seems to reflect the real situation (e.g. south-western border region and the Doupovské hory Mts.). The wildcat population in neighbouring Germany (especially in Bavaria) seems to be the most likely source of this species' occurrence in Bohemia, as genetic analysis confirmed that the population in Bohemia differs from the West-Carpathian wildcat population. However, this hypothesis should be verified by further genetic analysis including comparative samples from Germany.

We assume that a confluence of three basic factors has contributed substantially to the resulting picture of the current wildcat occurrence in the western part of the Czech Republic:
– population increase and saturation on the Bavarian side of the border;
– the existence of suitable habitats (at least locally) in the contact area at the Czech-German border as well as in the wider area of Bohemia and the possible influence of climate change inducing easier movements through the border mountain range;
– development of monitoring methods using, in particular, photographic and genetic research, which substantially improved the documentation of records and produced conclusive data on occurrence.

The results suggest that in some areas the current occurrence is rather transient (Šumava Mts.), while in others (especially Doupovské hory Mts.) it is permanent including reproduction.

The cases of wildcat reproduction, estimated minimum numbers of individuals detected and some spatial activity patterns represent unique information about the wildcat in Bohemia.

Continued camera-trapping combined with non-invasive sampling for genetic analysis focused on localities with confirmed occurrence as well as surveys within new potential habitats and migration corridors are desirable for the future.

In order to obtain even more reliable data on the wildcat occurrence in Bohemia, it will be necessary to intensify the monitoring effort, possibly by building a large volunteer network (citizen-science), similar to that existing in Germany.

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REFERENCES

Anděra M. & Červený J., 2009: *Velcí savci České republiky*. *Rozšíření*, *historie a ochrana*. *2*. *Šelmy* (*Carnivora*) [*Large Mammals in the Czech Republic*. *Distribution*, *History and Protection*. *2*. *Carnivores* (*Carnivora*)]. Národní muzeum, Praha, 216 pp (in Czech, with a summary in English).

Anděra M. & Gaisler J., 2019: *Savci České republiky*: *popis*, *rozšíření*, *ekologie*, *ochrana*. *2*. *upravené vydání* [*Mammals of the Czech Republic*: *Description*, *Distribution*, *Ecology and Protection*. *Second*, *Revised Edition*]. Academia, Praha, 286 pp (in Czech, with a summary in English).

Anile S., Amico C. & Ragni B., 2012a: Population density estimation of the European wildcat (*Felis silvestris silvestris*) in Sicily using camera trapping. *Wildlife Biology in Practice*, **8**(1): 1–12.

Anile S., Arrabito C., Mazzamuto M. V., Scornavacca D. & Ragni B., 2012b: A non-invasive monitoring on European wildcat (*Felis silvestris silvestris* Schreber, 1777) in Sicily using hair trapping and camera trapping: does it work? *Hystrix – Italian Journal of Mammalogy*, **23**(2): 45–50.

Anile S., Ragni B., Randi E., Mattucci F. & Rovero F., 2014: Wildcat population density on the Etna volcano, Italy: A comparison of density estimation methods. *Journal of Zoology*, *London*, **293**: 252–261.

AOPK ČR [Agentura ochrany přírody a krajiny České republiky / Nature Conservation Agency of the Czech Republic], 2022: *Nálezová databáze ochrany přírody* [*Species Occurrence Database*]. URL: http://portal.nature.cz.

Beutel T., 2015: *Occurrence of European Wildcat* (*Felis silvestris silvestris*) *and Domestic Cat in the Bavarian Forest National Park*. Unpubl. BSc Thesis. Technische Universität Darmstadt, 46 pp.

Beutel T., Reineking B., Tiesmeyer A., Nowak C. & Heurich M., 2017: Unexpected detection of the European wildcat (*Felis silvestris silvestris*) in the Bavarian Forest National Park: spatial patterns of co-occurrence with the domestic cat (*Felis silvestris catus*). *Wildlife Biology*, **2017**(1): 1–8.

Büttner K., 1991: Zwischenbilanz der Wiedereinbürgerung der europäischen Wildkatze in Bayern anhand der Auswwertung von Fragebögen über Sichtbeobachtungen und Totfunde in den Ansiedlungsgebieten. In: Grabe H., Markl C. & Pläh T. (eds.): *Die Wildkatze und ihre Wiedereinbürgerung in Bayern*. *Wiessenfeldener Reihe*, *Bund Naturschutz in Bayern e. V*., *München*, **1991**(8): 70–87.

Chapron G., Kaczensky P., Linnell J. D. C., von Arx M., Huber D., Andrén H., López-Bao J. V., Adamec M., Álvares F., Anders O., Balčiauskas L., Balys V., Bedő P., Bego F., Blanco J. C., Breitenmoser U., Brøseth H., Bufka L., Bunikyte R., Ciucci P., Dutsov A., Engleder T., Fuxjäger C., Groff C., Holmala K., Hoxha B., Iliopoulos Y., Ionescu O., Jeremić J., Jerina K., Kluth G., Knauer F., Kojola I., Kos I., Krofel M., Kubala J., Kunovac S., Kusak J., Kutal M., Liberg O., Majić A., Männil P., Manz R., Marboutin E., Marucco F., Melovski D., Mersini K., Mertzanis Y., Mysłajek R. W., Nowak S., Odden J., Ozolins J., Palomero G., Paunović M., Persson J., Potočnik H., Quenette P.-Y., Rauer G., Reinhardt I., Rigg R., Ryser A., Salvatori V., Skrbinšek T., Stojanov A., Swenson J. E., Szemethy L., Trajçe A., Tsingarska-Sedefcheva E., Váňa M., Veeroja R., Wabakken P., Wölfl M., Wölfl S., Zimmermann F., Zlatanova D. & Boitani L., 2014: Recovery of large carnivores in Europe's modern human-dominated landscapes. *Science*, **346**: 1517–1519.

Driscoll C., Yamaguchi N., O'Brien S. J. & Macdonald D. W., 2011: A suite of genetic markers useful in assessing wildcat (*Felis silvestris* ssp.) – domestic cat (*Felis silvestris catus*) admixture. *Journal of Heredity*, **102**(Supplement 1): S87–S90.

EEA [European Environmental Agency], 2017: *EEA Reference Grid*. URL: https://www.eea.europa.eu/data-and-maps/data/eea-reference-grids-2.

Eichholzer A., 2010: *Testing the Applicability of Pictures Taken by Camera-Traps for Monitoring the European Wildcat Felis silvestris silvestris in the Jura Mountains of Switzerland*. Unpubl. MSc Thesis, University of Zürich, 37 pp.

Fonda F., Bacaro G., Battistella S., Chiatante G., Pecorella S. & Pavanello M., 2021: Population density of European wildcats in a pre-alpine area (northeast Italy) and assessment of estimate robustness. *Mammal Research*, **67**: 9–22.

Görner M., 2012: Wildkatzen (*Felis silvestris*) in Thüringen aus aktueller Sicht von Jagd, Naturschutz und Wissenschaft. *Säugetierkundliche Informationen*, **8**(45): 387–403.

Götz M., Jerosch S., Simon O. & Streif S., 2018: Raumnutzung und Habitatansprüche der Wildkatze in Deutschland. *Die Wildkatze in Deutschland*. *Natur und Landschaft*, **93**(4): 4.

Hemmer H., 1993: *Felis silvestris* Schreber 1777 – Wildkatze. Pp. 1076–1118. In: Stubbe M. & Krapp F. (eds.): *Handbuch der Säugetiere Europas 5*: *Raubsäuger – Carnivora* (*Fissipedia*); *II*: *Mustelidae*, *Viverridae*, *Herpestidae*, *Felidae*. Aula Verlag, Wiesbaden, 1213 pp.

Jaška P., 2019: Kočka divoká po tři sta letech ve Slavkovském lese [Wildcat in Slavkovský les Mts. after three hundred years]. *Arnika*, **2019**(1): 2–4.

Jerosch S. & Götz M., 2011: Ist die offene Kulturlandschaft ien Wildkatzenlebensraum? Erste Ergebnisse einer Telemetriestudie in einem Verbundlebensraum. *Beiträge zur Jagd und Wildtierforschung*, 36: 369 – 376.

Jerosch S., Götz M., Klatz N. & Roth M., 2010: Characteristics of diurnal resting sites of the endangered European wildcat (*Felis silvestris silvestris*): Implications for its conservation. *Journal of Nature Conservation*, **18**: 45–54.

Kilshaw K. & Macdonald D. W., 2011: The use of camera trapping as a method to survey for the Scottish wildcat. *Scottish Natural Heritage Commissioned Report No*. *479*. Scottish Natural Heritage, Inverness, 32 pp.

Kilshaw K., Johnson P. J., Kitchener A. C. & MacDonald D. W., 2015: Detecting the elusive Scottish wildcat *Felis silvestris silvestris* using camera trapping. *Oryx*, **49**(2): 207–215.

Krojerová J., Duľa M., Tám B., Bojda M., Dekař P., Gajdárová B., Homolka M., Kubala J., Koubek P., Kutal M., Machciník B., Tonhaiserová A. & Váňa M., 2020: *Metodika monitoringu kočky divoké* (*Felis silvestris*) [*Methods of the Monitoring of the European Wildcat* (*Felis silvestris*)]. Unpubl. Project Final Report. Interreg V-A SK-CZ Felis SKCZ (304021R971), Brno, 29 pp (in Czech).

Krojerová J., Duľa M., Gajdárová B., Homolka M., Koubek P., Tám B., Bojda M., Dekař P., Dzurja J., Gendiar M., Grešner M., Kováč P., Kubala J., Kutal M., Machciník B., Tonhaiserová A. & Váňa M., 2022*: Hledáme kočku*, *pozor*, *divokou!* [*We Are Looking for* a *Wildcat!*]. Unpubl. Project Final Report. Interreg V-A SK-CZ Felis SKCZ (304021R971), Brno, 70 pp (in Czech).

Krüger M., Hertwig S. T., Jetschke G. & Fischer M. S., 2009: Evaluation of anatomical characters and the question of hybridization with domestic cats in the wildcat population of Thuringia, Germany. *Journal of the Zoological Systematics and Evolution Research*, **47**: 268–282.

Kutal M., Belotti E., Volfová J., Mináriková T., Bufka L., Poledník L., Krojerová J., Bojda M., Váňa M., Kutalová L., Beneš J., Flousek J., Tomášek V., Kafka P., Poledníková K., Pospíšková J., Dekař P., Machciník B., Koubek P. & Duľa M., 2017: Výskyt velkých šelem – rysa ostrovida (*Lynx lynx*), vlka obecného (*Canis lupus*) a medvěda hnědého (*Ursus arctos*) – a kočky divoké (*Felis silvestris*) v České republice a na západním Slovensku v letech 2012–2016 (Carnivora) [Occurrence of large carnivores – *Lynx lynx*, *Canis lupus* and *Ursus arctos* – and of *Felis silvestris* in the Czech Republic and western Slovakia in 2012–2016 (Carnivora)]. *Lynx*, *n.s.*, **48**: 93–107 (in Czech, with a summary in English).

Maronde L., Zimmermann F., Kunz F., Breitenmoser-Würsten C. H. & Breitenmoser U., 2020: *Bestimmungshilfe zur Unterscheidung von Wild- und Hauskatzen anhand von Fotofallenbildern aus dem Schweizer Jura*. *KORA Bericht Nr. 92*. KORA, Muri bei Bern, Schweiz, 18 pp.

Matias G., Rosalino L. M., Rosa J. L. & Monterroso P., 2021: Wildcat population density in NE Portugal: A regional stronghold for a nationally threatened felid. *Population Ecology*, **63**(3): 247–259.

Mináriková T., Poledníková K., Bufka L., Belotti E., Romportl D., Dietz S., Pavanello M., Munne S. & Poledník L., 2015: Výskyt středně velkých a velkých savců v jižních a jihozápadních Čechách (Carnivora, Artiodactyla, Lagomorpha) [Occurrence of medium-sized and large mammals in forests of southern and south-western Bohemia, Czech Republic (Carnivora, Artiodactyla, Lagomorpha). *Lynx*, *n.s.*, **46**: 43–64 (in Czech, with a summary in English).

Molinari-Jobin A., Molinari P., Breitenmoser-Würsten C., Wölfl M., Stanisa C., Fasel M., Stahl P., Vandel J.-M., Rotelli L., Kaczensky P., Huber T., Adamic M., Koren I. & Breitenmoser U., 2003: The pan-Alpine conservation strategy for the lynx. *Nature and Environment*, **130**: 1–19.

Molinari-Jobin A., Kéry M., Marboutin E., Molinari P., Koren I., Fuxjäger C., Breitenmoser-Würsten C., Wölfl S., Fasel M., Kos I., Wölfl M. & Breitenmoser U., 2012: Monitoring in the presence of species misidentification: the case of the Eurasian lynx in the Alps. *Animal Conservation*, **15**: 266–273.

Pierpaoli M., Biro Z. S., Herrmann M., Hupe K., Fernandes M., Ragni B., Szemethy L. & Randi E., 2003: Genetic distinction of wildcat (*Felis silvestris*) populations in Europe, and hybridization with domestic cats in Hungary. *Molecular Ecology*, **12**: 285–298.

Pospíšková J., 2015: *Rozšíření kočky divoké* (*Felis silvestris*) *v ČR / geomatické modelování a ekologický přístup* [*The Distribution of the Wildcat* (*Felis silvestris*) *in the Czech Republic / Geomatic Modelling and Ecological Approach*]. Unpubl. MSc Thesis. Department of Zoology, Faculty of Natural Science, Charles University, Praha, 64 pp (in Czech, with a summary in English).

Pospíšková J., 2016: Monitoring kočky divoké [Monitoring of the wildcat]. In: Kutal M. (ed.): *Monitoring velkých šelem* a *kočky divoké ve vybraných lokalitách soustavy Natura 2000* [*Monitoring of Large Carnivores and the Wildcat at the Selected Localities of the NATURA 2000 Network*]. Unpubl. Project Final Report. Hnutí Duha, Olomouc, 46 pp (in Czech).

Pospíšková J., 2019: Projekt mapování kočky divoké (*Felis silvestris*) v letech 2012–2015 [Mapping project of the wildcat (*Felis silvestris*) in the years 2012–2015]. *Příroda*, *Praha*, **39**: 3–14 (in Czech, with a summary in English).

Pospíšková J., Kutal M., Bojda M., Bufková-Daniszová K. & Bufka L., 2013: New records of *Felis silvestris* in the Czech Republic (Carnivora: Felidae). *Lynx*, *n.s.*, **44**: 139–147.

Röben P., 1974: Die Verbreitung der Wildkatze, *Felis silvestris* Schreber 1777, in der Bundesrepublik Deutschland. *Säugetierkundliche Mitteilungen*, **22**: 244–250.

Signer J., Filla M., Schoneberg S., Kneib T., Bufka L., Belotti E. & Heurich M., 2019: Rocks rock: the importance of rock formations as resting sites of the Eurasian lynx *Lynx lynx*. *Wildlife Biology*, **2019**(1): 1–5.

Stefen C., 2022: The European wildcat *Felis silvestris* – a brief review of status and research in Germany. Pp. 151–164. In: Conard N. J., Hassmann H., Hillgruber K. F., Serangeli J. & Terberger T. (eds.): *The Homotherium finds from Schöningen*, *13II-4*. *Man and Big Cats of the Ice Age*. *Forschungen zur Urgeschichte aus dem Tagebau von Schöningen 4* (*Mainz 2022*). Verlag des Römisch-Germanischen Zentralmuseums, Mainz, 203 pp.

Stefen C. & Görner M., 2009: Wildkatze in Deutschland und Mitteleuropa – zum Stand der Forschung und Konsequenzen für den Schutz. *Säugetierkundliche Informationen*, **38**: 1–216.

Steyer K., Simon O., Kraus R. H. S., Haase P. & Nowak C., 2013: Hair trapping with valerian-treated lure sticks as a tool for genetic wildcat monitoring in low-density habitats. *European Journal of Wildlife Research*, **59**: 39–46.

Steyer K., Kraus R., Mölich T., Anders O., Cocchiararo B., Frosch C., Geib A., Götz M., Hermann M., Hupe K., Kohnen A., Krüger M., Müller F., Pir J., Reiners T., Roch S., Schade U., Schiefenhövel P., Siemund M., Simon O., Steeb S., Streif S., Streit B., Thein J., Tiesmeyer A., Trinzen M., Vogel B. & Nowak C., 2016: Large-scale genetic census of an elusive carnivore, the European wildcat (*Felis s. silvestris*). *Conservation Genetics*, **17**: 1183–1199.

Steyer K., Tiesmeyer A., Muñoz-Fuentes V. & Nowak C., 2018: Low rates of hybridization between European wildcats and domestic cats in a human-dominated landscape. *Ecology and Evolution*, **8**: 2290–2304.

Sunquist M. E. & Sunquist F. C., 2009: Family Felidae (Cats). Pp. 167–168. In: Wilson D. E. & Mittermeier R. A. (eds.): *Handbook of the Mammals of the World*. *Volume 1*. *Carnivores*. Lynx Edicions, Barcelona, 450 pp.

Weingarth K., Heibl C., Knauer F., Zimmermann F., Bufka L. & Heurich M., 2012: First estimation of Eurasian lynx (*Lynx lynx*) abundance and density using digital cameras and capture-recapture techniques in a German national park. *Animal Biodiversity and Conservation*, **35**: 197–207.

Wölfl S., Mináriková T., Belotti E., Engleder T., Schwaiger M., Gahbauer M., Volfová J., Bufka L., Gerngross P., Weingarth K., Bednářová H., Strnad M., Heurich M., Poledník L. & Zápotočný Š., 2020: *Lynx Monitoring Report for the Bohemian-Bavarian-Austrian Lynx Population in 2018/2019*. *Interreg CENTRAL EUROPE Programme*. Unpubl. Project Report. 3Lynx Project. 27 pp. URL: https://www.npsumava.cz/wp-content/uploads/2021/01/d.t2.2.2_lynx-monitoring-report-bba-ly18__v4-9.pdf.

Worel G., 1991: Die Wiedereinbürgerung der Europäischen Wildkatze in Bayern durch den Bund Naturschutz. In: Grabe H., Markl C. & Plän T. (eds.): *Die Wildkatze und ihre Wiedereinbürgerung in Bayern*. *Wiessenfeldener Reihe*, *Bund Naturschutz in Bayern e. V.*, *München*, **1991**(8): 60–69.

Worel G., 2009: Erfahrungen mit der Wiederansiedlung der Wildkatze in Bayern. Pp. 5–9. In: Fremuth W., Jedicke E., Kaphegyi T. A. M.., Wachendörfer W. & Weinzierl H. (eds.): *Zukunft der Wildkatze in Deutschland – Ergebnisse des internationalen Wildkatzen Symposiums 2008 in Wiesenfelden*. *Initiativen zum Umweltschutz*, *75*. Erich Schmidt Verlag, Deutsche Bundesstiftung Umwelt, 236 pp.