Grey Wolf (*Canis lupus*)

Supporting information for the European IUCN Red List assessment for Grey Wolf (*Canis lupus*), including:

- Estimate of population size for Grey Wolf (*Canis lupus*) in Europe
- Method used for mapping Brown Bear occurrence in Europe for the European Red List assessment.

Estimate of population size for Grey Wolf (*Canis lupus*) in Europe

European countries estimate and monitor wolf numbers through a variety of approaches with varying field methods, intensity of effort, and continuity in time. These range from intensive DNA based studies where the full pedigree of each wolf is known to areas where expert guestimates are the best available information. This diversity is due to differences in wolf populations' sizes, their conservation status and management regime, the institutional capacity to design and implement monitoring programmes, funding availability and the extent of cooperation among subnational local governments. The result is that the quality and quantity of data on wolf numbers in Europe is extremely heterogeneous. This diversity poses a difficult challenge when trying to assess wolf numbers and status at population level (*sensu* Linnell *et al*. 2008) because most populations include portions distributed across several countries. Three main issues complicate the task of assembling data from different countries.

Estimates of total population size

Wolf population size is estimated through a variety of methods. In Europe, the most common methods include mark-recapture techniques applied to non-invasive genetic samples, snow-tracking and/or radio-tracking on small areas and/or few animals/packs and results extrapolated to known range, wolf-howling to identify reproducing packs, and a combination of all. There are two different approaches to estimate numbers: estimating individuals and estimating packs. When estimating individuals, the result is often a range of values, and when the field techniques and the survey methods allow it, a statistical estimate of the error around an estimate. Estimating individuals often produces broad ranges of values as several sources of uncertainty affect the estimate (e.g. large errors). When estimating packs, the number of packs is usually produced without or with limited errors but the transformation of pack numbers into a number of individuals (as required by the Red List assessments) is open to significant interpretation.

The relationship between pack numbers and total population size is open to several variables. Firstly, pack size varies with season, prey size and biomass, population fluctuation and territory size. A summary of average pack size in relation to prey species is between 5.66-9.05 with known exceptions of 3.5 when food was mainly garbage and/or small mammals and up to 15-20 and more wolves in particular circumstances. Secondly, a certain proportion of the wolf population lives as solitary transient individuals dispersing in search of a mate and territory: the percentage of lone wolves is normally 10-15% of the total population. Chapron *et al.* (2016) found that a conversion factor of 8 (95% CI = 6.62–10.07) was well suited to describe total population size in Sweden. The conversion factor accounted for the sum of territorial and vagrant animals. However, no other populations have access to the high quality demographic data needed to make similar calculations. Especially in areas where wolves are hunted there can also be a major difference in pack size between the start and the end of the hunting seasons.

Pack numbers, when studied with well-defined field protocols, are a powerful index of local abundance, extremely useful to monitor trends in the populations. They are also a useful proxy for total population size when a population model is available where both individuals and groups are explicitly described. In Europe, several countries adopt the method of estimating pack numbers (e.g. Estonia, Norway, Sweden, Finland, Spain, Italy in the Alps, Germany, Poland). To account for the unknown variation in pack size and the percentage of vagrant individuals, we applied two conversion factors: 6 and 8, the first being more conservative for populations living in highly human-dominated landscapes and the second more likely true for populations living in more natural settings and preying on medium-large prey. As the pack size and predation biology of most wolf populations is not quantified, producing a range of less and more conservative values for population size appears to be more acceptable than producing a fixed number based on a single conversion factor of unknown validity.

Estimate of the numbers of mature individuals

In any given wolf population, only a portion of animals is mature for reproduction (sensu Red List, i.e. potentially able to reproduce) and only a smaller portion actually breeds. Social constraints, environmental conditions, prey abundance and many other factors influence the proportion and age of breeding wolves. Although some wolves have bred at 10 months of age (in captivity and in the wild, e.g. in Yellowstone National Park soon after reintroduction to an area with a superabundance of prey) most female wolves only come into estrus at or after 22 months of age. Little is known about the relation of males' age and their ability to reproduce). It is likely that at on average at least 50% of all wolves living in packs are able to breed. Moreover, all vagrant animals (i.e. 10-15% of the population) are normally at or above the age of breeding. As a working (and conservative) rule, we have adopted the proportion of 60% of the population being reproductively mature and applied this percentage to the estimated population sizes.

Combining data at the population level

To obtain the estimates at population level, we used the following method:

- Use the most recent estimates available for each country (not always available for 2016);
- Convert pack numbers into total numbers by applying the conversion factors 6 and 8 to produce a range of numbers of individuals;
- Produce a range of population size (Confidence Intervals in exceptional cases when available) for each population by summing up all lower and higher values;
- Produce a range of numbers of mature individuals by applying the 60% proportion to the lower and higher estimates of population size.

References

Chapron, G., Wikenros, C., Liberg, O. and Sand, H. 2016. Estimating wolf (*Canis lupus*) population size from number of packs and an individual based model. *Ecological Modelling* 339: 33-44.

Fuller, T.K., Mech, L.D. and Fitts-Cochran, J. 2003. Wolf population dynamics. In: L.D. Mech & L. Boitani (eds). *Wolves: behavior, ecology, and conservation*, pp.161-191. University of Chicago Press, Chicago, Illinois, USA.

Kreeger, T.J. 2003. The internal wolf: physiology, pathology, and pharmacology. In: L.D. Mech & L. Boitani (eds). *Wolves: behavior, ecology, and conservation*, pp. 192-217 University of Chicago, Chicago, Illinois, USA.

Linnell, J., Salvatori, V. and Boitani, L. 2008. Guidelines for population level management plans for large carnivores in Europe. A Large Carnivore Initiative for Europe report prepared for the European Commission (contract 070501/2005/424162/MAR/B2).

Mech, L.D. and Boitani, L. 2003. *Wolves: Behavior, Ecology, and Conservation.* University of Chicago Press, Illinois, USA.

IUCN Red List Mapping for the regional assessment of the Wolf (*Canis lupus*) in Europe

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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)
- The categories included are: 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 the SCALP criteria developed for the standardized monitoring of Eurasian lynx (*Lynx lynx*) in the Alps (Molinari-Jobin *et al.* 2012) were used:

- **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

- The category “soft” which refers to large carnivore presence based on interview, questionnaires, and media coverage was also used

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	10	C1&C2	Aleksandër Trajçe
Austria	2012-2016	No	No	Points	All - annually	None	100	C1&C2	Georg Rauer
Bosnia and Herzegovina	2004-2016	Yes	NA	Points	All - annually	None	100	C1-C3	Igor Trbojević
Bulgaria	2012-2014	Yes	No	Points	All - cummulative	20km buffer all & past presence	~40 (C1-C2)	C1-C3, soft	Elena Tsingarska
Croatia	2012-2016	Yes	No	Points	All - cummulative	Past core area	~95	C1-C3	Josip Kusak
Czech Republic	2012-2016	No	No	Points	All - annually	None	100	C1&C2	Miroslav Kutal
Denmark	2012-2016	New		Points	All - annually	None	100	C1&C2	Peter Sunde, Kent Olsen, Ilka Reinhardt
Estonia	2012-2016	No	No	Points; Admin. Units	All - annually	None	95	C1-C3, soft	Peep Männil
Finland	2012-2016	No	No	Points	All - annually	None	??	C1-C3	Ilpo Kojola
France	2012-2016	Yes	No	Points	All - annually	9km buffer repro.	Repro: 18; other: 100	C1&C2	Christophe Duchamp
Germany	2012-2016	No	No	Points	All - annually	None	100	C1&C2	Ilka Reinhardt
Greece	2012-2016	No	No	Points; Admin. Units	All - annually	Gaps filled with sporadic	??	C1&C2	Yorgos Iliopoulos
Italy - Appennines	2012-2016	No	No	Points; Grids	Focal areas	Includes expert assesment	few	C1-C3, soft	Valeria Salvatori, Luigi Boitani
Italy - Alps	2014-2016	No	No	Points	All - annually	None	100	C1&C2	Francesca Marucco
Kosovo	2013-2017	Yes	Yes	Points	All - cummulative	None	100 (some cells from Serbia)	C1&C2	Aleksandër Trajçe
Latvia	2012-2016	Yes	Yes	Points	All - annually	None	100	C1	Janiz Ozoliņš
Lithuania	2012-2016	No	Yes	Points or nearest village	All - annually (only 3 years)	None	100	C1-C3	Vaidas Balys
FYRO Macedonia	2012-2016	Yes	Yes	Points	Focal areas	5km buffer all	??	C1	Dime Melovski
Netherlands	2014-2016	New		Points	All - annually	None	100	C1&C2	Peter Venema
Norway & Sweden	2012-2016	Yes	No	Points	All - annually	19km buffer repro/pack	??	C1&C2	Andreas Zetterberg
Poland - Baltic	2012-2016	Yes	No	Points	Focal areas	Cells around repro, Past presence	not calculated	C1&C2	Sabina Nowak, Robert Mysłajek
Poland - Carpathian	2012-2016				Focal areas			C1&C2	
Poland - Central European	2012-2016				All - annually	Cells around repro		C1&C2	
Portugal	2012-2016	Yes	No	Points; Admin. Units	All - cummulative	None	>75	C1&C2	Francisco Álvares
Romania	2012-2016	No	Yes	Points; Admin. Units	All - annually	None	??	C1-C3	Ovidiu Ionescu
Serbia	2012-2016	sign based		Points; Admin. Units	All - cummulative	None	??	C1-C3	Dusko Cirovic
Slovakia	2016	No info	No info	Points; Admin. Units	All - annually (only 2016)	Unknown	unknown	C1-C3, soft	Robin Rigg
Slovenia	2012-2016	Yes	No	Points	All - annually	HR buffer repro	??	C1&C2	Klemen Jerina
Spain	2012-2016	Yes	Yes	Points	All - cummulative	None	100	C1&C2	Juan Carlos Blanco
Switzerland	2012-2016	No	No	Points	All - cummulative	None	100	C1&C2	Fridolin Zimmermann
Ukraine - Carpathians	2005-2017	New		Points	Focal areas	Presence since 2005	30	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

Presence definitions for the IUCN Red Listing

The SPOIS definitions "permanent", "sporadic", "present", and "presence uncertain" had to be transferred to the IUCN Red 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, a new category which was not available in the IUCN Red List categories was added: 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
5 Present	1 (Extant)	5 (Seasonal Occurrence Uncertain)	1 (Native) 2 (Reintroduced)	Extant (Data Details Missing)	Population names

*Obligatory cells for the IUCN Red List shape files

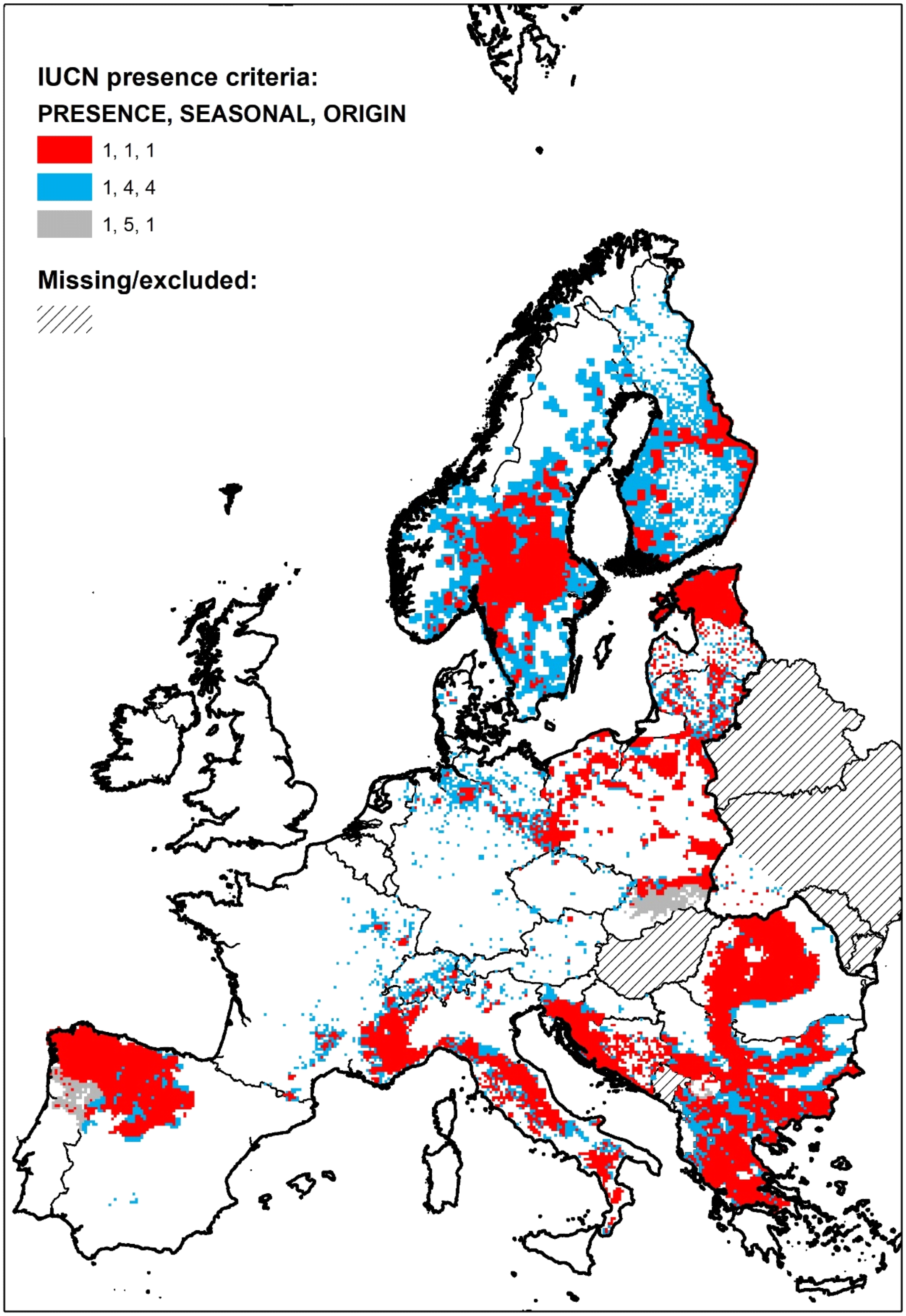

Figure 1. Wolf presence in Europe 2012-2016 according to IUCN presence criteria for PRESENCE, SEASONAL, and ORIGIN (for codes see Table 2).

Area calculations

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

Only the permanent cells were used for the calculation of the extent of occurrence (EOO) and area of occupancy (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 Wolf populations in Europe 2012-2016.

Populations	Area (km^2)
EOO	**6,184,500**
AOOs:	
Alpine*	51,500
Baltic	127,100
Carpathian	143,100
Central European	48,300
Dinaric-Balkan	229,500
Italian Peninsula	55,600
Karelian	51,000
NW Iberia	136,800
Scandinavian	151,800
Sum of AOOs	**994,700**

**For practical reason permanent* Wolf *presence in Austria was assigned to "Alpine" regardless of the genetical origin of the animals (wolves of Carpathian, Alpine, Dinaric and Central European origin have been detected in Austria over the last years).*

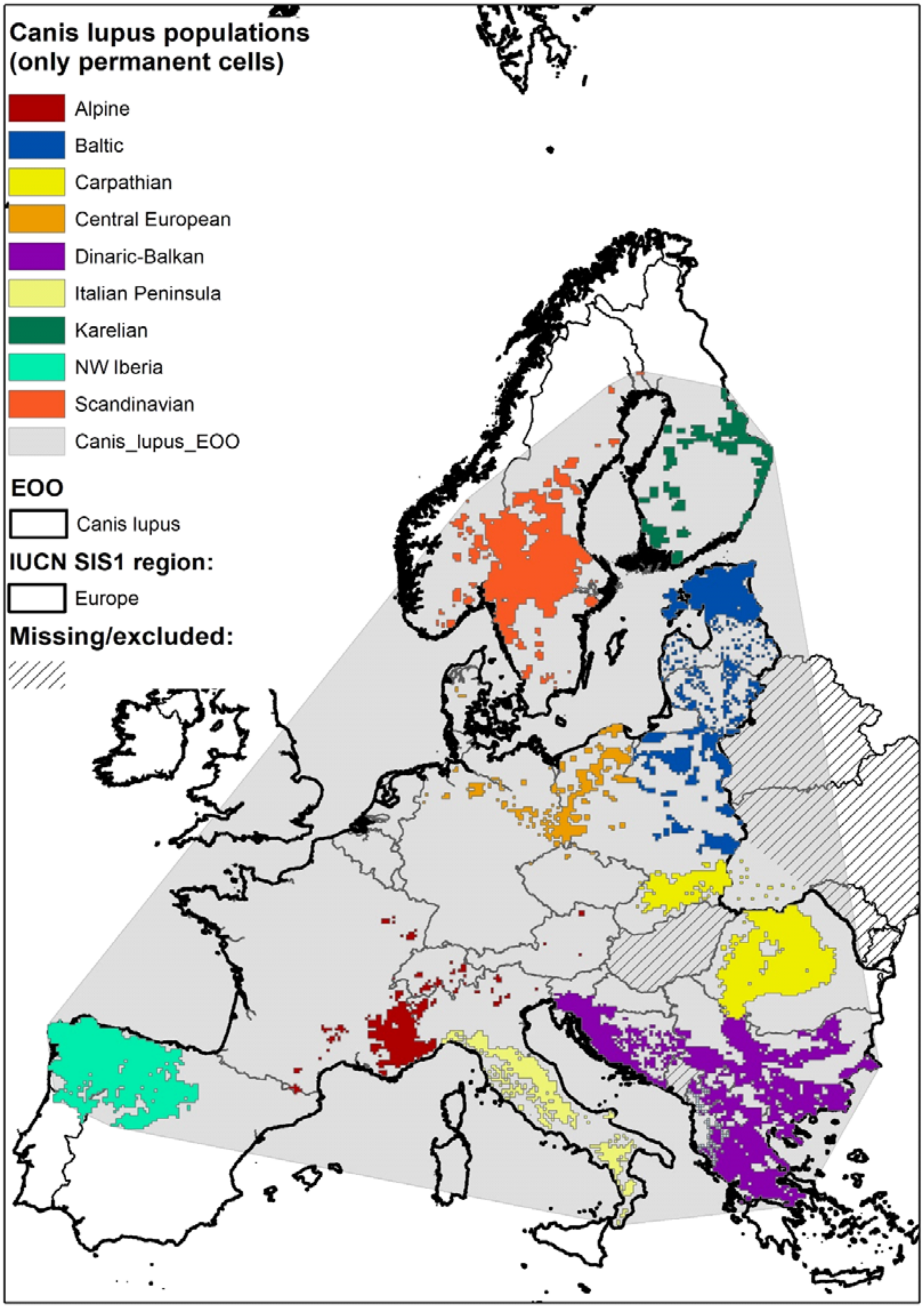

Figure 2. Wolf populations (cells with Presence 1.4.4. "sporadic" not shown) and total extent of occurrence (EOO) in Europe. Note: For practical reason permanent Wolf presence in Austria was assigned to "Alpine" regardless of the genetical origin of the animals (wolves of Carpathian, Alpine, Dinaric and Central European origin have been detected in Austria over the last years).

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	*Canis lupus*
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 10x10 km ETRS grid
SUBPOP	see Table 2

Contributors

Table 5. Contributors to Wolf 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	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 and Herzegovina	Igor Trbojević	University of Banja Luka, Faculty of Science
Bulgaria	Elena Tsingarska-Sedefcheva	Balkani Wildlife Society
Croatia	Josip Kusak[1], Slaven Reljić[1], Jasna Jeremić[2], personnel from State Directorate for Nature and Environment	[1]University of Zagreb, Department of Biology; [2]State Institute for Nature Protection, Department for Wild and Domesticated Taxa and Habitats
Czech Republic & Western Slovakia	Miroslav Kutal[1,2], Michal Bojda[1], Elisa Belotti[3], Luděk Bufka[3], Josefa Volfová[1], Robin Rigg[4], Martin Duľa, Michal Kalaš[5], Beňadik Machciník[6]	[1]Friends of the Earth Czech Republic, [2]Department of Forest Ecology, Faculty of Forestry and Wood technology, Mendel University Brno, Czech Republic; [3]Administration of the National Park and Protective Landscape Area of Šumava, Czech Republic; [4]Slovak Wildlife Society; [5]Administration of the National Park Malá Fatra, Slovakia; [6]Administration of the Protected Landscape Area Strážovské vrchy, Slovakia
Denmark	Peter Sunde[1], Kent Olsen[2]	[1]Aarhus University, Department of Bioscience; [2]Natural History Museum, Danish Agency for the Environment
Estonia	Peep Männil, Marko Kübarsepp, Rauno Veeroja	Estonian Environment Agency, Department of Wildlife Monitoring
Finland	Ilpo Kojola[1], Vesa Nivala[2]	[1]Natural Resources Institute Finland (Luke); Finish database https://tassu.luke.fi

Country/Region	Names of main data/map contributors	Affiliation [and in some cases also acknowledgement of data sources]
France	Christophe Duchamp	Office national de la chasse et de la faune sauvage ONCFS, Réseau Loup-Lynx
Germany	Ilka Reinhardt[1,2]	[1]LUPUS German Institute for Wolf Monitoring and Research; [2]Dokumentations- und Beratungsstelle des Bundes zum Thema Wolf (DBBW); Federal Agency for Nature Conservation (BfN); federal states of Germany
Greece	Yorgos Iliopoulos	Callisto Wildlife Society
Italy - Appenine	Valeria Salvatori[1], Luigi Boitani[2]	[1]Istituto di Ecologia Applicata, fedarel regions; [2]Dipartimento di Biologia e Biotecnologie, Università di Roma “La Sapienza”; from from data in the document "Piano Nazionale di conservazione e gestione del lupo" 2015.
Italy - Alps	Francesca Marucco[1], E. Avanzinelli[1], B. Bassano[2], R. Bionda[3], N. Bragalanti[4,5], S. Calderola[6], C. Chioso[7], C. Groff[4], L. Martinelli[1], U. Fattori[8], L. Pedrotti[4,9], D. Righetti[9,10], E. Tironi[11], F. Truc[1]	[1]Progetto LIFE WolfAlps, Centro Grandi Carnivori, Ente di Gestione delle Aree Protette delle Alpi Marittime; [2]Parco Nazionale del Gran Paradiso; [3]Progetto LIFE WolfAlps, Ente di Gestione delle Aree Protette dell’Ossola; [4]Provincia Autonoma di Trento, Servizio Foreste e fauna; [5]Progetto LIFE WolfAlps, MUSE, Museo delle Scienze, Trento; [6]Progetto LIFE WolfAlps, Regione Veneto, Sezione Caccia e Pesca; [7]Regione Autonoma Valle d’Aosta - Flora, fauna, caccia e pesca - Ufficio per la fauna selvatica; [8]Regione Autonoma Friuli Venezia Giulia, Ufficio studi faunistici; [9]Progetto LIFE WolfAlps, Parco Nazionale dello Stelvio; [10]Provincia Autonoma di Bolzano, Ufficio Caccia e Pesca; [11]Progetto LIFE WolfAlps, Regione Lombardia, DG Ambiente, Energia e Sviluppo sostenibile, Struttura Valorizzazione aree protette e biodiversità
Kosovo	Azem Ramadani, Rafet Elezi, 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], Renata Špinkytė-Bačkaitienė[2]	[1]Association for Nature Conservation “Baltijos vilkas”; [2]Aleksandras Stulginskis University; original raw data from Ministry of Environment (hunting bag and snowtracking data) & Ministry of Agriculture (official livestock registry)

Country/Region	Names of main data/map contributors	Affiliation [and in some cases also acknowledgement of data sources]
FYRO Macedonia	Dime Melovski, Vasko Avukatov	Macedonian Ecological Society, Balkan Lynx Recovery Programme
Netherlands	Leo Linnartz[1,2], Glenn Lelieveld[1,3], Peter Venema[4], Hugh Jansman[5]	[1]Wolven in Nederland; [2]ARK Natuurontwikkeling; [3]Dutch Mammal Society; [4]Provincie Drenthe; [5]Wageningen University, Environmental Research
Norway & Sweden	Andreas Zetterberg[1]	[1]Swedish University of Agricultural Sciences; Norwegian/Swedish database www.rovbase.no
Poland	Sabina Nowak, Robert W. Mysłajek	[1]Association for Nature "Wolf"; [2]University of Warsaw, Faculty of Biology, Institute of Genetics and Biotechnology
Portugal	Francisco Álvares[1], Mónia Nakamura[1], Virginia Pimenta[1], Inês Barroso[2]	[1]CIBIO, Research Center in Biodiversity and Genetic Resources, Porto University; [2]ICNF, Institute for Nature Conservation and Forests
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	Slovak Wildlife Society
Slovenia	Hubert Potočnik[1], Rok Černe[2], Miha Krofel[1], Klemen Jerina[1], Tomaž Skrbinšek[1], Matija Stergar[1], Marko Jonozovič[2], Ivan Kos1, Aleksandra Majić Skrbinšek[1], Matej Bartol[2], Hrovat Mojca[3,] Jelenčič Maja[1], Kljun Franc [1], Konec Marjeta[1], Kuralt Žan[1], Luštrik Roman[1], Ražen Nina[1],	[1]University of Ljubljana, Faculty of Biotechnology; [2]Slovenia Forest Service, [3]Dinaricum
Spain	Juan Carlos Blanco[1], José Vicente López-Bao[2]	[1]Wolf Project, Consultores en Biología de la Conservación, [2]Research Unit of Biodiversity (UO/CSIC/PA), Oviedo University
Switzerland	Fridolin Zimmermann, Ralph Manz, Florin Kunz	Carnivore Ecology and Wildlife Management - KORA
Ukraine	Maryna Shkvyria[1], Yegor Yakovlev[1, 2]	[1]Kyiv Zoological Park of National importance [2]Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine

References

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. and Boitani, L. 2014. Recovery of large carnivores in Europe's modern human-dominated landscapes. *Science* 346(6216):1517-1519.

Kaczensky, P., Chapron, G., Arx, M.v., Huber, D., Andrén, H. and Linnell, J.D.C. 2013. Status, management and distribution of large carnivores – bear, lynx, wolf & wolverine – in Europe. Report to the EU Commission, Part 1 and Part 2, 2013; http://ec.europa.eu/environment/nature/conservation/species/carnivores/pdf/task_1_part1_statusoflcineurope.pdf

Molinari-Jobin, A., Wölfl, S., Marboutin, E., Molinari, P., Wölfl, M., Kos, I., Fasel, M., Koren, I., Fuxjäger, C., Breitenmoser, C., Huber, T., Blazic, M. and Breitenmoser, U. 2012. Monitoring the Lynx in the Alps. Hystrix 23, 49-53. http://www.kora.ch/malme/05_library/5_1_publications/M/Molinari-Jobin_et_al_2012_Monitoring_the_lynx_in_the_Alps.pdf