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## The Eurasian lynx in Continental Europe



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Original contributions and short notes about wild cats are welcome

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**Cover Photo:** Camera trap picture of two Eurasian lynx kittens in north-eastern Switzerland. 11 December 2014 (Photo KORA).

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# Conservation needs of the Carpathian lynx population

**The population of Eurasian lynx in the Carpathian Mountains is one of the largest in Europe, with a total population size of ~2,100–2,400 individuals. However, the status of the species in the Carpathians was based solely on “expert opinions”, while relevant scientific data were restricted. Recent research indicated that these figures are not reliable and strongly overestimate the population size. Exaggerated data and misleading information on the status and trend of the lynx population have fostered conflicts between the lynx and human interests, and ultimately leading to illegal killings. Negative attitude of hunters towards lynx originates in a belief that the predator is responsible for the alleged decrease of roe deer populations in Slovakia. Moreover, illegal killing could have some synergetic effect with the development of traffic infrastructure, which increasingly disrupts the connectivity between suitable habitats and exacerbates human-induced mortality. Carpathian Mts. have been and still are a source for lynx reintroduction and reinforcement projects and are of great importance for the large-scale conservation of lynx in Europe. Authorities in charge, lynx experts and interested groups from the Carpathians should jointly establish a standardised robust population monitoring and seriously mitigate anthropogenic factors jeopardising lynx survival. A sound cooperation between all countries sharing the Carpathian population for the conservation and management of the lynx is required. We recommend in particular the adoption of a jointly developed Pan-Carpathian conservation and management strategy and related national action plans.**

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## Current status of the Carpathian lynx population

Covering an area of 209,256 km<sup>2</sup>, the Carpathian Mountains extend over eight European countries, from Romania and Serbia in the south through the Ukraine, Poland, Slovakia

and Hungary to the Czech Republic and Austria in the north (Fig. 1). The region provides home to 16–18 million people, living in many different environments, from traditional villages to urban centres. Forest cover is distributed unequally from 29.5% in the Hungarian

part to almost 60% in Romania; less than a third of the Carpathians are covered by open semi-natural habitats, predominantly grassland. From the Würm/Weichsel Glaciation (150k–15k bp) the Carpathians were a forest refugee most likely, already inhabited by the lynx that we today consider to be *Lynx lynx carpathicus*, a subspecies that obviously did not expand after the end of the Ice Age and therefore is still distinct from other lynx forms in Europe (Breitenmoser & Breitenmoser-Würsten 2008).

The autochthonous lynx population covers at present the north-western and southern part of the mountain chain of the Carpathians, and has recently expanded in the south into Serbia and Bulgaria; it however seems to be sparsely present in the Ukraine (Fig. 1). The share of the population among the countries corresponds almost to the respective share of the Carpathian region (Table 1), with exception of the Ukraine and Bulgaria, where the present distribution is not known. Most of the Carpathian population is situated within Romania and Slovakia (Fig. 1), which have therefore a special responsibility for the conservation of the entire population (von Arx et al. 2004, Kaczensky et al. 2013, Boitani et al. 2015, von Arx 2018). In all Carpathian countries, lynx is fully protected by law (Table 2). The population is considered to be one of the largest in Europe, with a total population size of ~2,100–2,400 lynx according to the population assessment for 2012–2016 (von Arx 2018). The Carpathian population appears to be stable, although in certain regions, numbers have decreased, either reflecting a real trend (e.g. Ukraine and Bulgaria) or due to more reliable monitoring (Table 3; von Arx 2018). The status of the species in the Carpathians was based solely on “expert opinions”, while relevant scientific data were limited or absent. Scientific robust monitoring in Slovakia has recently demonstrated that such data are not reliable and are overestimating the population size (Kubala et al. 2019, Duľa et al. 2021). Nevertheless, this situation has not been addressed for a long time by the state administration and consequently led to the presentation of vague and misleading information regarding the status and population trend at local and national levels (Smolko et al. 2018, Kubala et al. 2019).

## Conservation challenges

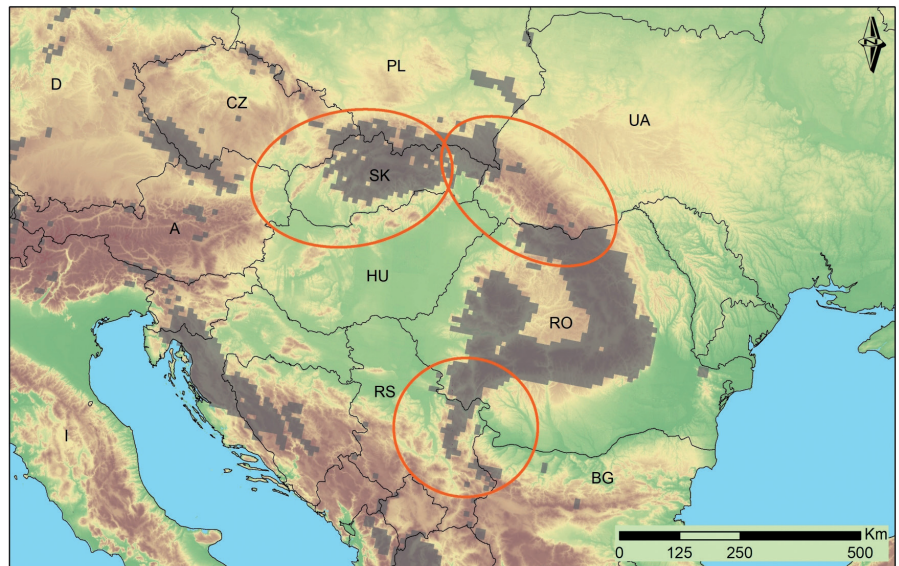
The lack of a scientific basis when reporting and interpreting data on lynx population leads to conflicts between the lynx and hu-

**Table 1.** Extension and distribution of lynx in the countries sharing the Carpathian population. Information from Hungary are poor, but there is an expansion in the north, along the border with Slovakia. The distribution in Ukraine and Bulgaria is presently unknown. In Bulgaria, confirmed observations (camera trapping) were available from the Osogovo Mountains till the end of 2015. Subsequently, in spite of intensive camera trapping, there were no records.

Country	Lynx extension and distribution area (km <sup>2</sup> )		
	Constantly occupied area	Single observation confirmed	Total
Romania	66,000	unknown	unknown
Slovakia	27,200	890	28,090
Poland	10,100	1,100	11,200
Ukraine	unknown	unknown	unknown
Czechia	1,200	800	2,000
Hungary	2,100	100	2,200
Serbia	3,000	5,000	8,000
Bulgaria	unknown	unknown	unknown

man interests such and fosters illegal killing (Table 4; Červený et al. 2002, 2019, Zlatanová et al. 2001, Duľa et al. 2021). Negative attitude of local hunters towards lynx originates in a belief that the species is responsible for the alleged decrease of roe deer *Capreolus capreolus* populations in Slovakia (Smolko et al. 2018). However, it has been ignored that apart from lynx as its main predator, roe deer population is also affected by competition from rapidly growing red deer *Cervus elaphus* population, which results in decreased fitness of both adults and juveniles (Latham 1999, Richard et al. 2010). The influence of other species on roe deer fawns, such as highly abundant red foxes *Vulpes vulpes*, wild boars *Sus scrofa* and a poor management of agricultural land is being overlooked as well (Smolko et al. 2018). Although factors behind illegal killing may differ according to the local socioeconomic situation, it may result in significant annual mortality in the lynx population. For example, it was estimated to account for at least 20% of the adults in Czechia (Červený et al. 2019) and up to 22% in the Białowieża Forest in Poland (Kowalczyk et al. 2015), and there is no reason to expect that Slovakia might be different (Kubala et al. 2020, Duľa et al. 2021).

Moreover, illegal killing can have a synergistic effect with habitat fragmentation (Table 4; Kubala et al. 2020): At large scale, loss of habitat quality and connectivity and decrease of prey availability (enhancing conflicts with hunters), could seriously jeopardise the viability of the lynx population, especially in the Ukrainian Carpathians (von Arx 2018). At small scale, as the traffic infrastructure development is expected to disrupt connectivity between suitable habitat patches and increase human-induced mortality (Huck et al. 2010, Kubala et al. 2019, 2020, Duľa et al. 2021). The expansion of road infrastructure menaces the long-term viability of lynx in Europe by restricting migration movements between and within mountain ranges (subpopulations) and increasing the risk of collisions with vehicles (von Arx et al. 2004, Kaczensky et al. 2013, Boitani et al. 2015). The development of transport networks is a high priority in all Carpathian countries as considered immensely important for the economy of the region. As a consequence, the creation of barriers and the interruption of important migration routes may result in limited gene flow and isolation of subpopulations (von Arx et al. 2004, Krojerová-Prokešová et al. 2019, Kubala et al. 2020). If the lynx range in the



**Fig. 1.** Eurasian lynx distribution in the Carpathian Mountains according to the population assessment for 2012–2016 (grey shaded; von Arx 2018). Red polygons represent regions for which the necessary conservation measures and actions must be implemented as a matter of priority: the Ukrainian Eastern Carpathians and especially the border areas with Romania, Slovakia and Poland, area of the core and marginal parts of the Slovak lynx population and its natural dispersion towards northern Hungary, western Austria and northern resp. southern Czechia, as well as the regions with a natural expansion of the Romanian lynx population in the Serbian Carpathians and Bulgaria.

Ukraine is broken (Fig. 1; von Arx 2018), it is a potentially dangerous gap in the continuous distribution in the Carpathians and threatens the long-term (genetic) viability of the entire population.

**Conservation actions and measures**

A sound cooperation between all countries sharing the Carpathian population for the

conservation and management of the lynx is required. To identify and implement most important conservation actions and measures, we recommend in particular the adoption of a jointly developed Pan-Carpathian conservation and management strategy and related national action plans. The overall trend of the Carpathian lynx population is assumed to be stable or slightly decreasing (Table 3;

**Table 2.** Conservation and management status of the lynx in the Carpathian countries. No Management plan is to be expected for Bulgaria within the next 5 years. <sup>A</sup> Conservation, Action or Management Plan, <sup>B</sup> implementation of Management plans in Slovakia, Czechia and Serbia is in progress.

Country	Legal status	Management	
		Planning <sup>A</sup> status 2011	Planning <sup>A</sup> status 2019
Romania	fully protected	none	none
Slovakia	fully protected	none	Management plan <sup>B</sup>
Poland	fully protected	none	none
Ukraine	fully protected	none	none
Czechia	fully protected	none	none
Hungary	fully protected	Conservation plan ended in 2011	no actual plan, revision is planned
Serbia	fully protected	Management plan <sup>B</sup>	Management plan <sup>B</sup>
Bulgaria	fully protected	none	none

**Table 3.** Lynx population size and trend in the Carpathian Mountains during the years 2011–2019. Density in number of lynx/100 km<sup>2</sup>. <sup>A</sup> for suitable lynx habitat. <sup>B</sup> Pirga et al. 2018: Bieszczady (Eastern Polish Carpathians), density only for adult individuals. <sup>C</sup> Pirga et al. 2018: Bieszczady (Eastern Polish Carpathians), density adults and juveniles.

Country	Estimation 2019	Density	Trend 2001–2011	Trend 2011–2019
Romania	not available	unknown	→	→
Slovakia	250–400	0.96 <sup>A</sup>	likely ↗	→/↘
Poland	no reliable data	1.3 <sup>B</sup> –2.4 <sup>C</sup>	unknown	unknown
Ukraine	336	unknown	unknown	unknown
Czechia	10–12	0.70 <sup>A</sup>	→/↘	→/↘
Hungary	12–20	0.68	stable	→/ likely ↗
Serbia	40–60	1	↗	→/slightly ↗
Bulgaria	unknown	unknown	likely ↗	likely ↘

von Arx 2018). However, this assessment is not based on robust data and the actual tendency is therefore difficult to judge (Kubala et al. 2019, Duľa et al. 2021). This stresses the need for more accurate information and the adoption of a standardised monitoring system based on a spatial concept and scientific robust methods applicable in each country by the national wildlife management and including the hunters' and foresters' organisations. It is also necessary to establish a programme to mitigate the effect of conflict between lynx and local communities and stakeholders (especially hunters) in order to

reduce illegal killing. Threats, such as habitat loss or fragmentation and the development of traffic infrastructure must be assessed and mitigated. All future development projects must be carefully designed to avoid negative impacts on the Carpathian lynx and other wildlife populations. Environmental Impact Assessment (EIA) procedures must be strictly carried out for transport network projects in the whole region.

These important conservation actions and measures are in accordance with the Action Plan for the Conservation of the Eurasian lynx in Europe (Breitenmoser et al. 2000, von Arx

et al. 2004), the Key Actions for Large Carnivores in Europe (Boitani et al. 2015) and the International Action Plan on Conservation of Large Carnivores and Ensuring Ecological Connectivity in the Carpathians, compiled by the Convention on the Protection and Sustainable Development of the Carpathians (Papp et al. 2020). The Carpathian Convention is supporting a preparation and compilation of standardised monitoring guidelines for lynx in the Carpathians as well as joint development of a Pan-Carpathian conservation and management strategy for the lynx as a blueprint for more concrete national action plans.

The Carpathians have been and still are a source for lynx reintroduction and reinforcement projects (Breitenmoser & Breitenmoser-Würsten 2008; Bonn Lynx Expert Group 2021) and have a great importance for the international management and large-scale conservation of lynx in Europe. Therefore, to a large extent, the conservation of lynx in western and central Europe depends on the status of the Carpathian lynx population (von Arx et al. 2004, Kaczensky et al. 2013, Boitani et al. 2015). Paradoxically, the reintroduced Carpathian lynx populations are today better surveyed and studied than the autochthonous source population (see various contributions in this Issue). Thus, there is a general need to improve the basic knowledge on the lynx population status and biology as well as on human attitudes in this region (Boitani et al. 2015, Kubala et al. 2019). It would be good to demonstrate the positive economic benefits available from large carnivores, for example through eco-tourism. Obviously, it is not enough to simply put the lynx under legal protection without further interacting with stakeholders or mitigating threats. Only a range-wide cooperation with an efficient adaptive approach can ensure the long-term and large-scale survival of the species at the geographic scope of the Carpathians and hence contribute to the conservation of both, the autochthonous and reintroduced populations (von Arx et al. 2004, Kaczensky et al. 2013, Boitani et al. 2015, Bonn Lynx Expert Group 2021).

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**Table 4.** Summary of lynx harvest and known losses, including illegal killings and other mortality in the Carpathian Mountains during the period 2011–2019. <sup>a</sup> 2001–2014. <sup>b</sup> vehicle collisions 2011–2016. <sup>c</sup> 2001–2018, other mortality: vehicle collisions 5, unknown 2. <sup>d</sup> 2012–2018. <sup>e</sup> vehicle collisions 2012–2018.

Country	Harvest and known losses			
	Harvest number	Illegal killings	Other mortality	Total 2011–2019
Romania	6	2 <sup>d</sup>	3 <sup>e</sup>	11
Slovakia	0	7 <sup>a</sup>	17 <sup>b</sup>	24
Poland	0	unknown	unknown	unknown
Ukraine	unknown	3 <sup>a</sup>	unknown	unknown
Czechia	0	2	3 <sup>c</sup>	5
Hungary	0	unknown	unknown	unknown
Serbia	0	unknown	unknown	unknown
Bulgaria	0	≥ 2 confirmed	unknown	3

Oliveira, Peter Smolko, Jerguš Tesak, Martin Vaňa, Yegor Yakovlev and volunteers.

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Male Beňadik pictured in Slovakia. It was later captured and included into the telemetry monitoring survey (Photo B. Machciník).