IUCN Red List Mapping for the regional assessment of the Eurasian lynx *Lynx lynx* In Europe

Petra Kaczensky, Norwegian Institute of Nature Research - NINA

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I. The map product

The mapping approach follows the methods described in Chapron et al. (2014) and Kaczensky et al. (2013). It updates the published Species Online Layers (SPOIS) to the period 2012-2016.

In short, large carnivore presence was mapped at a 10x10 km ETRS89-LAEA Europe grid scale. This grid is widely used for the Flora-Fauna-Habitat reporting by the European Union (EU) and can be downloaded at: http://www.eea.europa.eu/data-and-maps/data/eea-reference-grids-2.

The map encompasses the EU countries plus the non-EU Balkan states, Switzerland, Norway, and the Carpathian region of Ukraine.

Presence in a grid cell was ideally mapped based on carnivore presence and frequency in a cell resulting in:

- **1 = Permanent** (presence confirmed in >= 3 years in the last 5 years OR in >50% of the time OR reproduction confirmed within the last 3 years)
- **3 = Sporadic (highly fluctuating presence)** (presence confirmed in <3 years in the last 5 years OR in <50% of the time)
- We subsequently include: i) the category "**present**" when there is no doubt about the species presence in the country, but where additional information is missing & ii) the category "**presence uncertain**" where evidence is weak that large carnivore presence consists of more than very rare vagrants

Where grid cells have portions in more than one country and cells were assigned different values in neighbouring countries; the "disputed" cell was always given the "higher" presence value; that is a cell categorized as "sporadic" by one and "permanent" by the country was categorized as "permanent".

To assess the quality of carnivore signs we used the SCALP criteria developed for the standardized monitoring of Eurasian lynx (*Lynx lynx*) in the Alps (Molinari-Jobin et al. 2012):

- **Category 1 (C1)**: "Hard facts", verified and unchallenged large carnivore presence signs (e.g. dead animals, DNA, verified camera trap images);
- **Category 2 (C2)**: Large carnivore presence signs controlled and confirmed by a large carnivore expert (e.g. trained member of the network), which requires documentation of large carnivore signs; and

- **Category 3 (C3)**: Unconfirmed category 2 large carnivore presence signs and all presence signs such as sightings and calls which, if not additionally documented, cannot be verified
- We subsequently include the category "**soft**" which refers to presence large carnivore presence based on interview, questionnaires, and media coverage

Table 1 provides an overview of the mapping details (time period, coverage, data unit, data categories used, extrapolation methods). The table also provides the contact people that compiled or provided the national/regional maps which were subsequently compiled into the Europe-wide map. Table 5 lists further contributors for the national/regional mapping.

Table 1: Overview of large carnivore data basis for the presence layer 2012-2016.

Country/Region	Period	Method change	Major effort change	Data unit[1]	Coverage of range[2]	Extrapolation[3]	Estimated % of cells based on 2012-2016 signs	LC sign category	Map contacts
Albania	2012-2016	Yes	lower effort	Points	Focal areas	5km buffer all	44	C1&C2	Aleksandër Trajçe
Austria - Bohemia	2012-2016	No	No	Points	All - annually	None	100	C1&C2	Thomas Engleder
Austria - Alps	2012-2016	No	No	Points	All - annually	None	100	C1&C2	Christian Fuxjäger
Bosnia & Herzegovina	2013-2017	Yes	No	Points	All - annually	None	100	C1-C3	Igor Trbojevic
Bulgaria	2012-2016	No	No	Points	All - cummulative	None	100	C1&C2	Diana Zlatanova
Croatia	2012-2016	Yes	No	Points	All - cummulative	Past presence for core area	~50	C1-C3	Magda Sindičić
Czech Republic	2012-2016	No	No	Points	All - annually	None	100	C1&C2	Mirek Kutal
Estonia	2012-2016	No	No	Points	All - annually	None	??	C1-C3	Peep Männil
Finland	2012-2016	Yes (but results in little difference)	No	Points	All - annually	10km buffer repro	100	C1-C3	Katja Holmala
France	2012-2016	Yes	No	Points	All - annually	9km buffer repro	Reproduction: 54; other: 100	C1&C2	Christoph Duschamp
Germany	2011-2015/2016	No	No	Points	All - annually	None	100	C1&C2	Ole Anders
Germany-Bavaria	2012-2016			Points	All - annually	None	100	C1&C2	Sybille Woelfl
Pfaelzer Wald	2012-2016	new	new	Points	All - annually	None	100	C1&C2	Ditmar Huckschlag
Greece	1970-2017	New - but presence beyond rare vagrants uncertain		Points	All - very long timespan	Past presence	??	C1-C3, soft	Theodoros Kominos, (Yorgos Merzanis)
Italy	2012-2016	No	No	Points	All - annually	None	100	C1&C2	Anja Jobin Molinari
Kosovo	2013-2017	New		Points	All - cummulative	None	100?	C1	Aleksandër Trajçe, Bardh Sanaja
Latvia	2012-2016	Yes	Yes	Points	All - annually	None	100	C1	Jānis Ozoliņš
Lithuania	2012-2016	No	No/Yes (poor snow)	Points	All - annually	None	100	C1-C3	Vaidas Balys
FYRO Macedonia	2012-2016	Yes	lower effort	Points	Focal areas	5km buffer all & past presence	30	C1&C2	Dime Melovski
Poland - Carpathians	2012-2016	No	No	Points	All - cummulative	Past presence	??	C1&C2	Sabina Nowak, Robert
Poland - Baltic	2012-2016			Points	All - cummulative	Past presence	??	C1&C2	W. Mysłajek
Romania	2012-2016	No	No (but No more hunting)	Points; Admin. Units	All - annually	None	??	C1-C3	Ovidiu Ionesco
Serbia	2012-2016	New		Points	All - annually	None	??	C1-C3	Duško Ćirović
Slovakia	2012-2016	New	Yes	Points; Admin. Units	All - cummulative	More recent presence (2017-2019)	??	C1-C3	Jakub Kubala, Eva Gregorová
Slovenia	2012-2016	No	No	Points	All - annually	None	100	C1&C2	Klemen Jerina
Norway & Sweden	2012-2016	No		Points	All - annually	10km buffer all	??	C1&C2	Andreas Zetterberg
Switzerland - Alps	2011-2015	No		Points	All - annually	None	100	C1&C2	Fridolin Zimmermann
Switzerland - Jura	2011-2015			Points	All - annually	None	100	C1&C2	
Ukraine	2009-2016	New		Points	Focal areas	Presence since 2009	100	C1-C3	Maryna Shkvyria, Yegor Yakovlev

[1]Points=Location coordinates; Admin. Units=Administrational units like municipality, district, or hunting ground

[2]All-annually=monitoring covers entire range every year; All-cummulative=monitoring covered entire renage over the 2012-2016 period; Focal areas=monitoring only covered part of the range for 2012-2016

[3]buffer all=all LC signs buffered; buffer repro=only reproduction signs buffered; HR buffer repro=reproduction buffered by home range size from telemety or genetics cells around=9 cells around presence cell, Past presence=previous distribution layers used to fill gaps in monitoring coverage

II. Presence definitions for the IUCN Red Listing

Our SPOIS definitions “permanent”, “sporadic”, “present”, and “presence uncertain” had to be transferred to the IUCN Red List criteria via the two categories PRESENCE and SEASONAL. A third category also delineates the ORIGIN of populations (native versus (re)introduced). For detailed background documents see: http://www.iucnredlist.org/technical-documents/red-list-training/iucnspatialresources.

All SPOIS cells “permanent”, “sporadic”, and “present” were assigned a PRESENCE status of 1 (Extant). Under SEASONAL “permanent” cells were assigned to 1 (Resident), “sporadic” to 4 (Passage), and “present” to 5 (Seasonal occurrence uncertain). Under ORIGIN “sporadic” cells were assigned to 4 (vagrant), while “permanent” and “present” were assigned to whether they were native (1) or reintroduced (2). For some species and populations, we added a new category which was not available in the IUCN Red List categories: reinforced (7) – meaning that the population consists of reintroduced and native individuals.

Assigning “sporadic” cells to “Vagrants” saved us from delineating “sporadic” cells to specific populations. For many sporadic cells such an assignment can be done, but for enough other cells it is rather subjective and with expanding populations it will become even more difficult to assign these cells in any standardized way. For an overview of the SPOIS and subsequent IUCN Red List coding see Table 2.

Table 2: SPOIS and translation into IUCN Red List criteria – metadata table.

SPOIS code		IUCN Red List presence criteria*			Presence comment	IUCN*
		Presence	Seasonal	Origin		Subpopulation
1	Permanent	1 (Extant)	1 (Resident)	1 (native) 2 (reintroduced)	Extant (resident)	Population names
3	Sporadic	1 (Extant)	4 (Passage)	4 (vagrant)	Extant (sporadic)	Vagrants
6	Presence uncertain	3 (Possibly extant)	4 (Passage)	4 (vagrant)	Presence uncertain	Vagrants

*Obligatory cells for the IUCN Red List shape files

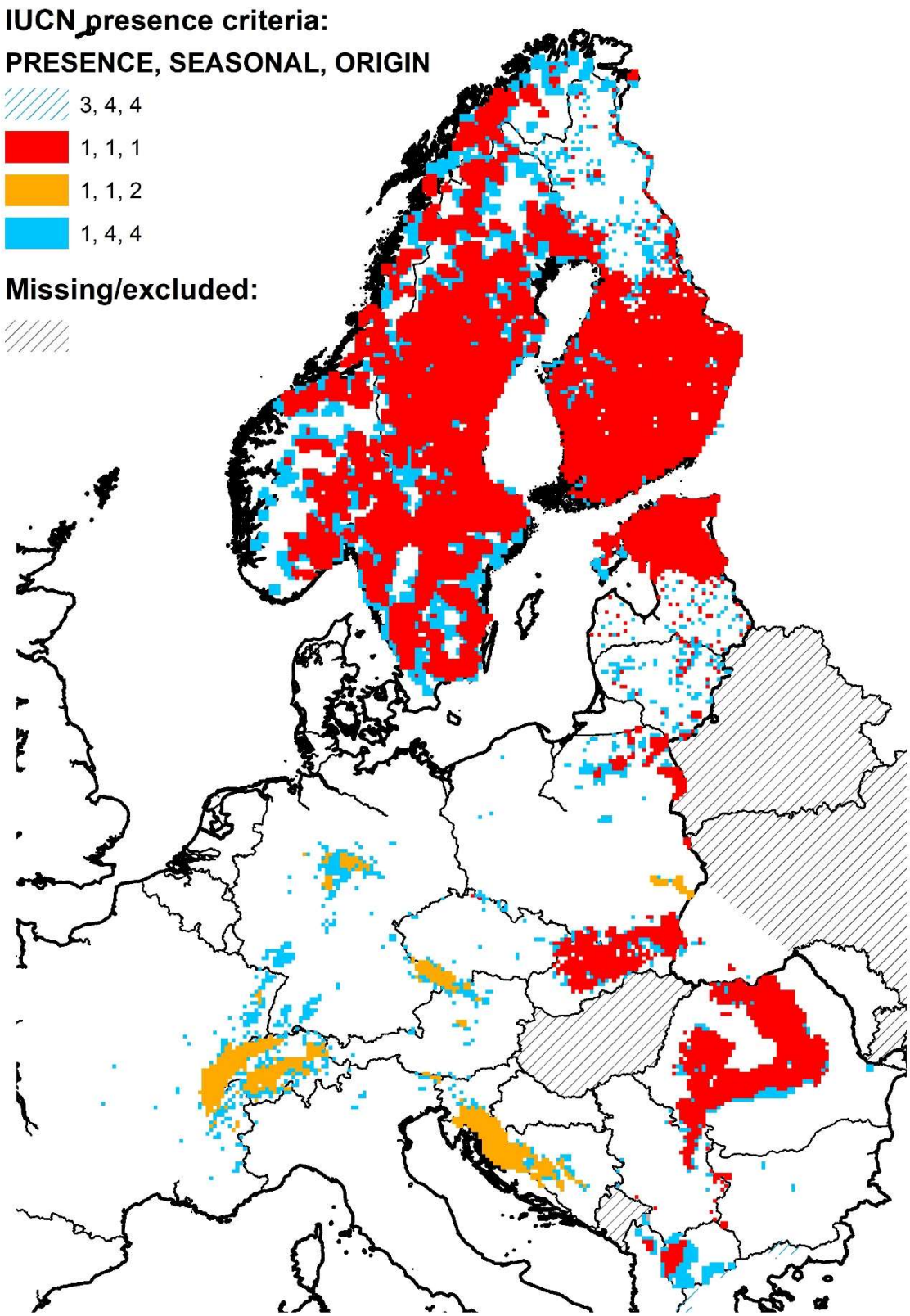

Fig. 1: Lynx presence in Europe 2012-2016 according to IUCN presence criteria for PRESENCE, SEASONAL, and ORIGIN (for codes see Table 2).

III. Area calculations

The IUCN SIS1 delineation of “Europe” excludes Belarus, Ukraine and Moldavia. In the end, we also excluded those countries, except the Carpathian part of Ukraine. Consequently, our definition is slightly different but has the advantage that it does not exclude a part of the Carpathian Mountains.

We only used the permanent cells for the calculation of the Extent of Occurrence (EOO) and Area of Occupation (AOO). The EOO is calculated as the 100% Minimum Convex Polygon (MCP) around all permanent cells and the AOOs are the sum of all permanent cells in each population (Fig. 2, Table 3).

Table 3: EOO and AOOs of lynx populations in Europe 2012-2016.

Populations	**Area (km2)**
EOO	**3,987,500**
AOOs:	
Alpine	13,700
Balkan	5,100
Baltic	71,600
Bohemian-Bavarian-Austrian	5,900
Carpathian	120,000
Dinaric	21,900
Harz Mountain	3,900
Jura	14,700
Karelian	223,300
Scandinavian	455,900
Vosges-Palatinian	500
Sum of AOOs	**936,500**

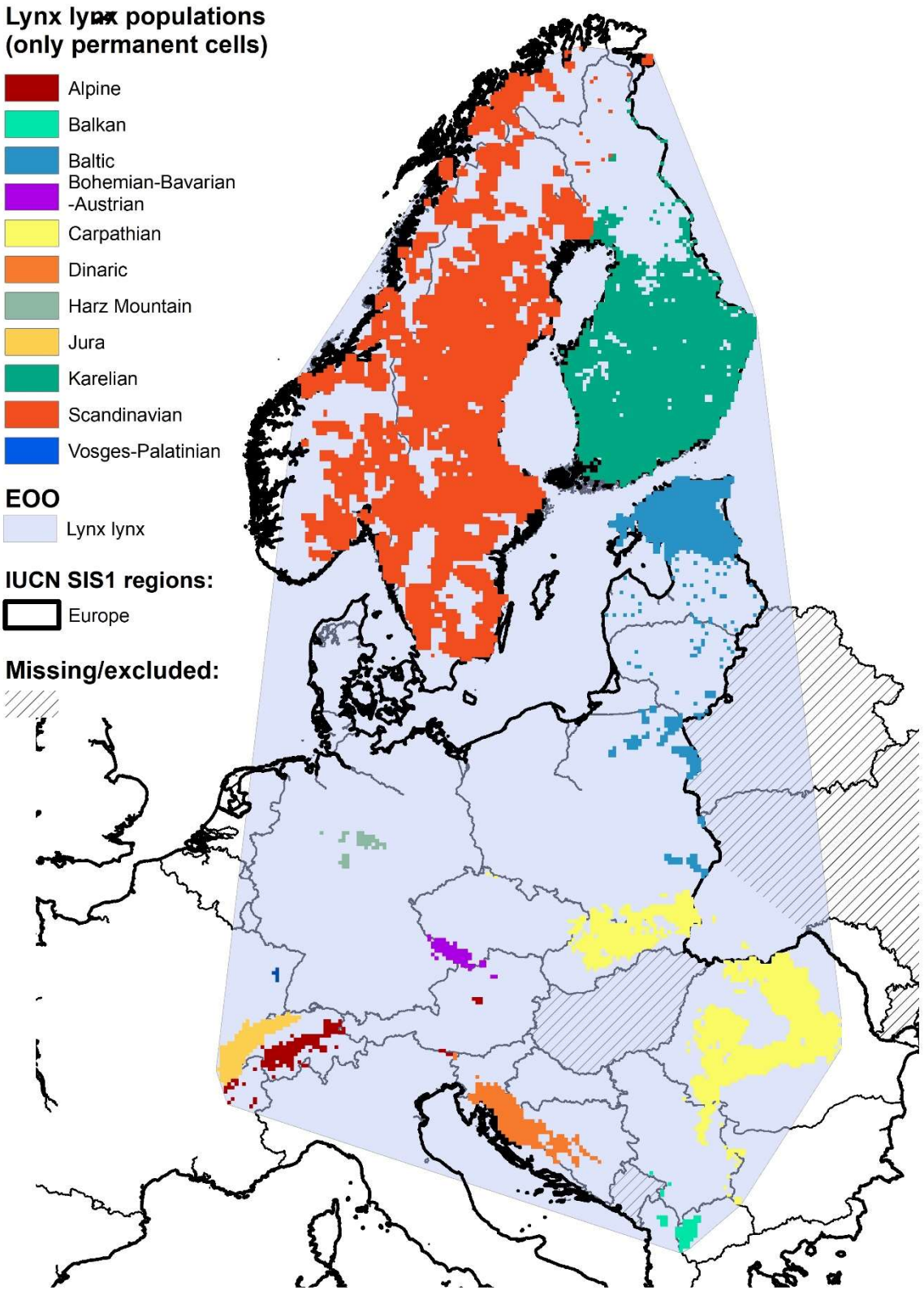

Fig. 2: Lynx populations (cells with Presence 1.4.4. "sporadic" not shown) and total extent of occurrence (EOO) in Europe.

IV. Shapefiles for the regional assessment

The shapefiles provided for the regional assessment contain one line for each cell where presence is defined as described in Table 2. Additional metadata for each line are listed below (Table 4).

Table 4: Metadata attached to the presence shapefile provide together with the regional IUCN Red List assessment for wolves in Europe.

Metadata table	**Information provided**
SPOIS	see Table 1
BINOMIAL	*Lynx lynx*
Presence	see Table 1
ORIGIN	see Table 1
SEASONAL	see Table 1
COMPILER	Large Carnivore Initiative for Europe (LCIE)
YRCOMPILED	2018 (2019 for SK)
DEC_LAT	Latitude of cell centroid
DEC_LONG	Longitude of cell centroid
SPATIALREF	WGS84
EVENT_YEAR	2016
EVENT_comm	data collected for period 2012-2016
CITATION	Large Carnivore Initiative for Europe IUCN/SSC Specialist Group et al. 2018
SOURCE	see supplementary material
DIST_COMM	Data compiled by region/county representatives on a 10x10km ETRS grid
SUBPOP	see Table 1

V. Contributors

Table 5: Contributors to lynx map 2012-2016.

Country/Region	Names of main data/map contributors	Affiliation [and in some cases also acknowledgement of data sources]
Albania	Aleksandër Trajçe, Bledi Hoxha	Protection and Preservation of Natural Environment in Albania
Austria - Bohemia	Thomas Engleder	Lynx Project Austria Northwest
Austria - Alps	Christian Fuxjäger[1] Kirsten Weingarth[2], Peter Gerngross[3]; Thomas Engleder[4], Anja Molinari-Jobin[5]	[1]Nationalpark Kalkalpen; [2]Habitat - Wildlife Services; [3]Biogeomaps; [4]Lynx Project Austria Northwest; [5]Status and Conservation of the Alpine Lynx Population - SCALP; Landesjagdverbände (Hunting associations) Kärnten, Oberösterreich, Steiermark, Tirol, Salzburg, Vorarlberg, and Niederösterreich
Bosnia and Herzegovina	Igor Trbojević[1], Tijana Trbojević[2]	[1]University of Banja Luka, Faculty of Science; [2]Ecology Research Association (EID)
Bulgaria	Diana Zlatanova	Department of Zoology and Anthropology, Faculty of Biology, Sofia University
Croatia	Tomislav Gomerčić[1], Magda Sindičić[1], Josip Kusak[1], Vedran Slijepčević[2], Goran Gužvica[3], Josip Tomaić[4],	[1]Faculty of Veterinary Medicine University of Zagreb, Croatia (administration of http://lynx.vef.hr); [2]Karlovac University of Applied Sciences; [3]Geonatura; [4]Nature park Velebit
Czech Republic	Miroslav Kutal[1,2], Michal Bojda[1], Elisa Belotti[3], Luděk Bufka[3], Josefa Volfová[1], Tereza Mináriková[4], Jarmila Krojerová[5]	[1]Friends of the Earth Czech Republic; [2]Department of Forest Ecology, Faculty of Forestry and Wood technology, Mendel University Brno; [3]Administration of the National Park and Protective Landscape Area of Šumava; [4]Alka Wildlife; [5]Institute of Vertebrate Biology, Academy of Sciences of the Czech Republic
Estonia	Peep Männil, Marko Kübarsepp, Rauno Veeroja	Estonian Environment Agency, Department of Wildlife Monitoring
Finland	Katja Holmala	Natural Resources Institute Finland (Luke); Finish database https://tassu.luke.fi
France	Christophe Duchamp	Office national de la chasse et de la faune sauvage ONCFS, Réseau Loup-Lynx

Germany	Ole Anders[1], Lilli Middlehoff[1], Jana Zschille[2], Uwe Mueller[3], Ingrid.Hucht-Ciorga[4], Susanne Jokisch[5], Martina Denk[6], Micha Herdtfelder[7], Ditmar Huckschlag[8]	[1]Harz National Park; [2]Technical University of Dresden, Institute of Forest Botany and Forest Zoology; [3]Thüringer Landesanstalt für Umwelt und Geologie (TLUG); 4Landesamt für Natur, Umwelt und Verbraucherschutz NRW, Fachbereich 24: Artenschutz, Vogelschutzwarte, LANUV-Artenschutz-Zentrum; [5]Hessisches Landesamt für Naturschutz, Umwelt und Geologie (HLNUG); [6]Arbeitskreis Hessenluchs, Bund für Umwelt und Naturschutz Deutschland (BUND); [7]Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg (FVA); [8]Landesforsten Rheinland-Pfalz
Germany-Bavaria	Sybille Woelfl[1], Manfred Woelfl[2]	[1]Lynx Project Bavaria, [2]Bavarian Agency of Environment
Greece	Theodoros Kominos, Antonia Galanaki	Aristotle University of Thessaloniki
Italy	Anja Molinari-Jobin[1], Paolo Molinari[2], Francesca Marucco[3], Dario De Martin[4], Umberto Fattori[5], Oscar Da Rold[6], Claudio Groff[7], Andreas Agreiter[8], Radames Bionda[9], Antonio Mingozzi[10], Alessandra Gagliardi[11]	[1]Status and Conservation of the Alpine Lynx Population - SCALP; [2]Progetto Lince Italia; [3]Centro Conservazione e Gestione Grandi Carnivori; [4]CUFA Comando Unità Forestale e Ambientale; [5]Regione Friuli Venezia Giulia; [6]Provincia di Belluno; [7]Provincia Autonoma di Trento; [8]Provincia Autonoma di Bolzano; [9]Provincia del Verbano Cusio Ossola; [10]Parco Nazionale del Gran Paradiso; [11]Università dell'Insubria
Kosovo	Bardh Sanaja	Environmentally Responsible Action (ERA), Balkan Lynx Recovery Programme
Latvia	Jānis Ozoliņš, Guna Bagrade, Mārtiņš Lūkins	Latvian State Forest Research Institute "Silava"
Lithuania	Vaidas Balys[1]	[1]Association for Nature Conservation "Baltijos vilkas"; Ministry of Agriculture (raw data)
FYRO Macedonia	Dime Melovski, Vasko Avukatov	Macedonian Ecological Society, Balkan Lynx Recovery Programme
Poland	Sabina Nowak, Robert W. Mysłajek	[1]Association for Nature "Wolf"; [2]University of Warsaw, Faculty of Biology, Institute of Genetics and Biotechnology
Romania	Ionescu Ovidiu[1,2], Ionescu Georgeta[1,2], Popa Marius[1,2]	[1]Transylvania University - Forest Faculty; [2]National Institute for Research and Development in Forestry - Marin Dracea

Serbia	Milan Paunović[1], Duško Ćirović[2]	[1]Natural History Museum; [2]University of Belgrade, Faculty of Biology
Slovakia	Jozef Bučko[1], Marián Slamka[1], Michal Kalaš[2], Beňadik Machciník[3], Miroslav Kutal[4,5], Robin Rigg[6], Jakub Kubala[7,8], Peter Smolko[7,8,9], Peter Klinga[8,10], Eva Gregorová[11] ; Branislav Tám[11], Tomáš Iľko[8,12], Martin Duľa[4;5], Michal Bojda[5], Vlado Trulík[13]	[1]National Forestry Centre, [2]Administration of the National Park Malá Fatra, [3]Administration of the Protected Landscape Area Strážovské vrchy, [4]Friends of the Earth Czech Republic, [5]Department of Forest Ecology, Faculty of Forestry and Wood Technology, Mendel University Brno, [6]Slovak Wildlife Society, [7]Faculty of Forestry, Department of Applied Zoology and Wildlife Management, Technical University in Zvolen, [8]DIANA – Carpathian Wildlife Research, [9]Department of Biological Sciences, University of Alberta, Edmonton, [10]Faculty of Forestry, Department of Phytology, Technical University in Zvolen, [11]National Zoological Garden Bojnice (Ret.), [12]Administration of the National Park Muránska planina, [13]Trulik Travel s.r.o.
Slovenia	Rok Černe[1], Miha Krofel[2], Ivan Kos[2], Matej Bartol[1], Nivers Pagon[1], Klemen Jerina[1], Hubert Potočnik[1], Aleksandra Majić Skrbinšek[1], Tomaž Skrbinšek[1], Marko Jonozovič[1], Mateja Blažič[3], Iztok Koren[1]	[1]Slovenia Forest Service; [2]University of Ljubljana, Faculty of Biotechnology; [3]Environmental Agency of the Republic of Slovenia, Ministry for Environmental
Norway & Sweden	Andreas Zetterberg	Swedish University of Agricultural Sciences; Norwegian/Swedish database www.rovbase.no
Switzerland	Fridolin Zimmermann, Florin Kunz, Christine Breitenmoser Würsten, Urs Breitenmoser	Carnivore Ecology and Wildlife Management - KORA
Ukraine	Maryna Shkvyria[1], Yegor Yakovlev[1, 2], Ihor Dykyy[3]	[1]Kyiv Zoological Park of National importance; [2]Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine; [3]Ivan Franko National University of Lviv

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