IUCN Red List Mapping for the regional assessment of the Brown bear *Ursus arctos* In Europe

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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	Yes	Points	Focal areas	5km buffer all & past presence	22	C1&C2	Aleksandër Trajçe
Austria	2012-2016	No	No	Points	All - annually	None	100	C1&C2	Georg Rauer
Bosnia-Herzegovina	2012-2016	Yes	No	Points	All - annually	None	100	C1-C3	Igor Trbojević
Bulgaria	2012-2016	No	No	Points; Admin. Units	All - cummulative; Focal areas	None	100	C1-C3	Diana Zlatanova
Croatia	2012-2016	No	No	Points; Admin. Units	All - annually	None	100	C1&C2	Djuro Huber
Czech Republic	2012-2016	No	No	Points	All - annually	None	100	C1&C2	Miroslav Kutal
Estonia	2012-2016	Yes	No	Points; Admin. Units	All - annually	None	100?	C1-C3	Peep Männil
Finland	2012-2016	No	No	Points	All - annually	Cells around repro	Permanent: 36%; other: 100%	C1&C2	Ilpo Kojola
France	2012-2016	No	No	Points	All - annually	None	100	C1&C2	PY Quenette
Greece	2012-2015 & 2017	No		Points; Admin. Units; Grids	All - cummulative	None	??	C1-C3	Yorgos Mertzanis
Italy - Abruzzo	2005-2014	Yes	No	Points	All - cummulative (long timespan)	Zonal analysis (krigging) & presence since 2005	??	C1&C2	Paolo Ciucci
Italy-Alps	2012-2016	No	No	Points	All - annually	None	100	C1&C2	Luca Pedrotti, Claudio Groff, Anja Molinari-Jobin
Latvia	2015-2016	Yes	Yes	Points	All - annually	None	100	C1	Janis Ozolins
Kosovo - West	2013-2017	Yes	Yes	Points	All - cummulative	None	100	C1&C2	Aleksandër Trajçe
Kosovo - South	2013-2017	No	No	Points	All - annually	None	??	C2&C2, soft	Aleksandër Trajçe
FYRO Macedonia	2012-2016	Yes	Yes	Points	Focal areas	5km buffer all & past presence	??	C1&C2	Dime Melovski
Montenegro	2015-2016?	No details		Points	All - cummulative	Unknown	??	C1-C3?	Dime Melovski, Aleksandar Perović
Norway	2012-2016	No	No	Points	All - cummulative	10km buffer all	58	C1 (repro), C1-C3 (rest)	Jonas Kindberg
Sweden		Yes	No						
Poland	2012-2016	No	No	Points	All - cummulative; Focal areas	None	100	C1-C3	Nuria Selva
Romania	2012-2016	No	Hunting ban in 2016	Points; Admin. Units	All - annually	None	??	C1-C3	Ovidiu Ionesco
Serbia	2012-2016	Yes	No	Points; Admin. Units	All - annually	None	??	C1-C3	Duško Ćirović
Slovakia	2016	No info	No info	Points; Admin. Units	All - annually	Unknown	??	C1-C3, soft?	Robin Rigg
Slovenia	2012-2016	No	No	Points	All - annually	None	100	C1&C2	Klemen Jerina
Spain - Pyrenees	2012-2016	No	No	Points	All - annually	None	100	C1&C2	Juan Carlos Blanco
Spain - Cantabria	2012-2016	Yes	No	Points	All - annually	None	100	C1&C2	Juan Carlos Blanco
Switzerland	2012-2016	No	No	Points	All - annually	None	100	C1&C2	Fridolin Zimmermann
Ukraine - Carpathians	2009-2016	new	NA	Points	Focal areas	Presence since 2009	100	C1-C3	Yegor Yakovlev, Maryna Shkvyria

[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 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)	Extant (resident)	Population names
				2 (reintroduced)		
				7 (reinforced)**		
3	Sporadic	1 (Extant)	4 (Passage)	4 (vagrant)	Extant (sporadic)	Vagrants
5	Present	1 (Extant)	5 (Seasonal occurrence uncertain)	1 (native)	Extant (data details missing)	Population names
				2 (reintroduced)		

*Obligatory cells for the IUCN Red List shape files, **This category is not (yet) in the IUCN Red List ORIGIN table

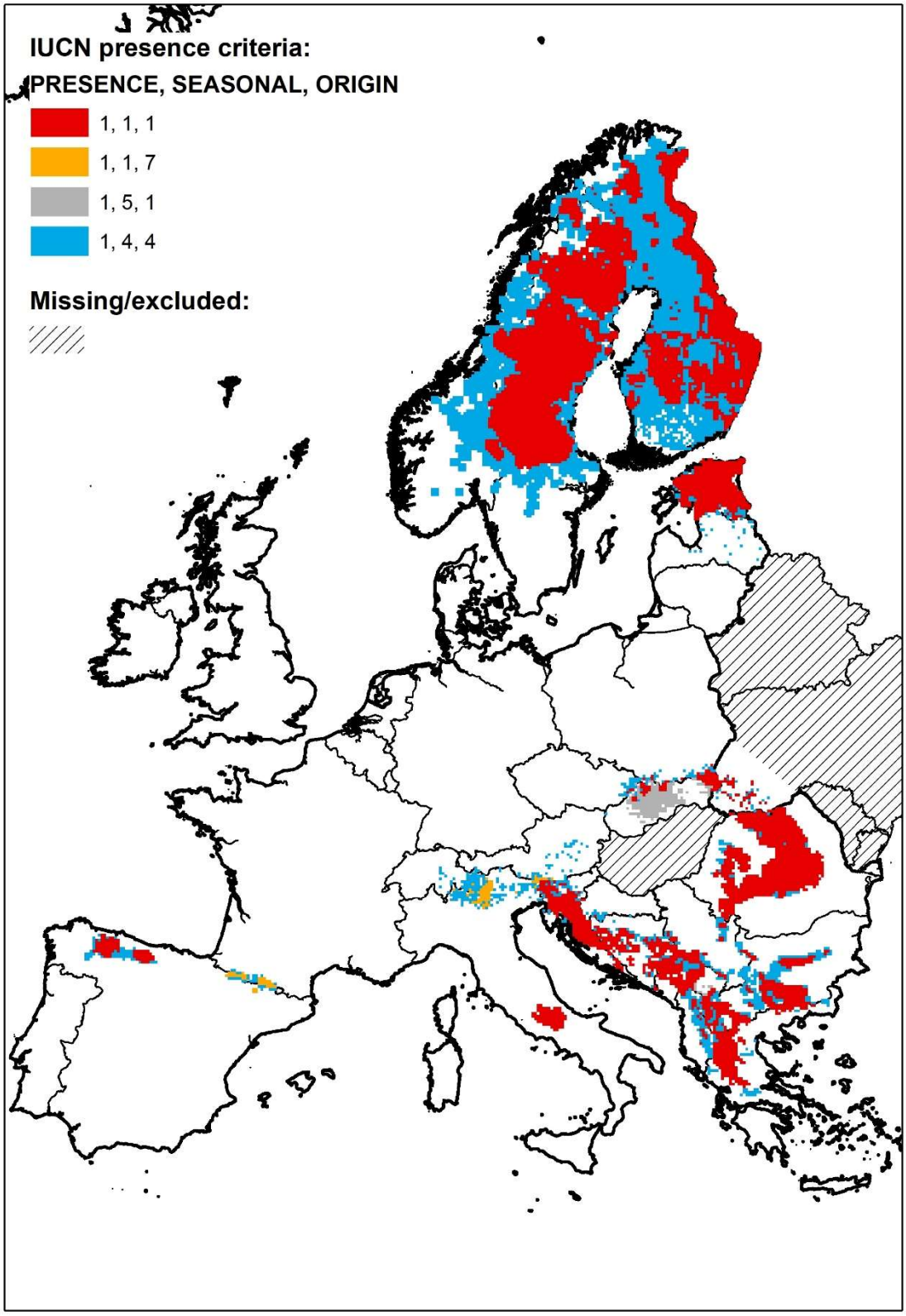

Fig. 1: Bear presence in Europe 2012-2016 according to IUCN presence criteria PRESENCE, SEASONAL, and ORIGIN (for codes see Table 2).

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 bear populations in Europe 2012-2016.

Populations	**Area (km2)**
EOO	**5,538,450**
AOOs:	
Alpine	6,000
Baltic	40,700
Cantabrian	8,800
Carpathian	113,000
Central Apennine	8,000
Dinaric-Pindos	90,000
East Balkan	21,800
Karelian	148,000
Pyrenean	3,600
Scandinavian	252,900
Sum of AOOs	**692,800**

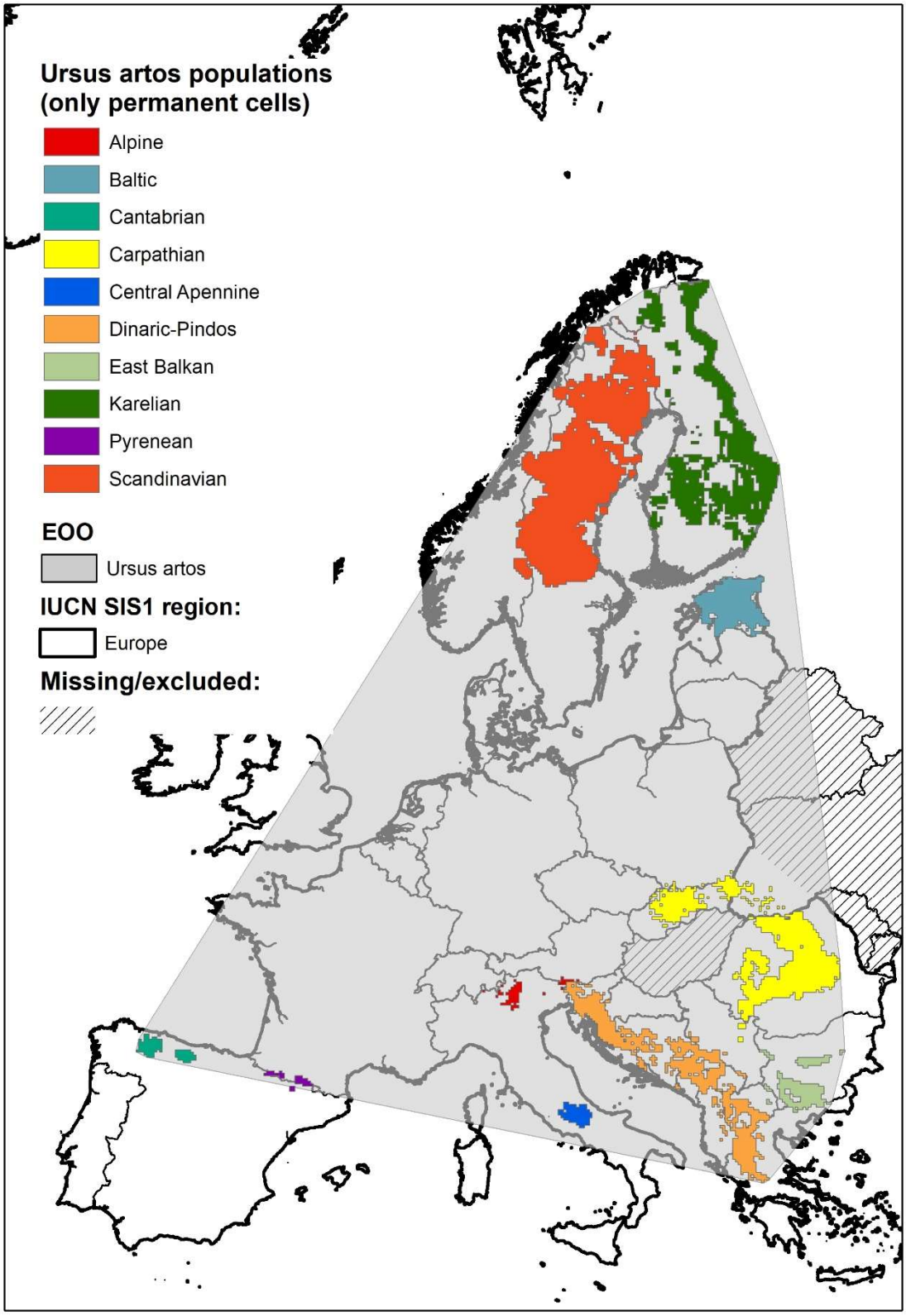

Fig. 2: Bear populations (cells with Presence 1.4.4. "sporadic" not shown) and total extent of occurrence (EOO) in Europe

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 bears in Europe.

Metadata table	**Information provided**
SPOIS	see Table 1
BINOMIAL	*Ursus arctos*
Presence	see Table 1
ORIGIN	see Table 1
SEASONAL	see Table 1
COMPILER	Large Carnivore Initiative for Europe (LCIE)
YRCOMPILED	2018
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 2

V. Contributors

Table 5: Contributors to bear 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	Society for the Protection and Preservation of Natural Environment in Albania - PPNEA
Austria	Georg Rauer[1]	[1]Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna; based on data collected for the Coordination Board for the Management of the Brown Bear, Lynx and Wolf in Austria - KOST
Bosnia-Herzegovina	Igor Trbojević	University of Banja Luka, Faculty of Science
Bulgaria	Diana Zlatanova, Alexander Dutsov	[1]Department of Zoology and Anthropology, Faculty of Biology, Sofia University; [2]Balkani Wildlife Society
Croatia	Djuro Huber, Slaven Reljić, Josip Kusak	University of Zagreb, Department of Biology; [2]State Institute for Nature Protection, Department for Wild and Domesticated Taxa and Habitats; personnel from State Directorate for Nature and Environment
Czech Republic & Western Slovakia	Miroslav Kutal[1,2], Michal Bojda[1], Robin Rigg[3], Martin Duľa[1,2], Michal Kalaš[4], Beňadik Machciník[5]	[1]Friends of the Earth Czech Republic; [2]Department of Forest Ecology, Faculty of Forestry and Wood technology, Mendel University Brno; [3]Slovak Wildlife Society; [4]Administration of the National Park Malá Fatra, Slovakia; [5]Administration of the Protected Landscape Area Strážovské vrchy, Slovakia
Estonia	Peep Männil, Rauno Veeroja	Estonian Environment Agency, Department of Wildlife Monitoring
Finland	Ilpo Kojola, Vesa Nivala	Natural Resources Institute Finland (Luke); Finish database https://tassu.luke.fi
France	Pierre-Yves Quenette, Cécile Vanpé, Jean-Jacques Camarra, Jérôme Sentilles	Office national de la chasse et de la faune sauvage ONCFS, Equipe Ours
Greece	Yorgos Mertzanis[1], Yorgos Iliopoulos[1], Alexandros Karamanlidis [2], Georgios Papamichael [3], Thomas Arapis[3], Katherina Petkidi [3], Ioanna Fytou[3], Vassilis	[1]CALLISTO; [2]ARCTUROS; [3]Hellenic Ministry of Environment; [4]University of Bristol, UK; [5]Aristotle University of Thessaloniki, Greece

	Hatzirvasanis[3], Charilaos Pylidis[4], Dimitris Tsaparis[5], Nikoletta Karaiskou[5], Alexandros Triantafyllidis[5]	
Italy - Abruzzo	Paolo Ciucci[1], Tiziana Altea[2], Antonio Antonucci[3], Luca Chiaverini[1], Antonio Di Croce[4], Mauro Fabrizio[5], Paolo Forconi[6], Roberta Latini[7], Luigi Maiorano[1], Antonio Monaco[5], Paola Morini[8], Filomena Ricci[9], Luciano Sammarone[10], Federico Striglioni[11], Elisabetta Tosoni[1]	[1]Dipartimento di Biologia e Biotecnologie, Università di Roma "La Sapienza"; [2]Corpo Forestale dello Stato, Ufficio Territoriale Biodiversità; [3]Parco Nazionale della Majella; [4]Unione Zoologica Italiana; [5]Riserva Naturale Regionale Monte Genzana Alto Gizio; [6]Studio Faunistico Chiros; [7]Parco Nazionale d'Abruzzo Lazio e Molise; [8]Parco Regionale Sirente Velino; [9]Riserva Naturale Regionale e Oasi WWF Gole del Sagittario; [10]Corpo Forestale dello Stato; [11]Parco Nazionale del Gran Sasso – Monti della Laga; [12]Direzione Regionale Ambiente e Sistemi Naturali; Regione Lazia Bear Monitoring Network
Italy-Alps	Luca Pedrotti[1], Claudio Groff[1], Natalia Bragalanti[1], Davide Righetti[2], Martin Stadler[2], Sonia Calderola[3], Umberto Fattori[4], Paolo Molinari[5], Stefano Filacorda[6], Elena Tironi[7], Elisabetta Rossi[7], Maria Ferloni[8], Paolo Tavelli[9], Daniele Carrara[10], Pietro Gatti[11]	[1]Provincia Autonoma di Trento, Forest and Wildlife Service; [2]Provincia Autonoma di Bolzano, Hunting and Fish Office; [3]Regione Veneto; [4]Regione Autonoma Friuli Venezia Giulia; [5]Progetto Lince Italia; [6]Università degli Studi di Udine; [7]Regione Lombardia; [8]Provincia di Sondrio; [9]Provincia di Brescia; [10]Provincia di Bergamo; [11]Provincia di Lecco
Kosovo	Aleksandër Trajçe[1], Bardh Sanaja[2], Azem Ramadani[3], Rafet Elezi[4]	[1]Protection and Preservation of Natural Environment in Albania; [2]Environmentally Responsible Action (ERA), Balkan Lynx Recovery Programme
Latvia	Jānis Ozoliņš, Guna Bagrade, Mārtiņš Lūkins	Latvian State Forest Research Institute "Silava"
FYRO Macedonia	Dime Melovski, Vasko Avukatov	Macedonian Ecological Society - MES, Balkan Lynx Recovery Programme
Montenegro	Aleksandar Perović	Centre for protection and research of birds of Montenegro - CZIP
Norway & Sweden	Jonas Kindberg, Henrik Brøseth	Norwegian Institute for Nature Research - NINA; Norwegian/Swedish database www.rovbase.no

Poland	Nuria Selva[1], Carlos Bautista[1]	[1]Institute of Nature Conservation, Polish Academy of Sciences; Tatra National Park, Bieszczadzki National Park, Magurski National Park, Babia Gora National Park, National State Forest Holding, Regional Directorates of Environmental Protection in Krakow, Katowice and Rzeszow, Association for Nature "Wolf"
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	Duško Ćirović	University of Belgrade, Faculty of Biology
Slovakia	Robin Rigg[1], Jozef Bučko[2]	[1]Slovak Wildlife Society, [2]National Forestry Centre
Slovenia	Klemen Jerina[1], Tomaž Skrbinšek[1], Matija Stergar[1], Matej Bartol[2], Tomaž Berce[2], Rok Črne[2], Miha Krofel[1], Marko Jonozovič[2], Aleksandra Majić Skrbinšek[1], Hubert Potočnik[1], Ivan Kos[1]	[1]University of Ljubljana, Faculty of Biotechnology; [2]Slovenia Forest Service
Spain - Pyrenees	Santiago Palazón[1], Bear teams of the regional governments of Catalonia, Aragón and Navarra	[1]Fauna and Flora Service, Ministry of Territory and Sustainability, Government of Catalonia
Spain - Cantabria	Guillermo Palomero[1], Fernando Ballesteros[1], Juan Carlos Blanco[2], José Vicente López Bao[3,]	[1]Fundación Oso Pardo; [2]Wolf Project, Consultores en Biología de la Conservación, [3]Research Unit of Biodiversity (UO/CSIC/PA), Oviedo University
Switzerland	Fridolin Zimmermann, Andreas Ryser	Carnivore Ecology and Wildlife Management - KORA

Ukraine	Maryna Shkvyria[1], Yegor Yakovlev[1, 2], Ihor Dykyy[3], Yevgeniya Ulyura[4], Mykola Svystun[5], Pavlo Khoyetskyy[6], Nelya Koval[7], Ivan Delehan[8]	[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; [4]National Museum of Natural History of NAS; [5]NNP Skolivski Beskydy; [6]Ukrainian National Forestry University; [7]NNP Uzhanskyy; [8]Institute of Forestry and Park Gardening of Ukrainian National Forestry University

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