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## **Back to the Future: The historical distribution of the Eurasian lynx (*Lynx lynx*) in the Iberian Peninsula**

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**Mestrado em Biologia da Conservação**

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## Resumo

O estudo da distribuição das espécies é importante para um maior entendimento da sua ecologia, evolução, biogeografia e conservação. Porém, devido à ação do Homem, as distribuições atuais das espécies encontram-se bastante alteradas, podendo representar frações diminutas daquilo que seriam as suas distribuições naturais, ou seja, se não fossem impactadas pelo ser humano. Os registos histórico e paleontológico oferecem uma janela de informação para o passado, podendo ser utilizados para reconstruir as distribuições naturais das espécies. A utilização destes registos para a reconstrução dessas distribuições é especialmente relevante pois poderá ter impactos diretos na conservação das espécies. Por exemplo, na Península Ibérica, a distribuição do urso-pardo (*Ursus arctos*) está atualmente limitada à cordilheira da Cantábria e aos Pireneus. Porém, no século XV, esta espécie ocorria no sudeste alentejano (mais especificamente, na região de Moura-Barrancos), o que mostra que a distribuição ibérica do urso-pardo era muito mais ampla do que a sua distribuição atual. Isto sugere que, ao nível ibérico e a longo prazo, a conservação do urso-pardo não se deveria focar apenas nas populações do norte de Espanha, mas também em possíveis zonas de recolonização, como o Gerês, onde a espécie está extinta há cerca de 180 anos e onde a sensibilização das comunidades locais será essencial para o sucesso da renaturalização da espécie.

Os grandes carnívoros (Classe Mammalia, Ordem Carnivora) são um dos grupos de mais ameaçados a nível global devido às suas grandes necessidades espaciais e tróficas que os colocam em conflito direto e indireto com o ser humano. Na Europa, após séculos de perseguição, as populações de carnívoros têm vindo a recuperar. Porém, as taxas de recuperação são diferentes entre espécies e, dentro da mesma espécie, entre populações. Um dos carnívoros mais impactados pela atividade humana foi o lince-euroasiático (*Lynx lynx*). Este felino (Ordem Carnivora, Família Felidae) é uma espécie tipicamente florestal e alimenta-se de ungulados, como os corços (*Capreolus* spp.), os veados (*Cervus* spp.), cabras-montesas (*Capra* spp.) e a camurça (*Rupicapra rupicapra*), assim como de lebres (*Lepus* spp.). Esta espécie foi erradicada de grande parte da Europa devido à desflorestação e à perseguição direta pelo ser humano.

Durante o século XX, existia uma população de lince-euroasiático nos Pireneus franceses. Porém, o consenso científico ditava que esta espécie nunca teria atravessado essa barreira biogeográfica e, por isso, nunca teria habitado a Península Ibérica. Contudo, durante a segunda metade do século XX, isto mudou devido ao aparecimento de registos históricos, paleontológicos e arqueológicos que sugeriam que o lince-euroasiático teria existido recentemente na Península Ibérica. Em 2015, no norte de Espanha, foi encontrado um crânio de lince que, através de sequenciação de DNA antigo, foi identificado como pertencente a um lince-euroasiático.

Este trabalho tem como objetivo criar uma distribuição de referência para o lince-euroasiático na Península Ibérica. Para tal, foi compilada uma base de dados com ocorrências históricas (tanto de fósseis como escritas) de lince (*Lynx* spp.) na Península Ibérica. Estas ocorrências foram depois utilizadas para modelar a distribuição da espécie no século XIX. As variáveis usadas para modelar a distribuição da espécie podem ser divididas em quatro grupos principais: (1) variáveis antropogénicas, (2) variáveis de interações bióticas, (3) variáveis climáticas, e (4) variáveis topográficas. O bioma de “Florestas Temperadas de Folha Larga & Mistas” é hipotetizado como tendo maior probabilidade de ocorrência de lince-euroasiático na Península Ibérica (Hipótese 1). Se essa hipótese for suportada pelos dados, prevê-se que o clima seja o fator mais relevante para a distribuição da espécie, pois é um *proxy* para a presença e tipo de floresta. A disponibilidade de presas, incluída nas variáveis de interações bióticas, é também hipotetizada como sendo um fator importante na distribuição da espécie (Hipótese 2).

As ocorrências históricas foram extraídas das fontes primárias através da “procura de palavras” (do inglês, *word search*) usando os termos associados a lince (como “lobo cerval”, “liberne”, “gato cravo”, etc.). Estas ocorrências foram posteriormente geolocalizadas através do Google Earth. Quando a fonte primária não providenciava uma datação para a ocorrência, a data da fonte primária era usada como *proxy*. Quando fornecidas, o reconhecimento das espécies era feito através das descrições dos indivíduos. Quando estas descrições não eram fornecidas, o nome comum usado para a espécie em cada ocorrência era usado para o reconhecimento da espécie, uma vez que existe alguma paridade entre o tamanho dos indivíduos das ocorrências e o nome usado para os descrever. Por exemplo, “lobo-cerval” parece estar associado a indivíduos de maior porte no norte da Península, sendo possivelmente lince-euroasiáticos, enquanto “gato-cravo” é mais associado a indivíduos de menor porte no sul de Portugal, sendo possivelmente lince-ibéricos (*Lynx pardinus*). Antes de modelar a distribuição da espécie, as ocorrências foram colocadas na grelha de 10x10km da Agência Europeia do Ambiente. Assumiu-se que o lince estava presente numa célula da grelha caso existisse uma ocorrência na mesma. Neste trabalho, foram usadas três abordagens para modelar a distribuição da espécie: (1) modelos lineares generalizados (GLM), (2) modelos aditivos generalizados (GAM), e (3) máxima entropia (MaxEnt). Estas três abordagens foram utilizadas para providenciar: (1) formas semi-independentes de modelação da espécie, (2) uma escala de interpretabilidade dos modelos (GLM > GAM > MaxEnt), e (3) uma escala de poder preditivo (MaxEnt > GAM > GLM). O desempenho dos modelos foi testado através de sete medidas de discriminação (por exemplo, a área por baixo da curva de operação do recetor), e até três medidas de calibração (por exemplo, o índice de Boyce). As previsões da abordagem com melhor desempenho foram agrupadas em quatro classes de presença (conservativo, intermédio, inclusivo, e ausente) de forma a criar um mapa categórico da distribuição da espécie. A correlação de Pearson foi usada para testar o consenso entre as previsões das diferentes abordagens de modelação. Caso a correlação fosse maior que 0.7, era assumido que existia uma forte correlação entre as previsões. A Hipótese 1 foi também testada explicitamente através de um GLM binomial. A incerteza das previsões foi quantificada através do mapeamento do erro padrão dos modelos de regressão e do mapeamento do desvio padrão populacional das previsões de todas as abordagens de modelação.

A revisão de fontes históricas primárias adicionou pelo menos 59 novas ocorrências de lince para a Península Ibérica (todas de Portugal), o que representa um aumento significativo do conhecimento sobre a distribuição histórica das espécies. Todas as abordagens de modelação mostram o norte e o noroeste da Península Ibérica como a área de maior probabilidade de presença para lince-euroasiático, numa região que se sobrepõe bastante com o bioma de “Florestas Temperadas de Folha Larga & Mistas”, algo que é suportado pelo GLM usado para testar a Hipótese 1. A abordagem de modelação com melhor desempenho foi a que usou GAM. Porém, todas as abordagens de modelação apresentaram bons desempenhos e as suas previsões foram semelhantes (mínima correlação entre previsões acima de 0.8). Em todas as abordagens de modelação, as variáveis associadas ao clima foram as mais importantes, sendo que as relacionadas com a disponibilidade de presas também foram consideradas como importantes. Estes resultados suportam a Hipótese 1 e a Hipótese 2 deste estudo. Em geral, os modelos apresentaram níveis reduzidos de incerteza.

Estes resultados são suportados por estudos prévios que mostram que a presença de floresta e a disponibilidade de presas são dos factores mais importantes para a distribuição da espécie. As previsões presentes neste trabalho aumentam em, pelo menos, 436 vezes a área considerada como adequada para o lince na Península Ibérica. As diferenças entre os modelos destes trabalhos e daqueles presentes em trabalhos prévios devem-se provavelmente a três factores: (1) adaptação local, (2) truncamento do nicho, e (3) erros no processo de reconhecimento das espécies. Por exemplo, a população ibérica extinta de

lince-euroasiático era significativamente distinta geneticamente e, por isso, poderia possuir constrangimentos ou necessidades ecológicas ausentes nas restantes populações (extantes) da Europa.

Em suma, este trabalho mostra como é que o registo fóssil e, principalmente, os registos históricos, juntamente com recurso a ferramentas de modelação, podem ser usados para estabelecer distribuições de referência, essenciais para desenhar, de forma quantitativa, ações de conservação eficazes.

**Palavras-chave:** carnívoros, ecologia histórica, modelação da distribuição de espécies, paleobiologia da conservação, análise de incerteza

## Abstract

The study of species distributions is essential for the effective design and execution of conservation actions. However, anthropogenic activity has drastically altered the range of most species. Therefore, their use in conservation is limited as many species currently present a fraction of their indigenous distribution. The historical and paleontological records are a window into a time when species distributions had not yet been tainted by human activity. In this work, a compilation of historical and fossil occurrences of lynxes in the Iberian Peninsula is presented. This database is used to model the distribution of the Eurasian lynx, one of two lynx species that historically occur in Iberia, to create a distribution baseline for the species. Furthermore, this work presents a multi-modelling framework that aims to quantify the uncertainty of its predictions, thus increasing their reliability. It is hypothesized that this lynx species will have a greater probability of occurrence in the Temperate Broadleaf & Mixed Forests biome. This hypothesis is explicitly tested by a binomial GLM that shows a significant positive association between lynx presence and this biome. The availability of prey is also hypothesized to increase the probability of occurrence of this species. Both hypotheses are supported by the variable importance in the distribution models. All species distribution modelling approaches (GLM, GAM, and MaxEnt) used show that the Eurasian lynx was found in the north and northwest of the Iberian Peninsula during the 19th century. When compared with previous European-wide studies, this work's best performing modelling approach (GAM) increased in 436 times the estimated suitable area for the Eurasian lynx in the Iberian Peninsula. This work establishes the first distribution baseline of the species at the Iberian level, and once again highlights the importance of historical and paleontological data for designing quantitative targets for conservation strategies.

**Keywords:** carnivores, historical ecology, species distribution modelling, conservation paleobiology, uncertainty analysis

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## List of Abreviattions

|          |                                                                     |
|----------|---------------------------------------------------------------------|
| aDNA     | Ancient DNA                                                         |
| AUC-PR   | Area under the precision-recall curve                               |
| AUC-ROC  | Area under the receiver operating characteristic curve              |
| $B_b$    | Continuous Boyce Index                                              |
| CHELSA   | Climatologies at High resolution for the Earth's Land Surface Areas |
| DNA      | Deoxyribonucleic acid                                               |
| EEA      | European Environment Agency                                         |
| GAM(s)   | Generalized additive model(s)                                       |
| GLM(s)   | Generalized linear model(s)                                         |
| popd     | Human population density                                            |
| HYDE     | History Database of the Global Environment                          |
| H1       | Hypothesis 1                                                        |
| H2       | Hypothesis 2                                                        |
| IUCN     | International Union for the Conservation of Nature                  |
| MaxEnt   | Maximum entropy                                                     |
| $\sigma$ | Population standard deviation of the model's predictions            |
| scd      | Snow covered days                                                   |
| SDM(s)   | Species distribution model(s)                                       |
| SE       | Standard error of the model                                         |
| TRI      | Terrain ruggedness index                                            |
| TraCE21k | Transient Climate Evolution of the last 21 000 years                |
| TPR      | True positive rate                                                  |
| TSS      | True skill statistic                                                |

# 1. Introduction

Knowledge of species distributions is essential for a better understanding of their ecology, evolution, and biogeography (Bridle & Hoffmann, 2022). This information is also vital for assessing the threat status of a species and planning conservation projects (International Union for the Conservation of Nature [IUCN], 2012). Humans, through land use change (e.g. conversion of forest to agricultural land; Silva et al., 2021), direct persecution (Burgess et al., 2017; Bleyhl et al., 2021), and competition for resources (Henschel et al., 2011; Darimont et al., 2015), have significantly altered many species' ranges (Pacifiçi et al., 2020). The range of some groups, such as apex predators (Wolf & Ripple, 2017), has reduced (Young et al., 2016), while other groups, such as invasive and adaptable species (Seebens et al., 2017), have increased their range (Pacifiçi et al., 2020). Thus, the current distribution of the species may not represent their indigenous ranges (*sensu* Akçakaya et al., 2018), but rather depleted and constricted ones (Sales et al., 2022). In this way, the usefulness of current distributions in establishing conservation recovery targets might be limited, since they provide short-sighted conservation recovery targets (Sales et al., 2022).

In this context, the use of historical, archaeological and fossil records together with evermore powerful species distribution modelling (SDM) tools can be used to create quantitative distribution baselines (hereafter historical baselines), while avoiding short-sighted baseline settings (Grace et al., 2019; Monsarrat et al., 2019; Clavero et al., 2022). The use of historical baselines is now recognized as pivotal for measuring conservation project success against data-driven recovery targets (Akçakaya et al., 2018; Grace et al., 2019). In fact, historical baselines can be used to deal with the shifting baseline syndrome (SBS; Monsarrat et al., 2019; Rodrigues et al., 2019). SBS is the gradual change of perception on what are “normal” conditions for a given environment, due to a lack of knowledge of its past conditions (Soga & Gaston, 2018). This phenomenon is now recognized as a problem in conservation biology (Papworth et al., 2009; Clavero, 2014; Ripple et al., 2024).

Due to their large spatial and ecological requirements (Noss et al., 1996), and consequently direct conflict with humans, large mammalian carnivores (Order Carnivora; henceforth carnivores) are globally threatened (Dalerum et al., 2009; Ripple et al., 2014; Wolf & Ripple, 2016). The threat level is not homogeneous at a global scale, with Southeast Asia and sub-Saharan Africa being the regions most at risk (Dalerum et al., 2009). This is partly explained by the fact that these are the areas that preserve the largest and most intact large carnivore guilds globally (Dalerum et al., 2009). In contrast, Europe, the Americas and Australasia have their large carnivore guilds severely depleted, a process that began in the late Pleistocene and continues today (Davoli et al., 2024; Fricke et al., 2022).

Although Europe globally may seem to provide a less grim case for the conservation of large carnivores, it is important to remember that the European continent is one of the most affected by human presence (Theobald et al., 2020). The anthropogenic impacts on the European carnivore community began in the late Pleistocene (Konidaris, 2022; Iannucci, 2024; Baumann et al., 2025), and continued throughout the historical period (Faurby & Svenning, 2015). Currently, the carnivore populations in Europe are recovering (Chapron et al., 2014). However, this recovery is not uniform, with some species recovering more than others and, within the same species, populations that are recovering and others that are declining. For instance, the grey wolf (*Canis lupus*) and the Eurasian lynx (*Lynx lynx*) show different demographic trends, both between them (i.e. increasing and stable, respectively; Boitani, 2018; von Arx, 2020), and between their own populations throughout Europe (Kaczensky et al., 2013a, 2013b, 2024). Regardless of the continent-wide recovery rates, most European large carnivores are classified by the IUCN as threatened in the Mediterranean region (i.e., brown bear *Ursus arctus*, Eurasian lynx, and the

Iberian lynx *Lynx pardinus*; Boitani et al., 2010; IUCN Mediterranean Biodiversity Assessment Team, 2010; Rodríguez, 2024).

The Eurasian lynx (hereafter lynx) is a typical forest-dependent species of carnivore (Family Felidae; Breitenmoser et al., 2000), whose distribution range extends across much of Europe and Asia (Breitenmoser et al., 2015). Throughout its range, the lynx preys primarily on ungulates, such as roe deer (*Capreolus* spp.), deer (*Cervus* spp.), goats or ibexes (*Capra* spp.) and Alpine chamois (*Rupicapra rupicapra*), as well as hares (*Lepus* spp.) (Khorozyan & Heurich, 2023; but see Krofel et al., 2011). However, the lynx sometimes preys on livestock (Mattisson et al., 2014; Odden et al., 2002, 2006; Stahl et al., 2002), which, combined with competition for wild game, puts it in direct and indirect conflict with humans (Andrén et al., 2006; Breitenmoser et al., 2000). Despite its geographic range being one of the largest of any terrestrial mammal species (IUCN, 2024), the lynx has had a significant contraction of its range (Breitenmoser, 1998; Wolf & Ripple, 2017). In Europe, the contraction of the lynx's distribution range has occurred mainly due to direct persecution by humans and land use change (i.e., deforestation; Breitenmoser, 1998).

Although a lynx population existed in the French Pyrenees during the 20th century (Breitenmoser & Breitenmoser-Würsten, 1990; Vandel & Stahl, 2005), the scientific consensus was, until recently, that the lynx had never inhabited the Iberian Peninsula (Breitenmoser, 1998). However, beginning in the 1980s, an accumulation of historical evidence (Clavero & Delibes, 2013; Jiménez et al., 2018; Nores, 1999; Nores & Vásquez, 1984; Urruela, 2021), and paleontological and archaeological evidence (e.g., Altuna, 1980) began to suggest that the Eurasian lynx may in fact have inhabited the Iberian Peninsula in historical periods. Rodríguez-Varela et al. (2015) analysed ancient DNA (aDNA) contained in a lynx skull found in Northern Spain that was dated to the 16th century. When sequencing of the aDNA showed that the skull belonged to a Eurasian lynx, this discussion ceased. Now, it is known that the biogeographical history of the Eurasian lynx in the Iberian Peninsula is ancient (Lucena-Perez et al., 2022) and that its historical occurrence has even affected the genetic diversity of the Iberian lynx (Lucena-Perez et al., 2024). Although there are some studies in Spain on the historical presence of the Eurasian lynx, there is no study that addresses this topic in Portugal (but see Álvares, 1997; Lopes-Fernandes, 2018).

In this work, an extensive set of historical and fossil records are compiled to create the largest and most comprehensive database on the historical presence of lynxes (*Lynx* spp.) in the Iberian Peninsula, by building on reviews of previous work, and adding new occurrences of lynx, most of which come from Portugal. This work aims to create a baseline distribution for the Eurasian lynx in the Iberian Peninsula. To achieve this objective, the historical distribution of the species in the Iberian Peninsula was modelled using several correlative modelling approaches. These SDMs were also used to understand which ecological drivers – anthropogenic impacts, biotic interactions, climate, and topography – were the most important in shaping the lynx's distribution in the Iberian Peninsula, and how did the lynx respond to these factors. It is hypothesized that the distribution of the lynx was associated with the Euro-Siberian region of the Iberian Peninsula (as suggested by Clavero and Delibes (2013) and Jiménez et al. (2018)) (H1). This is tested using a generalized linear model (GLM). If this hypothesis is supported, climate is predicted to be the most important factor for the lynx in the SDMs. The reasoning behind this prediction is that, although the lynx is a mammalian endotherm, the plant communities, which are hypothesized to be important to the species' distribution, are directly affected by the climate. Prey availability is also hypothesized to be an important factor in lynx distribution (H2), as it may be a limiting factor for this carnivore distribution (Wolf & Ripple, 2016). In short, this work uses the Eurasian lynx as a case study to show how the historical and paleontological records can be used to create quantitative distribution baselines through the modelling of the species' past distribution, which can then be used to define data-

driven conservation targets; all while using a novel framework which attempts to deal with the various uncertainty sources inherent both to past records and the modelling process.

## 2. Methods

### 2.1. Study Area

The study area encompasses all the Iberian Peninsula (including Andorra). According to Olson et al. (2001) and Dinerstein et al. (2017), the Iberian Peninsula can be divided in two biomes: *Temperate Broadleaf & Mixed Forests* and *Mediterranean Forests, Woodlands & Scrubs*. The *Temperate Broadleaf & Mixed Forests* biome is vast and extends throughout most of Europe, which, in the Iberian Peninsula, overlaps significantly with the area traditionally designated as the Eurosiberian phytogeographic region (Rivas-Martínez et al., 2017). In the Iberian Peninsula, this biome is further divided into two regions by the European Environment Agency [EEA] (2016): the Alpine region and the Atlantic region. The Alpine region is the smallest region (in area) and, in the Iberian Peninsula, only occurs in the Pyrenees (Sundseth, 2009a). This region is characterized by a cold and harsh climate, having a complex topography and high elevation (Sundseth, 2009a). In the Pyrenees, plant communities vary both with cardinal orientation and altitude. At low altitude, they are composed, on the northern slopes, of beech (*Fagus* spp.) and fir (*Abies alba*), and, on the southern slopes, by Scots pine (*Pinus sylvestris*), mountain pine (*Pinus mugo*), junipers (*Juniperus* spp.) and evergreen oaks (*Quercus* spp.) intertwined with Mediterranean scrub and Spanish broom (*Spartium junceum*) (Sundseth, 2009a). At high altitudes, vegetation diversity is lower, consisting mainly of dwarf willows (*Salix herbacea*) and alpenrose shrubs (*Rhododendron ferrugineum*) together with alpine heaths and grasslands (Sundseth, 2009a).

The Atlantic region occurs in the northwest of the Iberian Peninsula and is characterized by the oceanic climate, with mild winters, cool summers, and moderate rainfall throughout the year (Sundseth, 2009b). Despite being poor in biodiversity, the Atlantic region has the highest habitat diversity of any region in Europe (Sundseth, 2009b). Without human intervention, the forest habitat would be the most dominant in this region (Sundseth, 2009b). In the north and northwest of the Iberian Peninsula, despite centuries of severe deforestation, the forest habitat currently covers a significant area (Díaz-Maroto & Vila-Lameiro, 2008). The area occupied by forest can be divided into two classes: (1) native forest and (2) production forest. The native forest is mainly composed of broad-leaved species, which include deciduous and evergreen oaks (*Quercus* spp.), ash trees (*Fraxinus* spp.), but also maritime pine (*Pinus pinaster*); while the production forest is essentially composed of eucalyptus (*Eucalyptus* sp.) and pine (*Pinus* spp.) (Moreno et al., 1990; Díaz-Maroto & Vila-Lameiro, 2008).

In contrast, the *Mediterranean Forests, Woodlands & Scrubs* biome, which occurs in the rest of the Iberian Peninsula, is characterized by humid and cool winters, and hot dry summers (Sundseth, 2009c). This region has a very diverse landscape, which includes sclerophyll forests, dense scrub, agricultural landscapes and rocky outcrops (Sundseth, 2009c), being shaped by human presence for thousands of years (Joffre et al., 1999). The composition of forest areas is influenced by altitude, with the lowlands being dominated by several species of oak (*Quercus* spp.), while in elevated areas sweet chestnut (*Castanea sativa*) and conifers (i.e., *Abies pinsapo*, *Pinus* spp., *Juniperus* spp., and *Taxus baccata*) are more common (Sundseth, 2009c). In the Iberian Peninsula, over the last millennia, there were also large portions of land, that would otherwise be dominated by oak forests or woodlands, which were converted by human action into a sparse woodland-like agrosilvopastoral system called *montado* or *dehesa* (Joffre et al., 1999). The Mediterranean shrubland is highly diverse harbouring several species, such as rock-roses (*Cistus* spp.), lavender (*Lavandula* spp.), thyme (*Thymus* spp.), rosemary (*Salvia rosmarinus*), myrtle (*Myrtus communis*), lentisk (*Pistacia lentiscus*), laurel (*Laurus nobilis*), junipers (*Juniperus*

spp.), strawberry trees (*Arbutus unedo*), and wild olives (*Olea europaea* var. *sylvestris*) (Sundseth, 2009c).

Compared to other classifications (e.g., Rivas-Martínez et al., 2017), Olson et al. (2001)'s and Dinerstein et al. (2017)'s framework based on ecoregions (i.e. areas with similar characteristics in terms of natural communities, ecological dynamics, and environmental conditions; Olson & Dinerstein, 2002) and, consequently, biomes (i.e., global-scale vegetation units sharing similar structural and functional attributes; Higgins et al., 2016), has the advantage that the considered units are climatically more or less stable (Iwamura et al., 2010), allowing them to be used for comparisons in the recent past.

## 2.2. Species Occurrence Data

Data collection was done through the analysis of primary historical records and the review of work already carried out (Appendix 7.1.). The analysis of primary historical records consisted of carrying out word searches for the words “tigre” (tiger), “leopardo” (leopard), “onça” (jaguar), “lince” (lynx), “lobo” (wolf), “gato” (cat), and “cerval”, as well as their variations such as “serval” or “serbal” (for the full list, see Appendix 7.2.), which were all names used to describe lynxes (*Lynx* spp.). The primary historical records that were not available in digital format were scanned using the IRIScan™ Desk 5 A4 scanning device so that the word search could be carried out.

The use of written historical records has some disadvantages (Forman & Russell, 1983; Shelton & Weckerly, 2007), namely the high degrees of uncertainty in geographic location and, in some cases, in the species recognition (Boshoff & Kerley, 2010). To recognize the two lynx species, the criteria in Clavero and Delibes (2013) were followed (Figure 1). The authors suggest that, when available, physical and behavioural characteristics should be used to diagnose the species. However, when unavailable, these authors suggest that the common name could be used to indirectly diagnose the identity of the lynx species. In Northern Iberia, the most common names for lynx are “lobo cerval” (deer wolf) and “tigre” (tiger). On the other hand, in Southern Iberia, the most used name is “gato cerval” (deer cat), while the names “lobo cerval” and “tigre” were rarely used. According to the authors, this highlights a probable difference in size between lynxes from the North and South of the Iberian Peninsula, which can be used to indirectly differentiate the species in written records. Thus, names that suggest large-sized lynxes, such as “lobo”, “tigre”, “onça” or “leopardo”, are associated with the Eurasian lynx, while names that suggest smaller-sized lynxes, such as “gato”, are associated with the Iberian lynx (Figure 1).

The geographical locations of the historical records were extracted from Google Earth (<https://earth.google.com/web/>), having been approximated to the center of the referenced geographical location (e.g., the center of a village or town). When the date of observation was not explicit in the written record, the date of publication of the primary written historical record was used as a proxy (Appendix 7.3.).

Data on the presence of the two lynx species comes from historical records dating from the 15th century to the 20th century. Here, the 20th century is defined as the period from the beginning of the century until the 1980s, when sampling efforts and the study of the Iberian lynx became standardized (e.g., Rodríguez & Delibes, 1990). However, the 19th century is the best sampled century, in terms of geographical extent and number of records, by a large margin (see Appendix 7.4.). Therefore, to minimize the uncertainty associated with the modelling process, only data from the 19th century was used to model the Eurasian lynx range.

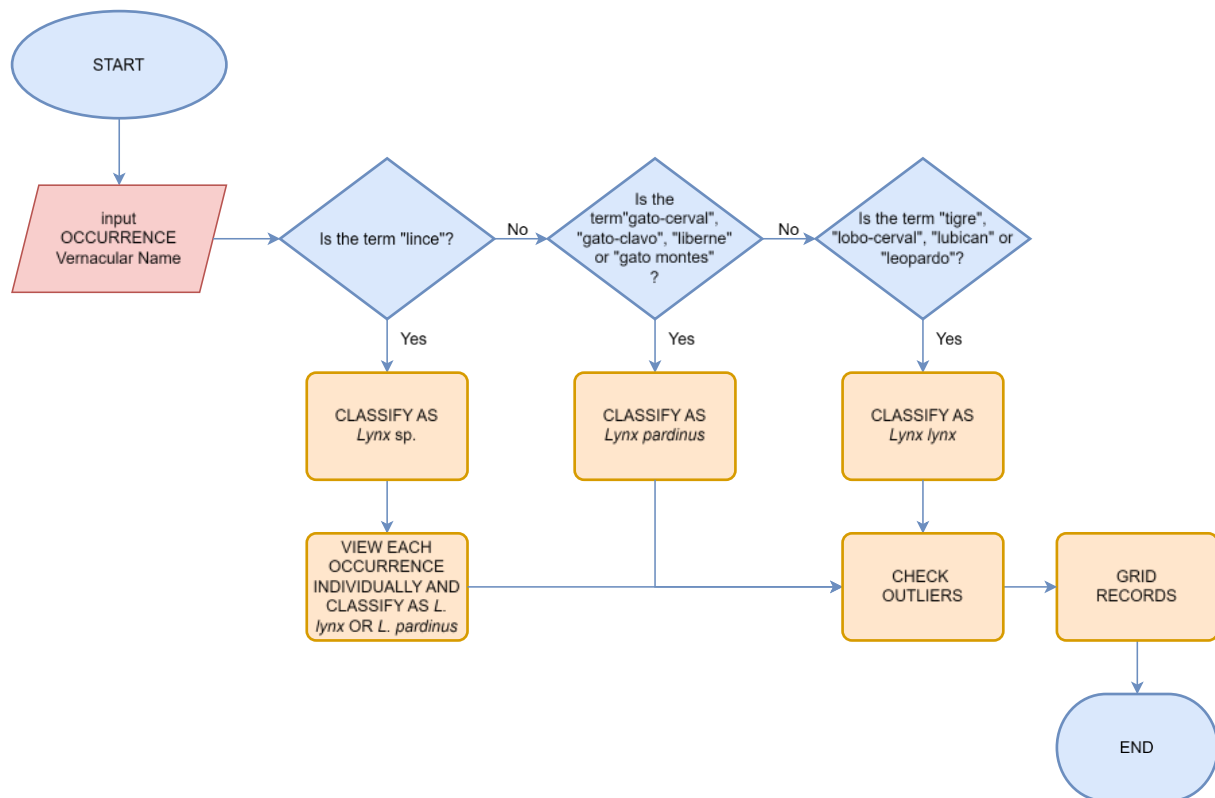


Figure 1 – Flowchart of species recognition based on common names for lynx (*Lynx spp.*) in the Iberian Peninsula.

Presence points were gridded to align with the EEA (2011)’s 10 km grid using the FUZZYSIM package (Barbosa, 2015). Gridding the presence records has three advantages: (1) it allows the points to fit the European Mammal Atlas format, which makes these models output comparable with many of the previous European-wide lynx models (e.g., Oeser et al., 2023); (2) it restricts data to one point per cell/pixel, which, by acting as a geographic filter, hampers the effect of sampling bias (Boria et al., 2014); and (3) it partially removes the effect of geographical uncertainty inherent to historical data (Clavero, García-Reyes, et al., 2023).

Identifying true absences in spatial ecology is difficult (Lobo et al., 2010). The type of record or the sampling methodology might affect the reliability of an absence. For example, citizen science data can be considered an unreliable source of data and as such its presences as well as absences must be analysed carefully (Bonney et al., 2014; Kelling et al., 2015; Balázs et al., 2021). Historical records can be considered citizen science (e.g., geographical dictionaries; Clavero & Revilla, 2014) and thus the reliability of its absences is also put into question, as an absence in the data set can be linked to real absences, but also to a misidentification of the target species, and to insufficient and/or geographically biased sampling. Another factor that might affect the reliability of an absence is the characteristics of the target species (Hirzel et al., 2001). Secretive species can occur in a location without being detected and be considered absent in that location (Martínez-Minaya et al., 2018). The target species of this study, the lynx, is a highly secretive species and may not be detected even when in the close proximity of observers (Zimmermann & Breitenmoser, 2007). Because of the unreliability associated with absences, some ecological modelers currently use pseudo-absences instead (Lobo et al., 2010). Following Barbet-Massin et al. (2012)’s protocol, five sets of 1000 pseudo-absences were randomly generated using the BIOMOD2 package (Thuiller et al., 2024). This seems to be the best design to generate pseudo-absences for generalized additive models (GAMs), while also being suitable for GLMs (Barbet-Massin et al., 2012; Senay et al., 2013).

### 2.3. Predictor Variables Selection

As a general rule, predictor variables should be selected based on prior knowledge about the target species (Beale & Lennon, 2012; Elith & Leathwick, 2009). Information on ecologically significant variables for the distribution of the lynx was collected through a bibliographical review in which a greater focus was placed on past work where the distribution of the species was modelled (Appendix 7.5.). This review showed that multiple factors, such as topography, anthropogenic disturbance, biotic interactions (such as interspecific competition or food availability), and the availability of suitable habitat are important drivers of lynx's distribution. Climatic factors, such as precipitation or temperature, were also sometimes used to model the distribution of the species. The latter were mostly used in works that aim to model the distribution of the species in the future (Mahdavi et al., 2020; Serva et al., 2023). However, excluding snow depth/snow cover, only few direct ecological links were detected between climate and lynx distribution (but see Podolski et al., 2013).

The study of the ecological factors that shape the distribution of the lynx began at the end of the 20th century, when the lynx was already extinct from a significant portion of its historical range (Breitenmoser & Breitenmoser-Würsten, 1990). In this context, the factors that are currently known to affect the distribution of the lynx are not necessarily the same as those that influenced it in the past. Additionally, there are factors that are known to be as relevant today as they were in the past to the distribution of the species (i.e., land uses), but whose information is currently not available for modelling. For these reasons, the variables used to model species' distribution were the subset of variables extracted from the literature review that were available and made ecological sense for the model timeframe (Table 1; Appendix 7.5.), which were restricted to four main types: topography, climate, biotic interactions (i.e. prey distribution), and anthropogenic disturbance.

The topographic variables used are the elevation, the terrain ruggedness index (TRI), the northness, and the slope. Elevation and terrain ruggedness are the most used topographic variables in modelling lynx distribution (Appendix 7.5.). The ruggedness of the terrain has a special influence on the distribution of the species as it is important at several scales. For example, ruggedness is a good proxy for rocks that are positively selected at the microhabitat level by the lynx (Signer et al., 2019; Čonč et al., 2023, 2024), and it is also a good proxy for steep terrain that the lynx selects for resting (Hočevár et al., 2021; Čonč et al., 2022). The aspect is a variable that is regularly used to model the lynx, being obtained through the elevation (Appendix 7.5.). Northness is a variable obtained through the cosine of the aspect, but it is preferable for modelling since, unlike aspect, this variable varies between -1 and 1 (Sillero et al., 2021). These variables can be used as proxy for productivity (Kalle et al., 2013) and, therefore, indirectly as proxy for prey availability (Herfindal et al., 2005; Ripari et al., 2022). The slope is another variable which can represent relief complexity. As with other carnivores (Morrell et al., 2021; but see Nisi et al., 2022), the lynx actively chooses steep terrain as these areas are less frequently used by humans (Sunde et al., 1998). These areas are also good proxies for resting sites for the species (Serva et al., 2023). Thus, the slope of the terrain might represent an important ecological driver for the distribution of the species. All the topographic variables were retrieved from the CHELSA-TraCE21k database (Karger et al., 2023).

Unlike most large European carnivores, the Eurasian lynx has a high habitat specificity, being considered a typically forest species (Breitenmoser et al., 2000). Since there is no land use data with adequate resolution currently available for the Iberian Peninsula in the 19th century, the standard bioclimatic variables (bio01-bio19) were used as a proxy for habitat variation (for similar case with remote sensing variables, see Oeser et al., 2020). In other words, since the distribution of plant communities is fundamentally influenced by climate and soil type (Woodward & Williams, 1987), these variables serve

here as a surrogate for forest presence and class, which are ecologically relevant for the lynx (Schadt et al., 2002). The snow cover days (scd) is used as a proxy for snow depth which has been shown to be positively correlated with lynx hunting success (Nilsen et al., 2009). All the climatic variables (including the snow-related variables) were retrieved from the CHELSA-TraCE21k database (Karger et al., 2023).

While biotic interactions are regarded as important factors shaping species' distribution (De Araújo et al., 2014; Cosentino et al., 2023; Lucas et al., 2023), their inclusion in SDMs is still challenging (see Dormann et al., 2018). This is because the distributions of two interacting species are not always independent (Anderson, 2017). However, despite introducing a new source of uncertainty into the models, the inclusion of these interactions in correlative SDMs has been shown to improve model predictions (Wisz et al., 2013; De Araújo et al., 2014; Cosentino et al., 2023). Thus, the probability of presence of the lynx's potential prey (roe deer *Capreolus capreolus*, red deer *Cervus elaphus*, and Iberian ibex *Capra pyrenaica*; see Khorozyan & Heurich, 2023) is used as a proxy for the prey availability. The historical presences of Eurasian lynx's potential prey were modelled using generalized additive models (GAMs; Wood, 2017) to obtain a continuous layer of probability of presence (Appendix 7.6.).

In the 19th century, anthropogenic disturbances probably had a significant impact on the distribution of the lynx and should therefore be accounted for in the model (see Feng et al., 2024). During this period, direct persecution by humans and habitat loss, due to changes in land use, were the most important forms of anthropogenic disturbances (Breitenmoser, 1998). Although there is currently no land use information available with adequate resolution for this model, human population density (popd), a proxy for direct persecution by humans (Woodroffe, 2000), can be incorporated in the models, as information with adequate resolution is available. The population density was retrieved from the HYDE 3.2 database (Klein Goldewijk et al., 2017), which sourced it from the national censuses of Portugal and Spain.

The collinearity between the candidate variables was tested using the FUZZYSIM package (Barbosa, 2015) and the PERFORMANCEANALYTICS package (Peterson & Carl, 2020) (for further information, see Appendix 7.7.). Variables that presented a Pearson's correlation greater than 0.7 were excluded from the final group of variables used in the models (Table 1; Sillero et al., 2021).

All variables were gridded and resampled so that the pixels overlap with the EEA (2011)'s grid. All processing of environmental and anthropogenic variables was carried out in the R software (R Core Team, 2022) through the TERRA package (Hijmans, 2024) and the SF package (Pebesma, 2018), and in the QGIS software (QGIS Development Team, 2023).

Table 1 – List of candidate variables for modelling the lynx's distribution (including which ones were included in the final model).

| Variable Type                    | Variable                                 | Code  | Included | Source                               |
|----------------------------------|------------------------------------------|-------|----------|--------------------------------------|
| <b>Anthropogenic Disturbance</b> | Human population density                 | popd  | Yes      | Klein Goldewijk et al. (2017)        |
| <b>Biotic Interactions</b>       | Roe deer Presence                        | roe   | Yes      | In this work                         |
|                                  | Red deer Presence                        | deer  | Yes      | In this work                         |
|                                  | Iberian ibex Presence                    | ibex  | Yes      | In this work                         |
| <b>Climate</b>                   | Annual mean temperature                  | bio01 | Yes      | Karger et al. (2023)                 |
|                                  | Mean diurnal range                       | bio02 | No       | Karger et al. (2023)                 |
|                                  | Isothermality                            | bio03 | Yes      | Karger et al. (2023)                 |
|                                  | Temperature seasonality                  | bio04 | Yes      | Karger et al. (2023)                 |
|                                  | Maximum temperature of the warmest month | bio05 | No       | Karger et al. (2023)                 |
|                                  | Minimum temperature of the coldest month | bio06 | No       | Karger et al. (2023)                 |
|                                  | Temperature annual range                 | bio07 | No       | Karger et al. (2023)                 |
|                                  | Mean temperature of the wettest quarter  | bio08 | Yes      | Karger et al. (2023)                 |
|                                  | Mean temperature of the driest quarter   | bio09 | No       | Karger et al. (2023)                 |
|                                  | Mean temperature of the warmest quarter  | bio10 | No       | Karger et al. (2023)                 |
|                                  | Mean temperature of the coldest quarter  | bio11 | No       | Karger et al. (2023)                 |
|                                  | Annual precipitation                     | bio12 | Yes      | Karger et al. (2023)                 |
|                                  | Precipitation of the wettest month       | bio13 | No       | Karger et al. (2023)                 |
|                                  | Precipitation of the driest month        | bio14 | Yes      | Karger et al. (2023)                 |
|                                  | Precipitation seasonality                | bio15 | Yes      | Karger et al. (2023)                 |
|                                  | Precipitation of the wettest quarter     | bio16 | No       | Karger et al. (2023)                 |
|                                  | Precipitation of the driest quarter      | bio17 | No       | Karger et al. (2023)                 |
|                                  | Precipitation of the warmest quarter     | bio18 | No       | Karger et al. (2023)                 |
|                                  | Precipitation of the coldest quarter     | bio19 | No       | Karger et al. (2023)                 |
|                                  | Snow cover days                          | scd   | Yes      | Karger et al. (2023)                 |
| <b>Topography</b>                | Elevation                                | dem   | No       | Karger et al. (2023)                 |
|                                  | Terrain ruggedness index                 | tri   | Yes      | In this work, based on the elevation |
|                                  | Northness                                | north | Yes      | In this work, based on the elevation |
|                                  | Slope                                    | slope | No       | In this work, based on the elevation |

## 2.4. Species Distribution Modelling

Three different algorithms were used to model the lynx distribution: (1) generalized linear models (GLMs), (2) generalized additive models (GAMs), and (3) maximum entropy (MaxEnt). These three algorithms were used to provide (1) semi-independent ways of modelling species distribution, (2) a scale of interpretability within the universe of correlative models (GLM > GAM > MaxEnt), and (3) a scale of predictive power within the universe of correlative models (MaxEnt > GAM > GLM) (Aguirre-Gutiérrez et al., 2013; Meynard & Quinn, 2007; Seo et al., 2008).

GLMs and GAMs are some of the most used regression-based models to perform SDMs (Guisan et al., 2002). The GLM used the binomial distribution and a “logit” link function to model the probability of presence. In the GLMs, the variable importance was evaluated in two ways: absolute z-value method and shuffle root mean square error (RMSE). The first method measures the magnitude of the absolute z-value test statistic and was calculated with the MODEVA package (Barbosa et al., 2013). In the second method, the RMSE, a permutation method that measures loss of function, is computed 10 times for

model predictions after randomizing a predictor variable and subtracting the RMSE for the non-randomized data. The variable importance is estimated by this difference and was obtained using the PREDICTS package (Hijmans, 2023). The GLM response curves were generated using the PLOTMO package (Milborrow, 2024). As in the case of GLMs, GAMs used the binomial distribution and a “logit” link function to model the probability of presence. The smoothing parameter estimation was obtained using the restricted maximum likelihood (REML) method and additional penalties for the null spaces of all smooths in the current model were allowed (select = TRUE). In GAMs, the variable importance was assessed via a *leave-one-out* jackknife test. This procedure shows which variables contribute most to explaining the model’s deviance. The response curves were analysed using partial effects plots. The GAMs, as well as the partial effects plots, were generated using the MGCV package (Wood, 2017).

For regression models (e.g., GLMs or GAMs), Barbet-Massin et al. (2012) suggests the use of equal weights. However, although in the GLM case the use of equal weights improves predictive power, the estimation of uncertainty metrics such as standard error is unfeasible (see Appendix 7.8.). In the case of the GAM, the situation is even worse as not only the estimation of uncertainty metrics becomes unfeasible, but the predictive capacity of the model is also reduced (see Appendix 7.8.). For these reasons, equal weights were not used in the GLMs and GAMs. For each of the regression models, five replicates were carried out (Barbet-Massin et al., 2012). On each replicate, 5-fold cross-validation (80:20 data split) was performed to assess the predictive performance of the model to unused data.

Maximum entropy (MaxEnt; Phillips et al., 2006) is an algorithm that is commonly used in presence-only datasets, as it has been shown to perform well with few occurrence records (Merow et al., 2013). In this algorithm, 10 replicates were generated for each of the 5-folds used in cross-validation (80:20 data split); and, except for the output format (logistic), the default settings were used (Appendix 7.9.). Firstly, the model’s average permutation importance percentage was used to understand which variables were the most important in the model’s final output. Secondly, a *leave-one-out* jackknife test was carried out to understand which of the variables contributed most to the model’s gain. The use of two metrics that calculate variable importance in different ways allows the intrinsic biases of these different methods to be evaluated and discussed. Furthermore, if there is consensus between the results of the different metrics, the results are supported in semi-independent ways. The MaxEnt model, as well as the response curves, the permutation importance calculation, and the jackknife test, were generated and obtained through the DISMO package (Hijmans et al., 2023).

The consensus between the different models’ predictions was tested based on the Pearson’s correlation between them. If the correlation value is greater than 0.7, it is assumed that there is consensus between the models.

## 2.5. Model Evaluation

The models produced using the three algorithms were evaluated based on six discrimination metrics and one calibration metric. The discrimination metrics used were: (1) sensitivity; (2) specificity; (3) correct classification rate (CCR); (4) the true skill statistic (TSS); (5) the area under the curve of the receiver operating characteristic (AUC-ROC); and (6) the area under the precision-recall curve (AUC-PR). The sensitivity (or recall) is the true positive rate (TPR) and represents the amount of correctly identified presences by the model, given a specific threshold (Jiménez-Valverde, 2012). The higher the value of this metric, the lower the probability of a presence not being identified (omission error). The specificity is the true negative rate and represents the amount of correctly identified absences by the model, given a specific threshold (Jiménez-Valverde, 2012). The higher the value of this metric, the lower the probability of an absence not being identified (commission error). The CCR (or overall accuracy)

represents the number of pixels/cells correctly identified by the model as absences and/or presences, given a specific threshold (Allouche et al., 2006). The TSS is equal to the sensitivity plus the specificity minus 1 (Allouche et al., 2006). The TSS represents the capacity of the model to discriminate true presences and true absences given a specific threshold by balancing the sensitivity and the specificity. The AUC-ROC represents the trade-off between sensitivity and the commission error at any given threshold value (Jiménez-Valverde, 2012). This metric evaluates the overall performance of the model to accurately classify presences and absences. The AUC-ROC values vary between 0 and 1, where 0.5 represents a model with a performance equal to chance and 1 representing perfect performance. Models with AUC-ROC values higher than 0.7 are regarded as good (Muscatello et al., 2021). The AUC-PR represents the trade-off between precision (i.e., rate of presences correctly identified among the presences predicted at a given threshold) and sensitivity at any given threshold (Sofaer et al., 2019). This metric evaluates the overall performance of a model to correctly predict presences. AUC-PR values vary between 0 and 1, with 1 representing a perfect model. However, in contrast to AUC-ROC, the value that represents a random model is the positive outcome ratio (i.e., the proportion of presences) in the evaluation dataset. In cases like this study, where the dataset is unbalanced, the use of AUC-PR is recommended (Sillero et al., 2021).

The calibration metric used was the continuous Boyce Index ( $B_b$ ). The Boyce Index assesses the consistency between the predicted number of presences and the number of presences available in the evaluation dataset (Boyce et al., 2002; Hirzel et al., 2006). In this index, 0 represents a random model while positive values show consistency between predicted and expected presences (Boyce et al., 2002; Hirzel et al., 2006). In addition to these metrics, GLMs and GAMs were also evaluated based on the percentage of deviance explained and the adjusted  $R^2$ , which are also calibration metrics. The percentage of deviance explained is the proportion of the null model's error explained by the model (Zuur et al., 2007).  $R^2$  is a calibration metric representing how close to a perfect fit the model is (Zuur et al., 2007). However, with the increase of the number of predictive variables, the  $R^2$  is susceptible producing high values derived from model overfitting. Therefore, the use of the adjusted  $R^2$  is advised (Zuur et al., 2007). The latter adjusts the  $R^2$  value for the number of model predictor variables which makes it less susceptible to increases indiscriminately due to model overfitting. The percentage of deviance explained and the adjusted  $R^2$  were calculated with the formulas provided in Guisan and Zimmermann (2000). All the other performance metrics were calculated using the MODEVA package (Barbosa et al., 2013).

The best performing model's predictions were thresholded into four categories: (1) conservative, (2) intermediate, (3) inclusive, and (4) absent. The conservative category is obtained by thresholding the predicted output by the highest TSS, which achieves a good balance between high sensitivity and high specificity. The intermediate and the inclusive categories are obtained by thresholding the predicted output by a sensitivity of 0.8 and 0.7, respectively. This is done because presences are more reliable than absences and therefore correctly predicting presences is more important (Clavero, García-Reyes, et al., 2023). The absent category represents the values which are outside the thresholds provided above. This thresholding process was performed so that the model outputs can be easily used by conservationists, stakeholders, and politicians to outline conservation projects (Elith et al., 2002).

## 2.6. Uncertainty Analysis

Uncertainty estimation is increasingly recognized as an important factor in SDMs despite being rarely integrated or discussed in the modelling process (Beale & Lennon, 2012; Guisan et al., 2013). The greater the number of sources of uncertainty, the more important it is to discuss and quantify it (Elith et al., 2002). This is particularly important when modelling species distributions based on historical records because in addition to the usual uncertainty sources, such as climatic layers (Elith et al., 2002), historical

records have greater geographic and species recognition uncertainty (Clavero et al., 2022), which might be carried to the models' outputs. In this work, the uncertainty will be analysed quantitatively by mapping the average standard error of the regression models and mapping the population standard deviation of the output of each run of the different algorithms.

## **2.7. Biome effect on lynx presence**

The initial hypothesis - the lynx is highly associated with the Atlantic/Eurosiberian region of the Iberian Peninsula - was tested using a binomial GLM that modelled the probability of presence/suitability predicted by the SDMs as a function of the biomes as defined by Dinerstein et al. (2017).

## **3. Results**

### **3.1. Lynx Occurrence Data**

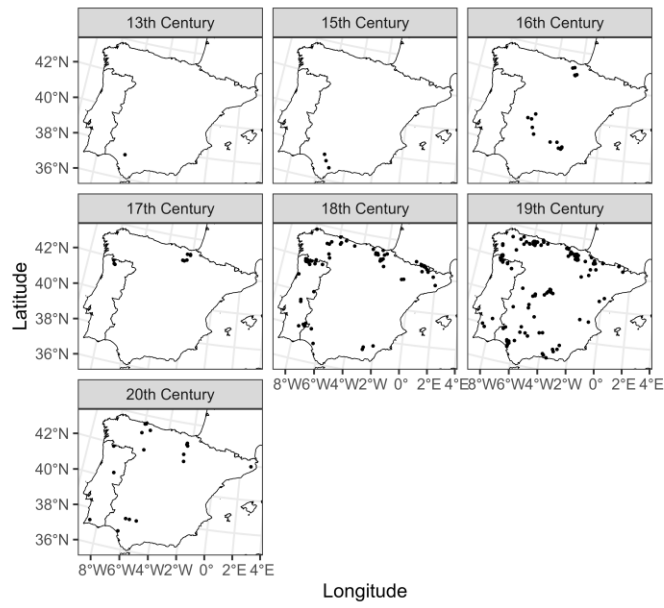
Through the review of previous works and new historical records, 324 lynx occurrences were compiled (Figure 2a). During the processing and reviewing process (see Methods), some occurrences (e.g. the 13th century occurrences) were excluded (e.g., due to unreliability of the source). After processing and reviewing these lynx occurrences, a database was formed with 314 lynx occurrences dating from the 15th to the 20th century (Figure 2b). Of these occurrences, 31.53% were recognized as Iberian lynx and 63.69% were recognized as Eurasian lynx. The 19th century, the only century used to produce the models, represents 54.8% of the total data and 30.5% of the observations identified as Eurasian lynx, which after gridding the records, corresponds to 61 presences (Figure 2c).

### **3.2. Eurasian lynx's Historical Distribution**

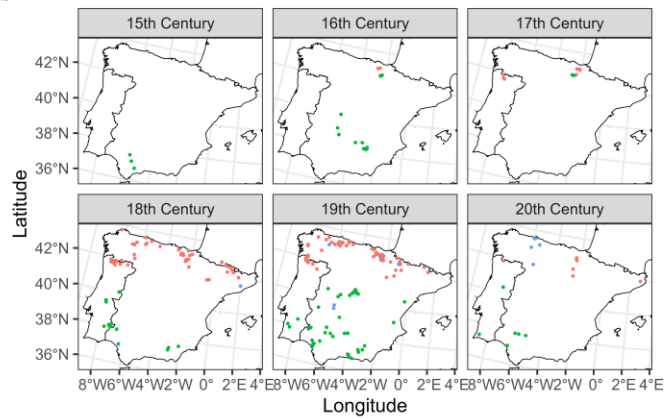
The distribution pattern obtained through the GLM indicates a greater probability of lynx presence in the north and non-coastal northwest of the Iberian Peninsula (Figure 3a). The two metrics used to determine variable importance showed similar results (Appendix 7.9.). In both metrics (absolute z-value and RMSE), the three most important variables shaping the lynx's distribution were precipitation seasonality, isothermality, and annual precipitation; however, these last two presented different importance in the two metrics. Precipitation seasonality had a negative effect on the probability of lynx presence, while isothermality and annual precipitation had positive effects on the probability of lynx presence. The presence of roe deer and precipitation in the driest month were also important for the absolute z-value and for the RMSE, respectively. The presence of roe deer had a positive effect on the distribution of lynx. In contrast, the precipitation of the driest month had a negative effect on the species' distribution.

The distribution obtained through the GAM also indicates a greater probability of lynx presence in the north and non-coastal northwest of the Iberian Peninsula (Figure 3b and Figure 4), corroborating GLM results. All five folds from each of the five replicates reached full convergence, which indicates that the models are reliable (see Appendix 7.9.). However, the variables showed high concurvity (average overall worst case concurvity  $\approx 0.9124$ ), so the output should be interpreted cautiously. The variables with the highest importance were (1) the precipitation in the driest month, (2) the annual precipitation, and (3) the presence of roe deer. The probability of lynx presence had unimodal, albeit truncated, response to the precipitation in the driest month (see Appendix 7.9.). The probability of lynx presence increased (monotonically) with both an increase in the annual precipitation and an increase in the presence of roe deer (Appendix 7.9.).

a



b



c

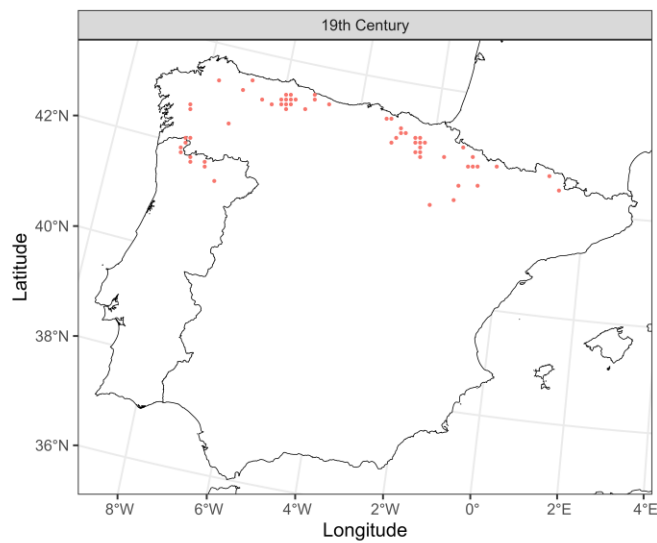


Figure 2 – Lynx occurrences. (a) Lynx spp. occurrences before processing. (b) lynx occurrences after processing and reviewing the observations and splitting the dataset into Eurasian lynx, Iberian lynx and Lynx sp.. (c) 19th century gridded observations of Eurasian lynx.

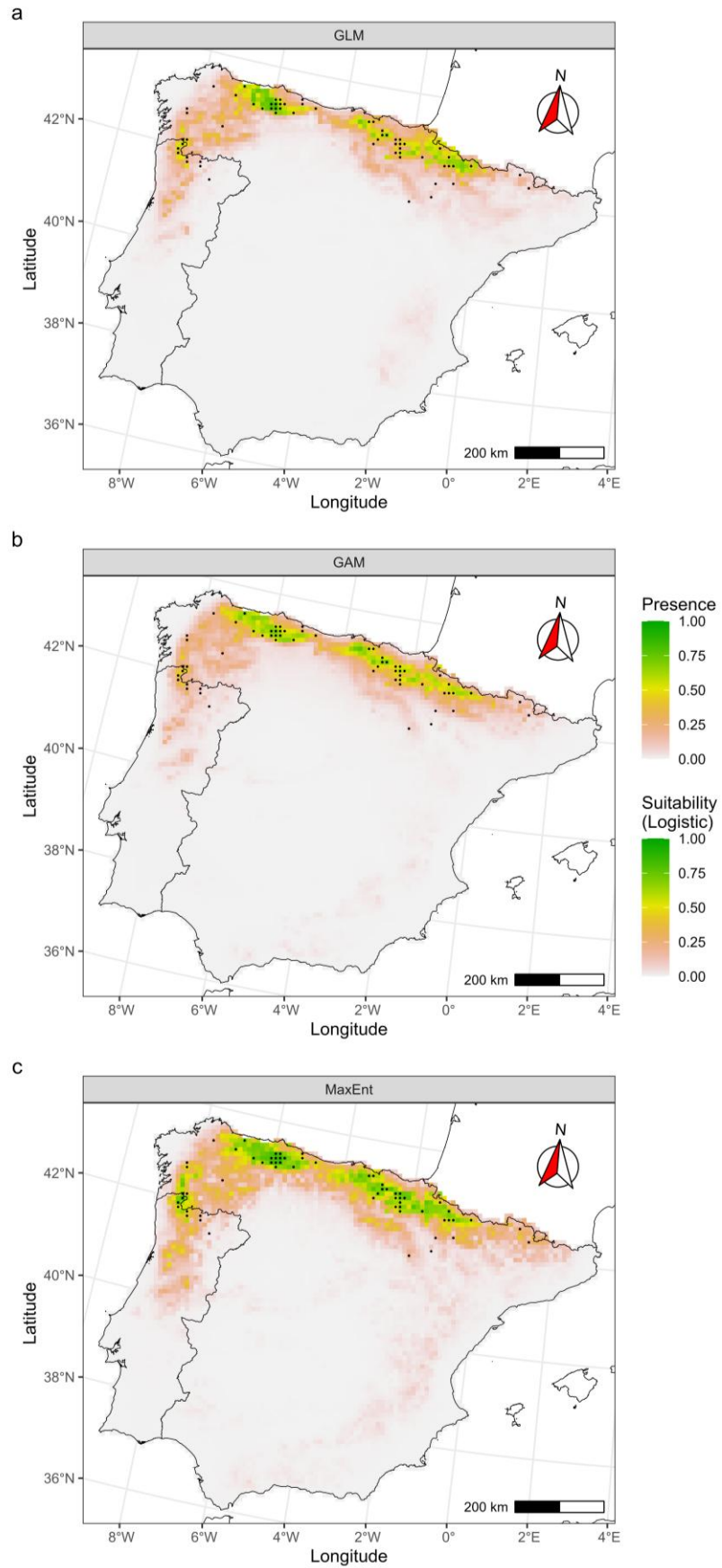


Figure 3 – Eurasian lynx Historical Distribution according to the different modelling approaches. (a) GLM's probability of presence. (b) GAM's probability of presence. (c) MaxEnt's Suitability (logistic). The dots represent (gridded) points of Eurasian lynx presence.

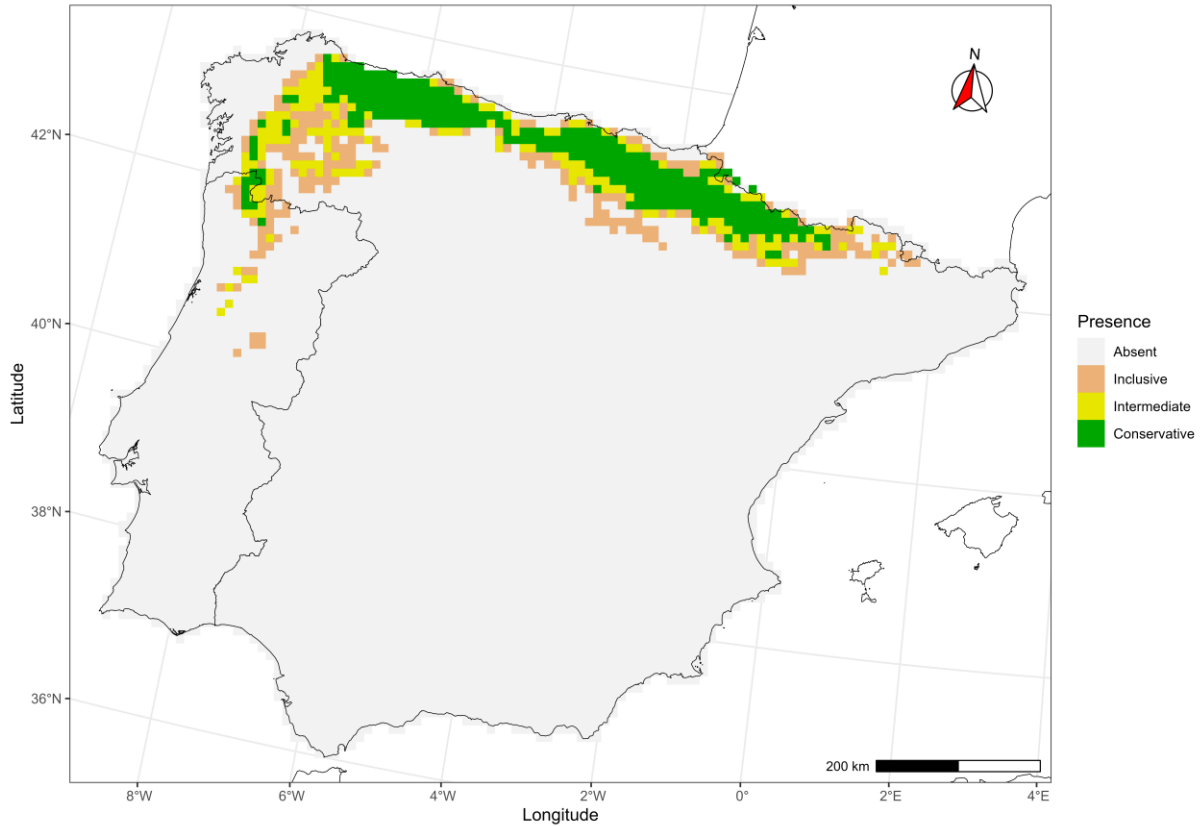


Figure 4 – Thresholded output of the best performing modelling approach for predicting the lynx's distribution within the Iberian Peninsula (GAM) in the 19th century. Conservative estimates suggest that the lynx would have been present 28 800 km<sup>2</sup> of the Iberian Peninsula; intermediate estimates suggest that the lynx would have been present in 46 100 km<sup>2</sup> of the Iberian Peninsula; and inclusive estimates suggest that the lynx would have been present in 68 200 km<sup>2</sup> of the Iberian Peninsula.

The distribution estimates obtained through MaxEnt, again, indicates a greater probability of lynx presence in the north and non-coastal northwest of the Iberian Peninsula (Figure 3c). In both metrics (permutation importance and jackknife test), the most important variable was the precipitation in the driest month (permutation importance  $\approx 30.40\%$ ) (Appendix 7.9.). The lynx presence had an unimodal, albeit not smooth, response to the increase in the precipitation in the driest month. The isothermality and the presence of ibex were also relevant in terms of permutation importance (29.49% and 10.72%, respectively). The lynx presence increased with an increase in isothermality and the presence of ibex. The annual precipitation and the presence of roe deer were relevant factors according to the jackknife test. The probability of lynx presence increased (monotonically) with an increase in the annual precipitation and the presence of roe deer.

### 3.3. Model approach performance and comparison of model outputs

In both the training set and the testing set, the overall best performing model was the one obtained through the GAM approach (Table 2). However, in the training set, the MaxEnt approach outperformed the GAM approach in both sensitivity ( $TPR_{MaxEnt} = 0.967$  and  $TPR_{GAM} = 0.960$ ) and in the Boyce Index ( $B_{bMaxEnt} \approx 0.928$  and  $B_{bGAM} \approx 0.863$ ). While in the testing set GLM outperformed the sensitivity of both the GAM and the MaxEnt models ( $TPR_{GLM} \approx 0.923$ ,  $TPR_{GAM} \approx 0.916$ , and  $TPR_{MaxEnt} \approx 0.903$ ); and the MaxEnt approach outperformed the GAM in the Boyce Index ( $B_{bMaxEnt} \approx 0.659$  and  $B_{bGAM} = 0.610$ ). The model outputs reached an overall consensus with the Pearson's correlation showing a minimum correlation between the model outputs higher than 0.8 (see Appendix 7.9.).

Table 2 – Average performance metrics for all modelling approaches of both training and testing datasets.

| Method        | Set   | Sensitivity | Specificity | C C R   | T S S   | AUC-ROC | AUC-PR  | $B_b$   | DevExp (%) | $R^2$ (adj.) |
|---------------|-------|-------------|-------------|---------|---------|---------|---------|---------|------------|--------------|
| <b>G L M</b>  | train | 0.94415     | 0.83115     | 0.83766 | 0.77510 | 0.94945 | 0.53502 | 0.84828 | 46.54351   | 0.45712      |
|               | test  | 0.92256     | 0.82820     | 0.83353 | 0.75076 | 0.93487 | 0.45078 | 0.61230 | NA         |              |
| <b>G A M</b>  | train | 0.96065     | 0.85870     | 0.86457 | 0.81935 | 0.96077 | 0.58803 | 0.86275 | 51.33933   | 0.50584      |
|               | test  | 0.91564     | 0.85440     | 0.85786 | 0.77004 | 0.93780 | 0.47411 | 0.61028 | NA         |              |
| <b>MaxEnt</b> | train | 0.96726     | 0.83979     | 0.84106 | 0.80706 | 0.95967 | 0.24238 | 0.92786 | NA         |              |
|               | test  | 0.90256     | 0.83704     | 0.83768 | 0.73960 | 0.93385 | 0.11937 | 0.65858 | NA         |              |

### 3.4. Uncertainty Analysis

The average standard error of the regression models was higher in the Pyrenees Mountains, in Serra da Estrela, and in densely populated regions in coastal northern Spain such as the cities of Gijón and Bilbao (Figure 5a and 5b, in the left panels). The standard deviation of the model predictions showed a similar pattern (Figure 5). However, in contrast with the standard error, the standard deviation in Serra da Estrela was not so pronounced. On average, the standard error was higher in the GLM ( $SE_{GLM} \approx 0.025$ ) than in the GAM ( $SE_{GAM} \approx 0.023$ ), and the standard deviation was higher in MaxEnt ( $\sigma_{MaxEnt} \approx 0.018$ ) than in the other models ( $\sigma_{GLM} \approx 0.011$  and  $\sigma_{GAM} \approx 0.014$ ).

### 3.5. Biome effect on lynx presence

The GLM showed that the probability of lynx presence/suitability was significantly higher in the Atlantic/Eurosiberian region of the Iberian Peninsula (Dinerstein et al. (2017)’s *Temperate Broadleaf & Mixed Forests* biome) (p-value < 0.001; see Appendix 7.10.).

## 4. Discussion

### 4.1. Lynx Historical Data

This work represents a significant increase in historical knowledge of the distribution of lynxes in the Iberian Peninsula. At the Portuguese level, this is a pioneering work and adds 59 lynx occurrences to the Iberian dataset of historical occurrences of the species. At the Spanish level, the review of previous works and new primary historical sources allowed, on the one hand, to find new lynx occurrences and, on the other hand, to exclude some occurrences that were mentioned in previous studies, but that upon reviewing the original sources, could not be detected. At this country’s level, it is difficult to compare the number of historical occurrences found in this work with that found in previous works for two reasons. First, some of the previous works eliminated (possible) duplicate occurrences (e.g., Clavero & Delibes, 2013). In this work, this process of eliminating duplicate occurrences did not occur, because during the gridding process all occurrences within a pixel are considered as just one occurrence (see Methods). Therefore, the elimination of duplicate occurrences would be redundant. Secondly, the occurrences found in some works (e.g., Urruela, 2021) could not be included in the final dataset (Appendix 7.3.). These works were excluded because, in their data compilations (which were not always available), they did not include characteristics that could be used to recognize the species (i.e., physical or behavioural characteristics, or common names of the specimens seen or captured).

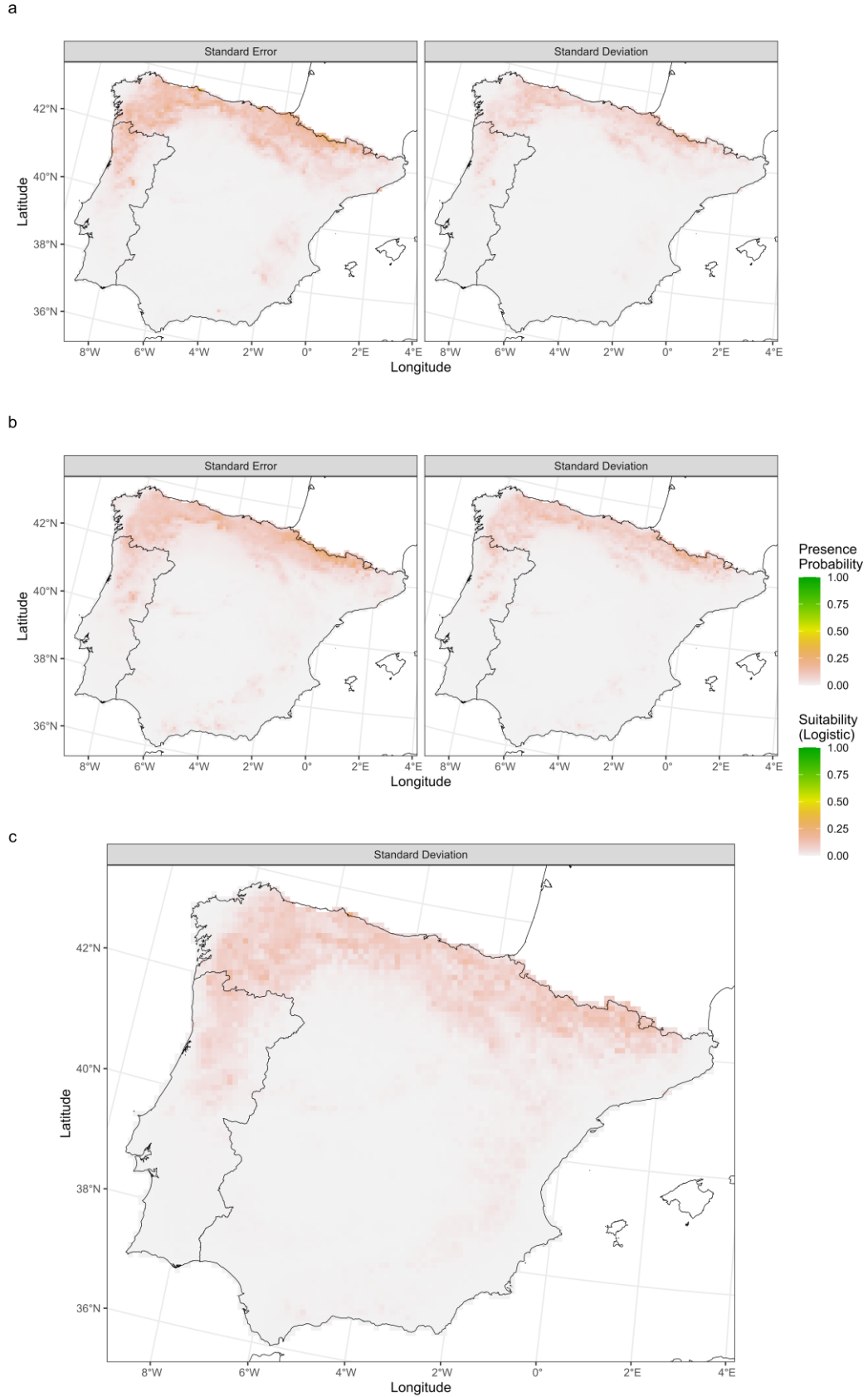


Figure 5 – Mapping the uncertainty of the models and their predictions. (a) Uncertainty in the GLM approach. The left panel contains the average standard error of the model, while the right panel contains the standard deviation of the model predictions (i.e., the standard deviation of the 25 runs of the model). (b) Uncertainty in the GAM approach. The left panel contains the average standard error of the model, while the right panel contains the standard deviation of the model predictions (i.e., the standard deviation of the 25 runs of the model). (c) Uncertainty of the MaxEnt approach. The uncertainty was calculated by doing the standard deviation of the model predictions.

## 4.2. Lynx Historical Distribution

The first hypothesis (H1) of this work was supported by the GLM used to test it explicitly as well as by the importance that climate revealed to have in all modelling approaches (i.e., climate variables were the most important in all modelling approaches). Several studies have shown that the presence of forest is the most important non-anthropogenic factor driving the Eurasian lynx distribution (e.g., Basille et al., 2008, 2009; Cimatti et al., 2021; see also Appendix 7.5.), while the forest type also seems to be a relevant factor (e.g., Doswald et al., 2007; Podgórski et al., 2008; Rauset et al., 2013; see also Appendix 7.5.). These studies seem to support the results of this work, which uses the standard bioclimatic variables as a surrogate for forest presence and type (see Methods). However, the only study that uses both land use, which includes the presence of forest, and bioclimatic variables reveals that the latter do not appear to be important for the presence of the lynx (Becker, 2013). This might have two explanations: (1) high levels of correlation between the land use and bioclimatic variables, and (2) the effect of these variables may be negligible at their scale, and in their study area (i.e. Alps), which, unlike the Iberian Peninsula, has only one biogeographic region (i.e. Alpine region; Sundseth, 2009a). The other two studies that use standard bioclimatic variables to model lynx distribution show slightly different responses of the species to different bioclimatic variables (Mahdavi et al., 2020; Kiraç, 2021), with temperature appearing to have an overall important effect on the species. One of these studies shows that the lynx presents an unimodal response to bioclimatic variables (i.e., annual mean temperature, minimum temperature of the coldest month, average temperature of the coldest quarter, and precipitation seasonality), of which the variables related to temperature were the most important (Kiraç, 2021). This pattern is supported by ecological theory, which states that species largely occur along ecological gradients in an unimodal or monotonic fashion (Oksanen & Minchin, 2002), and partially supports the results obtained in this work (see Appendix 7.9.). In the other study, the lynx showed negative monotonic responses to the increase in the three most important variables (i.e., annual mean temperature, precipitation seasonality, and mean diurnal temperature range, respectively) (Mahdavi et al., 2020). This pattern is supported by another study that shows that the lynx reduces its period of activity by an hour with an increase of 10°C (Podolski et al., 2013), and contradicts the results obtained in this work. However, this second study was focused on a narrow area (i.e., Northern Iran) and, therefore, might be suffering from the effect of niche truncation or local adaptation, both of which will be discussed later in this work. Furthermore, the differences in both the type and direction of the lynx's response to the bioclimatic variables can also be explained by the different types of forest (and plant communities, in general) that occur in the different study areas in the distinct studies that model the distribution of this species. This is because although they are relatively similar functionally (i.e., they are all mostly broadleaf and mixed forests), and, therefore, ecologically relevant to the lynx (Schadt et al., 2002; among many others), they may host species adapted to slightly different climates (see Dinerstein et al., 2017).

The second hypothesis (H2) of this work was also supported. In all modelling approaches, roe deer presence was shown to be important for an increase in lynx presence. Furthermore, in the MaxEnt approach, according to the permutation importance, the presence of Iberian ibex is also important for increasing the suitability of an area for the lynx. These results are supported by previous works showing that prey availability is an important factor in lynx distribution (e.g., Filla et al., 2017; Gehr et al., 2017; Hemmingmoore et al., 2020; see also Appendix 7.5.). In Europe, roe deer seems to be an important trophic resource for lynx (Andrén & Liberg, 2024; Khorozyan & Heurich, 2023). There is often a trade-off between the availability of roe deer (and prey in general) and human activity (e.g., Filla et al., 2017; Gehr et al., 2017; see also Appendix 7.5.). This happens because, although the lynx is attracted to areas with high prey availability, it is repelled by areas with high levels of human activity. Thus, the lynx selects areas with intermediate levels of both prey availability and human activity, since the availability

of some prey (e.g., roe deer) is greater closer to human settlements (e.g., Filla et al., 2017; Gehr et al., 2017; see also Appendix 7.5.). This trade-off may explain why the lynx has a positive response to an increase in human population density in this work's models (see Appendix 7.9.). Although it is not common to include the ibexes (*Capra* spp.) in distribution models of the lynx, it is known that in certain regions it is one of the main preys of the species (Khorozyan & Heurich, 2023). Therefore, it makes sense that the Iberian ibex is considered in the models of this work as an important trophic resource, especially when the predicted probability of lynx presence is greater in the North of the Iberian Peninsula (Figure 3 and 4), where some of the highest mountain ranges are found and the habitat is suitable for the ibex (Appendix 7.6.).

The best performing model predicts (conservatively) 28 800 km<sup>2</sup> of suitable area for Eurasian lynx in the Iberian Peninsula. This represents an increase of approximately 436 times in the area estimated as suitable for lynx by the most recent model of the species' distribution (Oeser et al., 2023), which estimated only an area of about 6600 km<sup>2</sup> in Northern Iberia based on the current distribution of the species. In addition to possible problems related to the modelling process, there are three factors that can explain the differences between the predictions of the models presented in this work and the predictions of the models presented in previous studies: (1) local adaptation, (2) truncated niche modelling, and (3) errors during the species' recognition process.

Local adaptations (i.e., within-species adaptation to local environments) are an important factor in the ecology and to conservation of some species' populations and subspecies (Hällfors et al., 2016; Meek et al., 2023). They can also play an important role in shaping species distribution (DeMarche et al., 2019; Hällfors et al., 2016). For instance, local adaptations can allow individuals to use locally abundant resources which may influence the species distributions (DeMarche et al., 2019; Hällfors et al., 2016). In the specific case of the lynx, there are documented cases of local adaptation to hunting a specific prey (e.g., European hare *Lepus europaeus* and edible dormouse *Glis glis*; Mengüllüoğlu et al., 2018; Krofel et al., 2011). In this species, the different populations also appear to vary significantly in body size, colour, and spotting pattern (Bizhanova et al., 2024; but see Behzadi et al., 2022; Darul et al., 2022). There is strong evidence that suggests that the Iberian Eurasian lynx population was significantly genetically distant from other European populations (Lucena-Perez et al., 2022). Thus, it is possible that the differences in the ecological niche between the Iberian population and those modelled in other studies are justified by local adaptation. Indeed, the most recent distribution model of the Eurasian lynx takes into account the local adaptations of the European populations of the species (Oeser et al., 2023). However, the extinct Iberian population could not be included. Therefore, the local ecological constraints of this population were not incorporated into the model, which could have limited its predictive capacity in Iberia.

Niche truncation is the incomplete modelling of a species' niche due to the non-inclusion of all conditions in which it occurs/occurred (Chevalier et al., 2022). This can happen for several reasons such as (1) insufficient or unbalanced sampling (Perret & Sax, 2022), (2) modelling of the species at a regional or local scale (Chevalier et al., 2021; Goicolea et al., 2024), or (3) the non-inclusion of occurrences of historic (or extinct) populations in the models (Martínez-Freiría et al., 2016; Kerley & Monsarrat, 2022; Mills et al., 2024). Thus, local adaptations and niche truncation are not mutually exclusive, as they also can complement each other. In this work, due to its scope and the unavailability of historical records from the rest of Eurasia, it was not possible to model the entire lynx niche, and, although there are some methodologies designed to deal with this problem (Chevalier et al., 2021, 2022; Adde et al., 2023; Goicolea et al., 2024; Mateo et al., 2024; for a mechanistic approach, see Kearney & Porter, 2009), these do not apply to this work, due to the historical nature of the data. Niche truncation is such a widespread problem that even if all the information from the 19th century historical record was readily available

there would probably still be parts of the lynx's ecological niche that would not be incorporated into the model, as the lynx's range had been significantly contracted (Breitenmoser, 1998; see also Veloz et al., 2012). The limitations of the species recognition process will be discussed later in this work.

### **4.3. Model comparison**

The best performing model approach was the GAM. However, this does not strictly mean that the GAM approach is the best modelling approach as this is highly dependent on the final objective of the model. For instance, the GAM approach showed an elevated degree of concurvity and therefore this approach would not have been a good choice if the work's objective was to project the distribution of the lynx for current conditions or for future conditions. For that objective, despite the remaining collinearity in the variables (Appendix 7.7.), which can also be troublesome (e.g., Rödder & Engler, 2012), the best choices would be the GLM and MaxEnt approaches. For the purposes of this study, given that all model runs converged, the reliability of the model's estimates should not be significantly affected (Wood, 2008), despite the on-average high concurvity (only northness showed low concurvity; Appendix 7.9.). MaxEnt is arguably the modelling approach with the highest predictive power amongst the modelling approaches used (Aguirre-Gutiérrez et al., 2013; Seo et al., 2008). However, it was outperformed by the GAM approach. This might be explained by an overreliance on the MaxEnt's default settings (Merow et al., 2013), which are not tuned for non-volant mammals (Phillips & Dudík, 2008), and which have been shown to reduce the predictive capacity of this modelling approach (Merow et al., 2013; but see Fiedler et al., 2018). If this is the case, then, a finer tuning of the MaxEnt's settings to the lynx's data and ecology might improve the model's performance (Merow et al., 2013). Nevertheless, in general, all model approaches performed well (Table 2), and their predicted distributions were similar (Figure 3 and 4; Appendix 7.9.).

### **4.4. Uncertainty Analysis**

Overall, the quantified uncertainty associated with the modelling process was low. However, there were hotspots of uncertainty in some mountainous areas, such as the Pyrenees and Serra da Estrela, as well as in some areas with high human population densities in northern Spain. The increase in uncertainty in mountainous areas may be due to the difficulty in geolocating lynx presences in these regions. For instance, most lynx occurrences in the Pyrenees were assigned to valleys, mountains or forests within the Pyrenean Mountain range. These areas represent huge portions of territory whose centroid does not correctly represent the extent of conditions occurring in those areas nor the true location of the lynx. This source of uncertainty could be addressed during the modelling process by giving less weight to presences whose locations represent vast areas (i.e., mountain ranges, big forests, provinces, etc.) and, therefore, are by default spatially imprecise (Matias et al., 2022). Uncertainty hotspots in areas of high human population density are difficult to explain. One possible reason is that these areas combine high human population density with other factors (e.g., precipitation of the warmest quarter) causing large model extrapolations and increasing uncertainty in these pixels (Rödder & Engler, 2012).

### **4.5. Limitations**

Further sources of uncertainty can also be derived from the limitations associated with the historical nature of this work's data. Historical data has high degrees of uncertainty related to (1) the different degrees of quality of primary sources, (2) spatially imprecise locations, and (3) errors associated with the species recognition process (Boshoff & Kerley, 2010). In this work, multiple historical records were used to obtain lynx occurrences (pool sampling), which might partly mitigate the problem of the difference in quality between records (Peel et al., 2019). However, in grid cells whose presence comes only from a historical record, this is still a problem that needs to be solved. The geospatial inaccuracy

of the locations was addressed through gridding of the data (see Methods). However, as discussed above, the data gridding process did not mitigate the geospatial inaccuracy associated with the location of occurrences that correspond to vast areas (i.e., mountain ranges, big forests, provinces, etc.).

The uncertainty of this species recognition process is difficult to incorporate into the model. However, the magnitude of uncertainty associated with the species recognition process is dependent on the time period modelled and, therefore, can be discussed. For example, it is possible to assume that the closer to the present a lynx occurrence is, the more likely this framework for recognizing the species is to fail. This is because the closer to the present, the less likely it is that the lynx still occurred in the Iberian Peninsula. Thus, it is predictable that this framework is more likely to misidentify an occurrence in the 20th century than in the 18th century, where there is physical evidence of the existence of the lynx in the Iberian Peninsula (Grandal d' Anglade, 2024). This once again highlights the role of fossils identified through aDNA sequencing in combating the misidentification of occurrences, since it may be one of the only ways to distinguish phylogenetically closely-related and difficult-to-distinguish species (Ramm et al., 2024; but see Buckley, 2018; Estraviz-López et al., 2021; Gruwier, 2024). The use of paleontological data as well as the analysis of a greater number of primary historical records can also help to reduce sampling bias, the magnitude of which also depends on the time period being modelled (see Appendix 7.4.).

Some of this work's limitations also arise from the modelling procedure. Although this modelling framework attempts to incorporate biotic interactions and quantify uncertainty, neither of these things was fully achieved. On the one hand, predator-prey dynamics were incorporated to a certain extent into the model through the inclusion in the model of the probability of presence of lynx's potential prey as a predictive variable. On the other hand, other biotic interactions such as competition, which certainly plays a fundamental role in shaping species distribution (Pellissier et al., 2010; Mpakairi et al., 2017; Fern et al., 2019), were not included. Incorporating biotic interactions into SDMs still represents a challenge (Dormann et al., 2018; among others) and, therefore, it was not possible to include all significant biotic interactions in the models. There is also a significant amount of unquantified uncertainty that found its way into the model. For instance, the uncertainty inherent to the predictor variables layers, which are themselves products of models, are incorporated within the model and are difficult to quantify. Another example is the uncertainty associated with the use of bioclimatic variables as a surrogate for forest presence and class. Both of these problems can be (partly) addressed by creating or improving historical predictor variables, such as land use maps (e.g., Fernández et al. in prep., as cited in Clavero, García-Reyes, et al., 2023), which could be used instead of the bioclimatic variables.

The direct application of the outputs of this work (Figure 4) also has some limitations and must be done with some caution. This happens because (1) the current landscape of the Iberian Peninsula is different from the one that existed during the 19th century (e.g., see Díaz-Maroto & Vila-Lameiro, 2008) and (2) the current sources of anthropogenic disturbance are both different in nature and greater in magnitude (i.e. currently the largest sources of mortality for the lynx are linear barriers such as roads; see Appendix 7.5.; but see Premier et al., 2025). In other words, the conditions in which the baseline distribution of the lynx was modelled are not the same as the ones the currently exist in the Iberian Peninsula.

#### **4.6. Conservation implications and perspectives**

Most SDMs are wrong (see Lee-Yaw et al., 2022), but some can be useful (Guisan et al., 2013). Thus, despite the various limitations of this work, its outputs are relevant for the conservation of the Eurasian lynx as it presents for the first time the species' historical baseline in Iberia and highlights the invaluable usefulness of the historical record in aiding conservation efforts. Conservation projects should be designed towards quantitative and data-driven goals and objectives (Conroy & Carroll, 2009). In the

current context of conservation biology, this is especially relevant due to the advent in popularity of approaches such as rewilding (*sensu* Nogués-Bravo et al., 2016) and ecological restoration (Young, 2000; Gorman, 2007; see also Nature Restoration Law, 2024), which in some cases advocate for the translocation and introduction of megafaunal species (Seddon & Armstrong, 2019). Practical approaches such as those must be accompanied by theoretical advances in the fields of historical ecology and conservation paleobiology (McClenachan et al., 2024; Barnosky et al., 2017). This is crucial because fundamental assumptions for the use of the fossil and historical record still need to be understood. For example, some authors assume the end of the 15th century as the time frame for which historical baselines should be set (e.g., Akçakaya et al., 2018), however, this time frame is not appropriate for all continents (or even countries and regions) nor for all taxonomic groups (Sanderson, 2019; but see Stephenson et al., 2019). In the Iberian Peninsula, specifically, past and present interactions in mammal communities are also still largely not understood (but see Nascimento et al., 2024; Garrote, 2024), and there are still relevant questions to investigate regarding the functional role of some species (see Martínez-Abraín et al., 2021). Thus, without a proper understanding of the past ecosystems' composition and structure (i.e., both historical and paleontological), these approaches must be taken with caution (Delibes-Mateos et al., 2019; see also Nores et al., 2024; Román & Aguilar-Gómez, 2025).

The historical and paleontological records also present geographic discontinuities and biases that would not be corrected with the isolated use of the occurrence records' locations to describe the distribution of species (Clavero et al., 2022; Krone et al., 2024; see also Monsarrat & Kerley, 2018). In this context, SDMs can be used to deal with geographic discontinuity and some of the biases (e.g., higher concentration of records near cities) associated with historical and fossil records (Svenning et al., 2011; Clavero et al., 2022). This work is not the first to use the historical record in conjunction with SDMs to model the distribution of a species (see Monsarrat et al., 2019; Clavero, García-Reyes, et al., 2023; Clavero, Naves, et al., 2023; Thornton & Murray, 2024). However, it is the first work of this nature with a framework that attempts to quantify the uncertainty associated with the modelling process, something that increases the reliability of its predictions and their usefulness to the species' conservation.

In the context of this work, the question of whether the Eurasian lynx should be reintroduced to the Iberian Peninsula may arise. The answer to this question is complex and there are pros and cons (see Clavero & Delibes, 2013), but for now the possibility of reintroducing the Eurasian lynx should not be the priority for the conservation of extant Iberian carnivores. Currently, a significant portion of the carnivore community inhabiting the Iberian Peninsula is threatened (Mathias et al., 2023; Palomo et al., 2007). Some of these highly threatened species, such as the European wildcat (*Felis silvestris*), are in dire need of being targeted by conservation projects (Ribeiro, 2023), which could be jeopardized by the reintroduction of the Eurasian lynx (e.g., due to intraguild competition/exclusion; Monterroso et al., 2020). Thus, for now, conservation efforts should focus on the carnivore species still present in the Iberian Peninsula. Nevertheless, the reintroduction of the Eurasian lynx may be an important step in order to fully restore the Iberian faunal communities

In general, future research on the application of historical and paleontological data to create distribution baselines should involve: (1) data collection and availability, and (2) improvement and standardization of the modelling process. The collection and availability of data must involve (1) the transcription and scanning of manuscripts only available in physical format, (2) increasing accessibility to records currently available in digital format, (3) increasing and reviewing the current knowledge of the fossil record and paleoecology of the Quaternary, and (4) in the case of species that are difficult to differentiate in both the historical and paleontological records (e.g., lynxes), sequencing the aDNA of a larger number of fossils. In the Iberian Peninsula, and in the case of the Eurasian lynx, it would be important to transcribe into digital format the rest of the manuscripts of the *Memórias Paroquiais de 1758* (Cardoso,

1758), the *Diccionario geográfico de España* (Lopez, 1701-1804), and the *Diccionario Geográfico-histórico de España por la Real Academia de la Historia*, as well as the taxonomic review and sequencing of the aDNA of a larger number of lynx fossils. The improvement and standardization of the modelling process must involve (1) the design and creation of a protocol or guide that ensures reproducibility and the lowest possible degree of uncertainty associated with the modelling process, (2) the study of new and better ways of integrating biotic relationships (in this case, predator-prey relationships and competition) in the modelling process, and (3) the design of new and better ways of quantifying and dealing with uncertainty at various levels (i.e., at the modelling-level, variable processing and selection levels, species' recognition level, and the historical records' quality level). Furthermore, more effort should be put into developing higher resolution and better-quality historical GIS layers (i.e., climate, land use, land cover, human population density, and administrative boundaries).

## 5. Conclusions

In summary, this work uses the Eurasian lynx as a case study to show how the historical record can be used in conjunction with species distribution models to establish baseline distributions for conservation projects through a framework that allows to (partially) quantify the uncertainty of modelling. In the 19th century, the Eurasian lynx appears to have been present in the north and northwest of the Iberian Peninsula in an area that overlaps significantly with the *Temperate Broadleaf & Mixed Forests* biome. This pattern might be explained by the presence of a climate favourable to the habitat of this species, but also by the presence of prey. While the quantified uncertainty was low, there is still a significant amount of unquantified uncertainty associated with the modelled data. The results obtained in this work highlight the importance of historical and paleontological data in aiding conservation projects, however, they also underline the need for more and better-quality data as well as the development of novel ways to deal with unquantified uncertainty present in historical and fossil data.

## 6. References

- Adde, A., Rey, P., Brun, P., Külling, N., Fopp, F., Altermatt, F., Broennimann, O., Lehmann, A., Petitpierre, B., Zimmermann, N. E., Pellissier, L., & Guisan, A. (2023). *N-SDM: A high-performance computing pipeline for Nested Species Distribution Modelling*. *Ecography*, 2023(6), e06540. <https://doi.org/10.1111/ecog.06540>
- Aguirre-Gutiérrez, J., Carvalheiro, L. G., Polce, C., Van Loon, E. E., Raes, N., Reemer, M., & Biesmeijer, J. C. (2013). Fit-for-Purpose: Species Distribution Model Performance Depends on Evaluation Criteria – Dutch Hoverflies as a Case Study. *PLoS ONE*, 8(5), e63708. <https://doi.org/10.1371/journal.pone.0063708>
- Akçakaya, H. R., Bennett, E. L., Brooks, T. M., Grace, M. K., Heath, A., Hedges, S., Hilton-Taylor, C., Hoffmann, M., Keith, D. A., Long, B., Mallon, D. P., Meijaard, E., Milner-Gulland, E. J., Rodrigues, A. S. L., Rodriguez, J. P., Stephenson, P. J., Stuart, S. N., & Young, R. P. (2018). Quantifying species recovery and conservation success to develop an IUCN Green List of Species. *Conservation Biology*, 32(5), 1128–1138. <https://doi.org/10.1111/cobi.13112>
- Allouche, O., Tsoar, A., & Kadmon, R. (2006). Assessing the accuracy of species distribution models: Prevalence, kappa and the true skill statistic (TSS). *Journal of Applied Ecology*, 43(6), 1223–1232. <https://doi.org/10.1111/j.1365-2664.2006.01214.x>
- Altuna, J. (1980). Hallazgo de un Lince Nórdico (*Lynx lynx* L. Mammalia) en la Sima de Pagolusieta, Gorbea (Vizcaya). *Munibe*, 32(3–4), 317–324.
- Álvares, F. (1997). *O Lince-ibérico (Lynx pardinus) no Noroeste de Portugal: Presença Histórica e Situação Actual* (Conservação do lince-ibérico em Portugal, p. 42). Instituto da Conservação da Natureza.
- Anderson, R. P. (2017). When and how should biotic interactions be considered in models of species niches and distributions? *Journal of Biogeography*, 44(1), 8–17. <https://doi.org/10.1111/jbi.12825>
- Andrén, H., & Liberg, O. (2024). Numerical response of predator to prey: Dynamic interactions and population cycles in Eurasian lynx and roe deer. *Ecological Monographs*, 94(1), e1594. <https://doi.org/10.1002/ecm.1594>
- Andrén, H., Linnell, J. D. C., Liberg, O., Andersen, R., Danell, A., Karlsson, J., Odden, J., Moa, P. F., Ahlqvist, P., Kvam, T., Franzén, R., & Segerström, P. (2006). Survival rates and causes of mortality in Eurasian lynx (*Lynx lynx*) in multi-use landscapes. *Biological Conservation*, 131(1), 23–32. <https://doi.org/10.1016/j.biocon.2006.01.025>
- Balázs, B., Mooney, P., Nováková, E., Bastin, L., & Jokar Arsanjani, J. (2021). Data Quality in Citizen Science. In K. Vohland, A. Land-Zandstra, L. Ceccaroni, R. Lemmens, J. Perelló, M. Ponti, R. Samson, & K. Wagenknecht (Eds.), *The Science of Citizen Science* (pp. 139–157). Springer International Publishing. [https://doi.org/10.1007/978-3-030-58278-4\\_8](https://doi.org/10.1007/978-3-030-58278-4_8)
- Barbet-Massin, M., Jiguet, F., Albert, C. H., & Thuiller, W. (2012). Selecting pseudo-absences for species distribution models: How, where and how many? *Methods in Ecology and Evolution*, 3(2), 327–338. <https://doi.org/10.1111/j.2041-210X.2011.00172.x>
- Barbosa, A. M. (2015). fuzzySim: Applying fuzzy logic to binary similarity indices in ecology. *Methods in Ecology and Evolution*, 6(7), 853–858. <https://doi.org/10.1111/2041-210X.12372>
- Barbosa, A. M., Real, R., Munoz, A. R., & Brown, J. A. (2013). New measures for assessing model equilibrium and prediction mismatch in species distribution models. *Diversity and Distributions*, 19(10), 1333–1338. <https://doi.org/10.1111/ddi.12100>
- Barnosky, A. D., Hadly, E. A., Gonzalez, P., Head, J., Polly, P. D., Lawing, A. M., Eronen, J. T., Ackerly, D. D., Alex, K., Biber, E., Blois, J., Brashares, J., Ceballos, G., Davis, E., Dietl, G. P., Dirzo, R., Doremus, H., Fortelius, M., Greene, H. W., ... Zhang, Z. (2017). Merging paleobiology with

- conservation biology to guide the future of terrestrial ecosystems. *Science*, 355(6325), eaah4787. <https://doi.org/10.1126/science.aah4787>
- Basille, M., Calenge, C., Marboutin, É., Andersen, R., & Gaillard, J.-M. (2008). Assessing habitat selection using multivariate statistics: Some refinements of the ecological-niche factor analysis. *Ecological Modelling*, 211(1–2), 233–240. <https://doi.org/10.1016/j.ecolmodel.2007.09.006>
- Basille, M., Herfindal, I., Santin-Janin, H., Linnell, J. D. C., Odden, J., Andersen, R., Arild Høgda, K., & Gaillard, J. (2009). What shapes Eurasian lynx distribution in human dominated landscapes: Selecting prey or avoiding people? *Ecography*, 32(4), 683–691. <https://doi.org/10.1111/j.1600-0587.2009.05712.x>
- Baumann, C., Kandel, A. W., & Hussain, S. T. (2025). Evidence for the catalytic role of humans in the assembly and evolution of European Late Pleistocene scavenger guilds. *Quaternary Science Reviews*, 349, 109148. <https://doi.org/10.1016/j.quascirev.2024.109148>
- Beale, C. M., & Lennon, J. J. (2012). Incorporating uncertainty in predictive species distribution modelling. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 367(1586), 247–258. <https://doi.org/10.1098/rstb.2011.0178>
- Becker, T. (2013). *Modeling Eurasian lynx (Lynx lynx) distribution and estimation of patch and population size in the Alps* [Master Dissertation, Centre for Development, Environment and Policy (CeDEP), School of Oriental and African Studies (SOAS), University of London]. <https://api.semanticscholar.org/CorpusID:210158949>
- Behzadi, F., Malekian, M., Fadakar, D., Adibi, M. A., & Bärmann, E. V. (2022). Phylogenetic analyses of Eurasian lynx (*Lynx lynx* Linnaeus, 1758) including new mitochondrial DNA sequences from Iran. *Scientific Reports*, 12(1), 3293. <https://doi.org/10.1038/s41598-022-07369-z>
- Bizhanova, N., Nanova, O., Fadakar, D., Grachev, A., Hong, Z., Mohd Sah, S. A., Bizhanova, Z., Sablin, M., & Grachev, Y. (2024). Insights into subspecies classification and conservation priorities of Central Asian lynx populations revealed by morphometric and genetic analyses. *Scientific Reports*, 14(1), 5186. <https://doi.org/10.1038/s41598-024-55807-x>
- Bleyhl, B., Ghoddousi, A., Askerov, E., Bocedi, G., Breitenmoser, U., Manvelyan, K., Palmer, S. C. F., Soofi, M., Weinberg, P., Zazanashvili, N., Shmunk, V., Zurell, D., & Kuemmerle, T. (2021). Reducing persecution is more effective for restoring large carnivores than restoring their prey. *Ecological Applications*, 31(5), e02338. <https://doi.org/10.1002/eap.2338>
- Boitani, L. (2018). *Canis lupus* (Europe assessment) (errata version published in 2019). *The IUCN Red List of Threatened Species* 2018, e.T3746A144226239. <https://www.iucnredlist.org/species/3746/144226239>
- Boitani, L., Jdeidi, T., Masseti, M., Nader, I., de Smet, K., & Cuzin, F. (2010). *Ursus arctos* (Mediterranean assessment). *The IUCN Red List of Threatened Species* 2010, e.T41688A10514336. <https://www.iucnredlist.org/species/41688/10514336>
- Bonney, R., Shirk, J. L., Phillips, T. B., Wiggins, A., Ballard, H. L., Miller-Rushing, A. J., & Parrish, J. K. (2014). Next Steps for Citizen Science. *Science*, 343(6178), 1436–1437. <https://doi.org/10.1126/science.1251554>
- Boria, R. A., Olson, L. E., Goodman, S. M., & Anderson, R. P. (2014). Spatial filtering to reduce sampling bias can improve the performance of ecological niche models. *Ecological Modelling*, 275, 73–77. <https://doi.org/10.1016/j.ecolmodel.2013.12.012>
- Boshoff, A. F., & Kerley, G. I. H. (2010). Historical mammal distribution data: How reliable are written records? *South African Journal of Science*, 106(1/2). <https://doi.org/10.4102/sajs.v106i1/2.116>
- Boyce, M. S., Vernier, P. R., Nielsen, S. E., & Schmiegelow, F. K. A. (2002). Evaluating resource selection functions. *Ecological Modelling*, 157(2–3), 281–300. [https://doi.org/10.1016/S0304-3800\(02\)00200-4](https://doi.org/10.1016/S0304-3800(02)00200-4)

- Breitenmoser, U. (1998). Large predators in the Alps: The fall and rise of man's competitors. *Biological Conservation*, 83(3), 279–289. [https://doi.org/10.1016/S0006-3207\(97\)00084-0](https://doi.org/10.1016/S0006-3207(97)00084-0)
- Breitenmoser, U., & Breitenmoser-Würsten, C. (1990). *Status, conservation needs and reintroduction of the lynx (Lynx lynx) in Europe*. Council of Europe.
- Breitenmoser, U., Breitenmoser-Würsten, C., Lanz, T., von Arx, M., Antonevich, A., Bao, W., & Avgan, B. (2015). *Lynx lynx* (errata version published in 2017). *The IUCN Red List of Threatened Species 2015*, e.T12519A121707666. <https://www.iucnredlist.org/species/12519/121707666>
- Breitenmoser, U., Breitenmoser-Würsten, C., Okarma, H., Kaphegyi, T., Kaphygyi-Wallmann, U., & Müller, U. M. (2000). *Action Plan for the conservation of the Eurasian Lynx (Lynx lynx) in Europe*. Council of Europe.
- Bridle, J., & Hoffmann, A. (2022). Understanding the biology of species' ranges: When and how does evolution change the rules of ecological engagement? *Philosophical Transactions of the Royal Society B: Biological Sciences*, 377(1848), 20210027. <https://doi.org/10.1098/rstb.2021.0027>
- Buckley, M. (2018). Zooarchaeology by Mass Spectrometry (ZooMS) Collagen Fingerprinting for the Species Identification of Archaeological Bone Fragments. In C. M. Giovas & M. J. LeFebvre (Eds.), *Zooarchaeology in Practice* (pp. 227–247). Springer International Publishing. [https://doi.org/10.1007/978-3-319-64763-0\\_12](https://doi.org/10.1007/978-3-319-64763-0_12)
- Burgess, M. G., Costello, C., Fredston-Hermann, A., Pinsky, M. L., Gaines, S. D., Tilman, D., & Polasky, S. (2017). Range contraction enables harvesting to extinction. *Proceedings of the National Academy of Sciences*, 114(15), 3945–3950. <https://doi.org/10.1073/pnas.1607551114>
- Cardoso, L. (Ed.). (1758). *Memórias Paroquias de 1758* [Manuscript] (1–44). <https://digitarq.arquivos.pt/details?id=4238720>
- 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., ... Boitani, L. (2014). Recovery of large carnivores in Europe's modern human-dominated landscapes. *Science*, 346(6216), 1517–1519. <https://doi.org/10.1126/science.1257553>
- Chevalier, M., Broennimann, O., Cornuault, J., & Guisan, A. (2021). Data integration methods to account for spatial niche truncation effects in regional projections of species distribution. *Ecological Applications*, 31(7), e02427. <https://doi.org/10.1002/eap.2427>
- Chevalier, M., Zarzo-Arias, A., Guélat, J., Mateo, R. G., & Guisan, A. (2022). Accounting for niche truncation to improve spatial and temporal predictions of species distributions. *Frontiers in Ecology and Evolution*, 10, 944116. <https://doi.org/10.3389/fevo.2022.944116>
- Cimatti, M., Ranc, N., Benítez-López, A., Maiorano, L., Boitani, L., Cagnacci, F., Čengić, M., Ciucci, P., Huijbregts, M. A. J., Krofel, M., López-Bao, J. V., Selva, N., Andren, H., Bautista, C., Ćirović, D., Hemmingmoore, H., Reinhardt, I., Marenče, M., Mertzanis, Y., ... Santini, L. (2021). Large carnivore expansion in Europe is associated with human population density and land cover changes. *Diversity and Distributions*, 27(4), 602–617. <https://doi.org/10.1111/ddi.13219>
- Clavero, M. (2014). Shifting Baselines and the Conservation of Non-Native Species. *Conservation Biology*, 28(5), 1434–1436. <https://doi.org/10.1111/cobi.12266>
- Clavero, M., & Delibes, M. (2013). Using historical accounts to set conservation baselines: The case of *Lynx* species in Spain. *Biodiversity and Conservation*, 22(8), 1691–1702. <https://doi.org/10.1007/s10531-013-0506-4>
- Clavero, M., García-Reyes, A., Fernández-Gil, A., Revilla, E., & Fernández, N. (2022). On the misuse of historical data to set conservation baselines: Wolves in Spain as an example. *Biological Conservation*, 276, 109810. <https://doi.org/10.1016/j.biocon.2022.109810>

- Clavero, M., García-Reyes, A., Fernández-Gil, A., Revilla, E., & Fernández, N. (2023). Where wolves were: Setting historical baselines for wolf recovery in Spain. *Animal Conservation*, 26(2), 239–249. <https://doi.org/10.1111/acv.12814>
- Clavero, M., Naves, J., Delibes, M., & Fernández, N. (2023). Spanish brown bears in the last 700 years. *El Libro de Resúmenes Del XVI Congreso de La Sociedad Española Para La Conservación y Estudio de Los Mamíferos*, 34. <https://secem.es/pt/congressos/xvi-congreso-internacional-de-la-secem>
- Clavero, M., & Revilla, E. (2014). Mine centuries-old citizen science. *Nature*, 510(7503), 35. <https://doi.org/10.1038/510035c>
- Čonč, Š., Hočevár, L., Oliveira, T., Flezar, U., Belotti, E., Bufka, L., Heurich, M., Breg Valjavec, M., & Krofel, M. (2023). *Importance of rocky landforms for Eurasian lynx (Lynx lynx) ecology in landscapes with different relief types*. LIFE Lynx International Conference: “Together for lynx,” Zadar, Croatia. <https://doi.org/10.13140/RG.2.2.10417.56165>
- Čonč, Š., Oliveira, T., Belotti, E., Bufka, L., Černe, R., Heurich, M., Breg Valjavec, M., & Krofel, M. (2024). Revealing functional responses in habitat selection of rocky features and rugged terrain by Eurasian lynx (*Lynx lynx*) using LiDAR data. *Landscape Ecology*, 39(7), 121. <https://doi.org/10.1007/s10980-024-01923-y>
- Čonč, Š., Oliveira, T., Portas, R., Černe, R., Breg Valjavec, M., & Krofel, M. (2022). Dolines and Cats: Remote Detection of Karst Depressions and Their Application to Study Wild Felid Ecology. *Remote Sensing*, 14(3), 656. <https://doi.org/10.3390/rs14030656>
- Conroy, M. J., & Carroll, J. P. (2009). *Quantitative conservation of vertebrates* (1st ed.). Wiley-Blackwell. <https://doi.org/10.1002/9781444303155>
- Cosentino, F., Seamark, E. C. J., Van Cakenberghe, V., & Maiorano, L. (2023). Not only climate: The importance of biotic interactions in shaping species distributions at macro scales. *Ecology and Evolution*, 13(3), e9855. <https://doi.org/10.1002/ece3.9855>
- Dalerum, F., Cameron, E. Z., Kunkel, K., & Somers, M. J. (2009). Diversity and depletions in continental carnivore guilds: Implications for prioritizing global carnivore conservation. *Biology Letters*, 5(1), 35–38. <https://doi.org/10.1098/rsbl.2008.0520>
- Darimont, C. T., Fox, C. H., Bryan, H. M., & Reimchen, T. E. (2015). The unique ecology of human predators. *Science*, 349(6250), 858–860. <https://doi.org/10.1126/science.aac4249>
- Darul, R., Gavashelishvili, A., Saveljev, A. P., Seryodkin, I. V., Linnell, J. D. C., Okarma, H., Bagrade, G., Ornicans, A., Ozolins, J., Männil, P., Khorozyan, I., Melovski, D., Stojanov, A., Trajçe, A., Hoxha, B., Dvornikov, M. G., Galsandorj, N., Okhlopkov, I., Mamuchadze, J., ... Schmidt, K. (2022). Coat Polymorphism in Eurasian Lynx: Adaptation to Environment or Phylogeographic Legacy? *Journal of Mammalian Evolution*, 29(1), 51–62. <https://doi.org/10.1007/s10914-021-09580-7>
- Davoli, M., Monsarrat, S., Pedersen, R. Ø., Scussolini, P., Karger, D. N., Normand, S., & Svenning, J. (2024). Megafauna diversity and functional declines in Europe from the Last Interglacial to the present. *Global Ecology and Biogeography*, 33(1), 34–47. <https://doi.org/10.1111/geb.13778>
- De Araújo, C. B., Marcondes-Machado, L. O., & Costa, G. C. (2014). The importance of biotic interactions in species distribution models: A test of the Eltonian noise hypothesis using parrots. *Journal of Biogeography*, 41(3), 513–523. <https://doi.org/10.1111/jbi.12234>
- Delibes-Mateos, M., Barrio, I. C., Barbosa, A. M., Martínez-Solano, Í., Fa, J. E., & Ferreira, C. C. (2019). Rewilding and the risk of creating new, unwanted ecological interactions. In N. Pettorelli, S. M. Durant, & J. T. Du Toit (Eds.), *Rewilding* (1st ed., pp. 355–374). Cambridge University Press. <https://doi.org/10.1017/9781108560962.017>

- DeMarche, M. L., Doak, D. F., & Morris, W. F. (2019). Incorporating local adaptation into forecasts of species' distribution and abundance under climate change. *Global Change Biology*, 25(3), 775–793. <https://doi.org/10.1111/gcb.14562>
- Díaz-Maroto, I. J., & Vila-Lameiro, P. (2008). Historical evolution and land-use changes in natural broadleaved forests in the north-west Iberian Peninsula. *Scandinavian Journal of Forest Research*, 23(4), 371–379. <https://doi.org/10.1080/02827580802203552>
- Dinerstein, E., Olson, D., Joshi, A., Vynne, C., Burgess, N. D., Wikramanayake, E., Hahn, N., Palminteri, S., Hedao, P., Noss, R., Hansen, M., Locke, H., Ellis, E. C., Jones, B., Barber, C. V., Hayes, R., Kormos, C., Martin, V., Crist, E., ... Saleem, M. (2017). An Ecoregion-Based Approach to Protecting Half the Terrestrial Realm. *BioScience*, 67(6), 534–545. <https://doi.org/10.1093/biosci/bix014>
- Dormann, C. F., Bobrowski, M., Dehling, D. M., Harris, D. J., Hartig, F., Lischke, H., Moretti, M. D., Pagel, J., Pinkert, S., Schleuning, M., Schmidt, S. I., Sheppard, C. S., Steinbauer, M. J., Zeuss, D., & Kraan, C. (2018). Biotic interactions in species distribution modelling: 10 questions to guide interpretation and avoid false conclusions. *Global Ecology and Biogeography*, 27(9), 1004–1016. <https://doi.org/10.1111/geb.12759>
- Doswald, N., Zimmermann, F., & Breitenmoser, U. (2007). Testing expert groups for a habitat suitability model for the lynx *Lynx lynx* in the Swiss Alps. *Wildlife Biology*, 13(4), 430–446. [https://doi.org/10.2981/0909-6396\(2007\)13\[430:TEGFAH\]2.0.CO;2](https://doi.org/10.2981/0909-6396(2007)13[430:TEGFAH]2.0.CO;2)
- EEA. (2011). *EEA reference grid for Europe (10km)* [Shapefile]. [https://www.eea.europa.eu/ds\\_resolveuid/9686f8a03541442c9f7838739134ef29](https://www.eea.europa.eu/ds_resolveuid/9686f8a03541442c9f7838739134ef29)
- EEA. (2016). *Biogeographical regions* (Version 1) [Shapefile]. <https://www.eea.europa.eu/en/datahub/datahubitem-view/11db8d14-f167-4cd5-9205-95638dfd9618>
- Elith, J., Burgman, M. A., & Regan, H. M. (2002). Mapping epistemic uncertainties and vague concepts in predictions of species distribution. *Ecological Modelling*, 157(2–3), 313–329. [https://doi.org/10.1016/S0304-3800\(02\)00202-8](https://doi.org/10.1016/S0304-3800(02)00202-8)
- Elith, J., & Leathwick, J. R. (2009). Species Distribution Models: Ecological Explanation and Prediction Across Space and Time. *Annual Review of Ecology, Evolution, and Systematics*, 40(1), 677–697. <https://doi.org/10.1146/annurev.ecolsys.110308.120159>
- Estraviz-López, D., García-Vázquez, A., & Grandal d'Anglade, A. M. (2021). Quantitative classification of metapodial bones of *Ursus spelaeus* and *Ursus arctos* from Northwestern Iberia using multivariate analysis. *Ciências Da Terra Procedia - Earth Sciences Journal Procedia*, 1, 92–95. <https://doi.org/10.21695/cterraproc.v1i0.418>
- Faurby, S., & Svenning, J.-C. (2015). Historic and prehistoric human-driven extinctions have reshaped global mammal diversity patterns. *Diversity and Distributions*, 21(10), 1155–1166. <https://doi.org/10.1111/ddi.12369>
- Feng, X., Peterson, A. T., Aguirre-López, L. J., Burger, J. R., Chen, X., & Papeş, M. (2024). Rethinking ecological niches and geographic distributions in face of pervasive human influence in the Anthropocene. *Biological Reviews*, brv.13077. <https://doi.org/10.1111/brv.13077>
- Fern, R. R., Morrison, M. L., Wang, H.-H., Grant, W. E., & Campbell, T. A. (2019). Incorporating biotic relationships improves species distribution models: Modeling the temporal influence of competition in conspecific nesting birds. *Ecological Modelling*, 408, 108743. <https://doi.org/10.1016/j.ecolmodel.2019.108743>
- Fiedler, P. C., Redfern, J. V., Forney, K. A., Palacios, D. M., Sheredy, C., Rasmussen, K., García-Godos, I., Santillán, L., Tetley, M. J., Félix, F., & Ballance, L. T. (2018). Prediction of Large Whale Distributions: A Comparison of Presence–Absence and Presence-Only Modeling Techniques. *Frontiers in Marine Science*, 5, 419. <https://doi.org/10.3389/fmars.2018.00419>

- Filla, M., Premier, J., Magg, N., Dupke, C., Khorozyan, I., Waltert, M., Bufka, L., & Heurich, M. (2017). Habitat selection by Eurasian lynx (*Lynx lynx*) is primarily driven by avoidance of human activity during day and prey availability during night. *Ecology and Evolution*, 7(16), 6367–6381. <https://doi.org/10.1002/ece3.3204>
- Forman, R. T. T., & Russell, E. W. B. (1983). Evaluation of Historical Data in Ecology. *The Bulletin of the Ecological Society of America*, 64(1), 5–7. <https://doi.org/10.2307/20111668>
- Fricke, E. C., Hsieh, C., Middleton, O., Gorczynski, D., Cappello, C. D., Sanisidro, O., Rowan, J., Svenning, J.-C., & Beaudrot, L. (2022). Collapse of terrestrial mammal food webs since the Late Pleistocene. *Science*, 377(6609), 1008–1011. <https://doi.org/10.1126/science.abn4012>
- Garrote, P. J. (2024). Carnívoros y plantas: Interacciones clave en la conservación y restauración de los ecosistemas [Invited Conference Session]. *CARNib: I Reunión Ibérica del Grupo de Carnívoros Terrestres - SECEM, Libro de resúmenes*, 1.
- Gehr, B., Hofer, E. J., Muff, S., Ryser, A., Vimercati, E., Vogt, K., & Keller, L. F. (2017). A landscape of coexistence for a large predator in a human dominated landscape. *Oikos*, 126(10), 1389–1399. <https://doi.org/10.1111/oik.04182>
- Goicolea, T., Adde, A., Broennimann, O., García-Viñas, J. I., Gastón, A., José Aroca-Fernández, M., Guisan, A., & Mateo, R. G. (2024). Spatially-nested hierarchical species distribution models to overcome niche truncation in national-scale studies. *Ecography*, e07328. <https://doi.org/10.1111/ecog.07328>
- Gorman, M. L. (2007). Restoring ecological balance to the British mammal fauna. *Mammal Review*, 37(4), 316–325. <https://doi.org/10.1111/j.1365-2907.2007.00113.x>
- Grace, M., Akçakaya, H. R., Bennett, E., Hilton-Taylor, C., Long, B., Milner-Gulland, E. J., Young, R., & Hoffmann, M. (2019). Using historical and palaeoecological data to inform ambitious species recovery targets. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 374(1788), 20190297. <https://doi.org/10.1098/rstb.2019.0297>
- Grandal d'Anglade, A. M. (2024, March 5). *El último lince boreal de la Península Ibérica: El individuo de Sima Topinoria y su excepcional valor científico* [Invited Lecture].
- Gruwier, B. (2024). A geometric morphometric approach to distinguish ferret from polecat and its application to an archaeological specimen from Mechelen (Belgium). *Antiquity*, 98(399), 795–804. <https://doi.org/10.15184/aqy.2024.4>
- Guisan, A., Edwards, T. C., & Hastie, T. (2002). Generalized linear and generalized additive models in studies of species distributions: Setting the scene. *Ecological Modelling*, 157(2–3), 89–100. [https://doi.org/10.1016/S0304-3800\(02\)00204-1](https://doi.org/10.1016/S0304-3800(02)00204-1)
- Guisan, A., Tingley, R., Baumgartner, J. B., Naujokaitis-Lewis, I., Sutcliffe, P. R., Tulloch, A. I. T., Regan, T. J., Brotons, L., McDonald-Madden, E., Mantyka-Pringle, C., Martin, T. G., Rhodes, J. R., Maggini, R., Setterfield, S. A., Elith, J., Schwartz, M. W., Wintle, B. A., Broennimann, O., Austin, M., ... Buckley, Y. M. (2013). Predicting species distributions for conservation decisions. *Ecology Letters*, 16(12), 1424–1435. <https://doi.org/10.1111/ele.12189>
- Guisan, A., & Zimmermann, N. E. (2000). Predictive habitat distribution models in ecology. *Ecological Modelling*, 135(2–3), 147–186. [https://doi.org/10.1016/S0304-3800\(00\)00354-9](https://doi.org/10.1016/S0304-3800(00)00354-9)
- Hällfors, M. H., Liao, J., Dzurisin, J., Grundel, R., Hyvärinen, M., Towle, K., Wu, G. C., & Hellmann, J. J. (2016). Addressing potential local adaptation in species distribution models: Implications for conservation under climate change. *Ecological Applications*, 26(4), 1154–1169. <https://doi.org/10.1890/15-0926>
- Hemmingmoore, H., Aronsson, M., Åkesson, M., Persson, J., & Andrén, H. (2020). Evaluating habitat suitability and connectivity for a recolonizing large carnivore. *Biological Conservation*, 242, 108352. <https://doi.org/10.1016/j.biocon.2019.108352>

- Henschel, P., Hunter, L. T. B., Coad, L., Abernethy, K. A., & Mühlenberg, M. (2011). Leopard prey choice in the Congo Basin rainforest suggests exploitative competition with human bushmeat hunters. *Journal of Zoology*, 285(1), 11–20. <https://doi.org/10.1111/j.1469-7998.2011.00826.x>
- Herfindal, I., Linnell, J. D. C., Odden, J., Nilsen, E. B., & Andersen, R. (2005). Prey density, environmental productivity and home-range size in the Eurasian lynx (*Lynx lynx*). *Journal of Zoology*, 265(1), 63–71. <https://doi.org/10.1017/S0952836904006053>
- Higgins, S. I., Buitenwerf, R., & Moncrieff, G. R. (2016). Defining functional biomes and monitoring their change globally. *Global Change Biology*, 22(11), 3583–3593. <https://doi.org/10.1111/gcb.13367>
- Hijmans, R. J. (2023). *predicts: Spatial Prediction Tools* (Version 0.1.11) [Computer software]. <https://CRAN.R-project.org/package=predicts>
- Hijmans, R. J. (2024). *terra: Spatial Data Analysis* (Version 1.8.5) [Computer software]. <https://CRAN.R-project.org/package=terra>
- Hijmans, R. J., Phillips, S., Leathwick, J., & Elith, J. (2023). *dismo: Species Distribution Modeling* (Version 1.3.16) [Computer software]. <https://CRAN.R-project.org/package=dismo>
- Hirzel, A. H., Helfer, V., & Metral, F. (2001). Assessing habitat-suitability models with a virtual species. *Ecological Modelling*, 145(2–3), 111–121. [https://doi.org/10.1016/S0304-3800\(01\)00396-9](https://doi.org/10.1016/S0304-3800(01)00396-9)
- Hirzel, A. H., Le Lay, G., Helfer, V., Randin, C., & Guisan, A. (2006). Evaluating the ability of habitat suitability models to predict species presences. *Ecological Modelling*, 199(2), 142–152. <https://doi.org/10.1016/j.ecolmodel.2006.05.017>
- Hočevár, L., Oliveira, T., & Krofel, M. (2021). Felid bedrooms with a panoramic view: Selection of resting sites by Eurasian lynx (*Lynx lynx*) in a karstic landscape. *Behavioral Ecology and Sociobiology*, 75(2), 34. <https://doi.org/10.1007/s00265-021-02977-7>
- Iannucci, A. (2024). Ecospace occupancy and disparity in Pleistocene large carnivores of Europe and implications for hominin dispersal and ecological role. *Quaternary Science Reviews*, 329, 108562. <https://doi.org/10.1016/j.quascirev.2024.108562>
- IUCN. (2012). *IUCN Red List Categories and Criteria: Version 3.1* (2nd Edition). IUCN.
- IUCN. (2024). *Terrestrial Mammals. The IUCN Red List of Threatened Species* (Version 2024-1) [Shapefile]. <https://www.iucnredlist.org/>
- IUCN Mediterranean Biodiversity Assessment Team. (2010). *Lynx lynx* (Mediterranean assessment). *The IUCN Red List of Threatened Species 2010*, e.T12519A3350985. <https://www.iucnredlist.org/species/12519/3350985>
- Iwamura, T., Wilson, K. A., Venter, O., & Possingham, H. P. (2010). A Climatic Stability Approach to Prioritizing Global Conservation Investments. *PLoS ONE*, 5(11), e15103. <https://doi.org/10.1371/journal.pone.0015103>
- Jiménez, J., Clavero, M., & Reig-Ferrer, A. (2018). New old news on the “Lobo cervical” (*Lynx lynx*?) in NE Spain. *Galemys, Spanish Journal of Mammalogy*, 30, 31–36. <https://doi.org/10.7325/Galemys.2018.A3>
- Jiménez-Valverde, A. (2012). Insights into the area under the receiver operating characteristic curve (AUC) as a discrimination measure in species distribution modelling. *Global Ecology and Biogeography*, 21(4), 498–507. <https://doi.org/10.1111/j.1466-8238.2011.00683.x>
- Joffre, R., Rambal, S., & Ratte, J. P. (1999). The dehesa system of southern Spain and Portugal as a natural ecosystem mimic. *Agroforestry Systems*, 45, 57–79. <https://doi.org/10.1023/A:1006259402496>
- Kaczensky, P., Chapron, G., Von Arx, M., Djuro Huber, Andrén, H., & Linnell, J. (2013a). *Status, Management and Distribution of Large Carnivores – Bear, Lynx, Wolf and Wolverine in Europe. Part 1* (070307/2012/629085/SER/B3; p. 72). European Commission, IUCN/SSC Large

- Carnivore Initiative for Europe (LCIE) and Istituto di Ecologia Applicata (IEA). <https://rgdoi.net/10.13140/RG.2.2.11382.88645>
- Kaczensky, P., Chapron, G., Von Arx, M., Djuro Huber, Andrén, H., & Linnell, J. (2013b). *Status, Management and Distribution of Large Carnivores – Bear, Lynx, Wolf and Wolverine in Europe. Part 2 (Country summaries)* (070307/2012/629085/SER/B3; p. 200). European Commission, IUCN/SSC Large Carnivore Initiative for Europe (LCIE) and Istituto di Ecologia Applicata (IEA). <https://rgdoi.net/10.13140/RG.2.2.18093.77281>
- Kaczensky, P., Ranc, N., Hatlauf, J., Payne, J. C., Acosta-Pankov, I., Álvares, F., Andrén, H., Andri, P., Aragno, P., Avanzinelli, E., Bagrade, G., Balys, V., Barroso, I., Bartol, M., Bassano, B., Bauduin, S., Bautista, C., Bedő, P., Belotti, E., ... Boitani, L. (2024). *Large carnivore distribution maps and population updates 2017 – 2022/23* (09.0201/2023/907799/SER/ENV.D.3; Support for Coexistence with Large Carnivores, p. 134). European Commission, IUCN/SSC Large Carnivore Initiative for Europe (LCIE) and Istituto di Ecologia Applicata (IEA). <http://dx.doi.org/10.13140/RG.2.2.24301.70883>
- Kalle, R., Ramesh, T., Qureshi, Q., & Sankar, K. (2013). Predicting the Distribution Pattern of Small Carnivores in Response to Environmental Factors in the Western Ghats. *PLoS ONE*, 8(11), e79295. <https://doi.org/10.1371/journal.pone.0079295>
- Karger, D. N., Nobis, M. P., Normand, S., Graham, C. H., & Zimmermann, N. E. (2023). CHLSA-TraCE21k – high-resolution (1 km) downscaled transient temperature and precipitation data since the Last Glacial Maximum. *Climate of the Past*, 19(2), 439–456. <https://doi.org/10.5194/cp-19-439-2023>
- Kearney, M. R., & Porter, W. P. (2009). Mechanistic niche modelling: Combining physiological and spatial data to predict species' ranges. *Ecology Letters*, 12(4), 334–350. <https://doi.org/10.1111/j.1461-0248.2008.01277.x>
- Kelling, S., Johnston, A., Hochachka, W. M., Iliff, M., Fink, D., Gerbracht, J., Lagoze, C., La Sorte, F. A., Moore, T., Wiggins, A., Wong, W.-K., Wood, C., & Yu, J. (2015). Can Observation Skills of Citizen Scientists Be Estimated Using Species Accumulation Curves? *PLOS ONE*, 10(10), e0139600. <https://doi.org/10.1371/journal.pone.0139600>
- Kerley, G. I., & Monsarrat, S. (2022). Shifted models cannot be used for predicting responses of biodiversity to global change: The African elephant as an example. *African Zoology*, 57(1), 70–73. <https://doi.org/10.1080/15627020.2022.2053883>
- Khorozyan, I., & Heurich, M. (2023). Patterns of predation by the Eurasian lynx *Lynx lynx* throughout its range: Ecological and conservation implications. *Mammal Review*, 53(3), 177–188. <https://doi.org/10.1111/mam.12317>
- Kıraç, A. (2021). Potential distribution of two lynx species in Europe under paleoclimatological scenarios and anthropogenic climate change scenarios. *CERNE*, 27, e-102517. <https://doi.org/10.1590/01047760202127012517>
- Klein Goldewijk, K., Beusen, A., Doelman, J., & Stehfest, E. (2017). Anthropogenic land use estimates for the Holocene – HYDE 3.2. *Earth System Science Data*, 9(2), 927–953. <https://doi.org/10.5194/essd-9-927-2017>
- Konidaris, G. E. (2022). Guilds of large carnivorans during the Pleistocene of Europe: A community structure analysis based on foraging strategies. *Lethaia*, 55(2), 1–18. <https://doi.org/10.18261/let.55.2.5>
- Krofel, M., Huber, D., & Kos, I. (2011). Diet of Eurasian lynx *Lynx lynx* in the northern Dinaric Mountains (Slovenia and Croatia): Importance of edible dormouse *Glis glis* as alternative prey. *Acta Theriologica*, 56(4), 315–322. <https://doi.org/10.1007/s13364-011-0032-2>

- Krone, I. W., Magoulick, K. M., & Yohler, R. M. (2024). All the Earth will not remember: How geographic gaps structure the record of diversity and extinction. *Paleobiology*, 50(2), 214–225. <https://doi.org/10.1017/pab.2023.34>
- Lee-Yaw, J. A., McCune, J. L., Pironon, S., & Sheth, S. N. (2022). Species distribution models rarely predict the biology of real populations. *Ecography*, 2022(6), e05877. <https://doi.org/10.1111/ecog.05877>
- Lobo, J. M., Jiménez-Valverde, A., & Hortal, J. (2010). The uncertain nature of absences and their importance in species distribution modelling. *Ecography*, 33(1), 103–114. <https://doi.org/10.1111/j.1600-0587.2009.06039.x>
- Lopes-Fernandes, M. (2018). *Entre predadores: Relações com a natureza a propósito da reintrodução de lince-ibérico* [PhD Thesis, Universidade NOVA de Lisboa]. <http://hdl.handle.net/10362/53900>
- Lopez, T. (Ed.). (1701-1804). *Diccionario geográfico de España* [Manuscript] (1–20). <https://bdh.bne.es/bne/search/Search.do?numfields=1&field1=titulo&field1val=%22%5bDiccionario+geogr%c3%a1fico+de+Espa%c3%bl+a.+%5d%22&field1Op=AND&docLikeThis=bdh0000013465&exact=on&advanced=true&pageSize=30&language=es&fillForm=false&showBack=true&visor=>
- Lucas, P. M., Thuiller, W., Talluto, M. V., Polaina, E., Albrecht, J., Selva, N., Barba, M. D., Maiorano, L., Penteriani, V., Guéguen, M., Balkenhol, N., Dutta, T., Fedorca, A., Frank, S. C., Zedrosser, A., Afonso-Jordana, I., Ambarlı, H., Ballesteros, F., Bashta, A.-T., ... Pollock, L. J. (2023). *Including biotic interactions in species distribution models improves the understanding of species niche: A case of study with the brown bear in Europe* [Preprint]. bioRxiv. <https://doi.org/10.1101/2023.03.10.532098>
- Lucena-Perez, M., Bazzicalupo, E., Paijmans, J., Kleinman-Ruiz, D., Dalén, L., Hofreiter, M., Delibes, M., Clavero, M., & Godoy, J. A. (2022). Ancient genome provides insights into the history of Eurasian lynx in Iberia and Western Europe. *Quaternary Science Reviews*, 285, 107518. <https://doi.org/10.1016/j.quascirev.2022.107518>
- Lucena-Perez, M., Paijmans, J. L. A., Nocete, F., Nadal, J., Detry, C., Dalén, L., Hofreiter, M., Barlow, A., & Godoy, J. A. (2024). Recent increase in species-wide diversity after interspecies introgression in the highly endangered Iberian lynx. *Nature Ecology & Evolution*, 8(2), 282–292. <https://doi.org/10.1038/s41559-023-02267-7>
- Mahdavi, T., Shams-Esfandabad, B., Toranjzar, H., Abdi, N., & Ahmadi, A. (2020). Potential impact of climate change on the distribution of the Eurasian Lynx (*Lynx lynx*) in Iran (Mammalia: Felidae). *Zoology in the Middle East*, 66(2), 107–117. <https://doi.org/10.1080/09397140.2020.1739371>
- Martínez-Abraín, A., Llaneza, L., Ballesteros, F., & Grandal-d'Anglade, A. (2021). Do apex predators need to regulate prey populations to be a right conservation target? *Biological Conservation*, 261, 109281. <https://doi.org/10.1016/j.biocon.2021.109281>
- Martínez-Freiría, F., Tarroso, P., Rebelo, H., & Brito, J. C. (2016). Contemporary niche contraction affects climate change predictions for elephants and giraffes. *Diversity and Distributions*, 22(4), 432–444. <https://doi.org/10.1111/ddi.12406>
- Martínez-Minaya, J., Cameletti, M., Conesa, D., & Pennino, M. G. (2018). Species distribution modeling: A statistical review with focus in spatio-temporal issues. *Stochastic Environmental Research and Risk Assessment*, 32(11), 3227–3244. <https://doi.org/10.1007/s00477-018-1548-7>
- Mateo, R. G., Morales-Barbero, J., Zarzo-Arias, A., Lima, H., & Goicolea, T. (2024). *sabinaNSDM: An R package for spatially-nested hierarchical species distribution modeling* [Preprint]. Zenodo. <https://doi.org/10.5281/ZENODO.11096287>

- Mathias, M. da L., Fonseca, C., Rodrigues, L., Grilo, C., Lopes-Fernandes, M., Palmeirim, J., Santos-Reis, M., Alves, P. C., Cabral, J. A., Ferreira, M., Mira, A., Eira, C., Negrões, N., Paupério, J., Pita, R., Rainho, A., Rosalino, L. M., Tapisso, J. T., & Vingada, J. (Eds.). (2023). *Livro vermelho dos mamíferos de Portugal continental*. FCIencias.ID, ICNF. <https://livrovermelhodasmamiferos.pt/>
- Matias, G., Rosalino, L. M., Alves, P. C., Tiesmeyer, A., Nowak, C., Ramos, L., Steyer, K., Astaras, C., Brix, M., Domokos, C., Janssen, R., Kitchener, A. C., Mestdagh, X., L'Hoste, L., Titeux, N., Migli, D., Youlatos, D., Pfenninger, M., Devillard, S., ... Monterroso, P. (2022). Genetic integrity of European wildcats: Variation across biomes mandates geographically tailored conservation strategies. *Biological Conservation*, 268, 109518. <https://doi.org/10.1016/j.biocon.2022.109518>
- Mattisson, J., Odden, J., & Linnell, J. D. C. (2014). A catch-22 conflict: Access to semi-domestic reindeer modulates Eurasian lynx depredation on domestic sheep. *Biological Conservation*, 179, 116–122. <https://doi.org/10.1016/j.biocon.2014.09.004>
- McClenachan, L., Rick, T., Thurstan, R., Trant, A., Alagona, P., Alleway, H., Armstrong, C., Bliege Bird, R., Rubio-Cisneros, N., Clavero, M., Colonese, A., Cramer, K., Davis, A., Drew, J., Early-Capistrán, M., Gil-Romera, G., Grace, M., Hatch, M., Higgs, E., ... Van Houtan, K. (2024). Global research priorities for historical ecology to inform conservation. *Endangered Species Research*, 54, 285–310. <https://doi.org/10.3354/esr01338>
- Meek, M. H., Beever, E. A., Barbosa, S., Fitzpatrick, S. W., Fletcher, N. K., Mittan-Moreau, C. S., Reid, B. N., Campbell-Staton, S. C., Green, N. F., & Hellmann, J. J. (2023). Understanding Local Adaptation to Prepare Populations for Climate Change. *BioScience*, 73(1), 36–47. <https://doi.org/10.1093/biosci/biac101>
- Mengüllüoğlu, D., Ambarlı, H., Berger, A., & Hofer, H. (2018). Foraging ecology of Eurasian lynx populations in southwest Asia: Conservation implications for a diet specialist. *Ecology and Evolution*, 8(18), 9451–9463. <https://doi.org/10.1002/ece3.4439>
- Merow, C., Smith, M. J., & Silander, J. A. (2013). A practical guide to MaxEnt for modeling species' distributions: What it does, and why inputs and settings matter. *Ecography*, 36(10), 1058–1069. <https://doi.org/10.1111/j.1600-0587.2013.07872.x>
- Meynard, C. N., & Quinn, J. F. (2007). Predicting species distributions: A critical comparison of the most common statistical models using artificial species. *Journal of Biogeography*, 34(8), 1455–1469. <https://doi.org/10.1111/j.1365-2699.2007.01720.x>
- Milborrow, S. (2024). *plotmo: Plot a Model's Residuals, Response, and Partial Dependence Plots* (Version 3.6.3) [Computer software]. <https://CRAN.R-project.org/package=plotmo>
- Mills, M., Schreve, D., Middleton, O., & Sandom, C. J. (2024). Going back for the future: Incorporating Pleistocene fossil records of saiga antelope into habitat suitability models. *Journal of Biogeography*, jbi.14831. <https://doi.org/10.1111/jbi.14831>
- Monsarrat, S., & Kerley, G. I. H. (2018). Charismatic species of the past: Biases in reporting of large mammals in historical written sources. *Biological Conservation*, 223, 68–75. <https://doi.org/10.1016/j.biocon.2018.04.036>
- Monsarrat, S., Novellie, P., Rushworth, I., & Kerley, G. (2019). Shifted distribution baselines: Neglecting long-term biodiversity records risks overlooking potentially suitable habitat for conservation management. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 374(1788), 20190215. <https://doi.org/10.1098/rstb.2019.0215>
- Monterroso, P., Díaz-Ruiz, F., Lukacs, P. M., Alves, P. C., & Ferreras, P. (2020). Ecological traits and the spatial structure of competitive coexistence among carnivores. *Ecology*, 101(8), e03059. <https://doi.org/10.1002/ecy.3059>

- Moreno, J. M., Pineda, F. D., & Rivas-Martínez, S. (1990). Climate and vegetation at the Eurosiberian-Mediterranean boundary in the Iberian Peninsula. *Journal of Vegetation Science*, 1(2), 233–244. <https://doi.org/10.2307/3235660>
- Morrell, N., Appleton, R. D., & Arcese, P. (2021). Roads, forest cover, and topography as factors affecting the occurrence of large carnivores: The case of the Andean bear (*Tremarctos ornatus*). *Global Ecology and Conservation*, 26, e01473. <https://doi.org/10.1016/j.gecco.2021.e01473>
- Mpakairi, K. S., Ndaimani, H., Tagwireyi, P., Gara, T. W., Zvidzai, M., & Madhlamoto, D. (2017). Missing in action: Species competition is a neglected predictor variable in species distribution modelling. *PLOS ONE*, 12(7), e0181088. <https://doi.org/10.1371/journal.pone.0181088>
- Muscatello, A., Elith, J., & Kujala, H. (2021). How decisions about fitting species distribution models affect conservation outcomes. *Conservation Biology*, 35(4), 1309–1320. <https://doi.org/10.1111/cobi.13669>
- Nascimento, J. C. S., Blanco, F., Domingo, M. S., Cantalapiedra, J. L., & Pires, M. M. (2024). The reorganization of predator–prey networks over 20 million years explains extinction patterns of mammalian carnivores. *Ecology Letters*, 27(6), e14448. <https://doi.org/10.1111/ele.14448>
- Nature Restoration Law or Regulation (EU) 2024/1991 on nature restoration and amending Regulation (EU) 2022/869* (Legislation (L) 2024/1991; Official Journal of the European Union, pp. 1–93). (2024). The Council of the European Union and the European Parliament. <http://data.europa.eu/eli/reg/2024/1991/oj>
- Nilsen, E. B., Linnell, J. D. C., Odden, J., & Andersen, R. (2009). Climate, season, and social status modulate the functional response of an efficient stalking predator: The Eurasian lynx. *Journal of Animal Ecology*, 78(4), 741–751. <https://doi.org/10.1111/j.1365-2656.2009.01547.x>
- Nisi, A. C., Suraci, J. P., Ranc, N., Frank, L. G., Oriol-Cotterill, A., Ekwanga, S., Williams, T. M., & Wilmsers, C. C. (2022). Temporal scale of habitat selection for large carnivores: Balancing energetics, risk and finding prey. *Journal of Animal Ecology*, 91(1), 182–195. <https://doi.org/10.1111/1365-2656.13613>
- Nogués-Bravo, D., Simberloff, D., Rahbek, C., & Sanders, N. J. (2016). Rewilding is the new Pandora's box in conservation. *Current Biology*, 26(3), R87–R91. <https://doi.org/10.1016/j.cub.2015.12.044>
- Nores, C. (1999). ¿Es el lobo cervical un lince boreal (*Lynx lynx*)? *IV Jornadas Españolas de Conservación y Estudio de Mamíferos, Libro de resúmenes*, 87. <https://secem.es/pt/congressos/iv-jornadas-de-la-secem>
- Nores, C., Álvarez-Laó, D., Navarro, A., Pérez-Barbería, F. J., Castaños, P. M., Castaños De La Fuente, J., Morales Muñiz, A., Azorit, C., Muñoz-Cobo, J., Fernández Delgado, C., Granado Lorencio, C., Palmqvist, P., Soriguer, R., Delibes, M., Vilà, M., Simón, M., Cabezudo, B., Galán, C., García-Berthou, E., ... López-Bao, J. V. (2024). Rewilding through inappropriate species introduction: The case of European bison in Spain. *Conservation Science and Practice*, e13221. <https://doi.org/10.1111/csp2.13221>
- Nores, C., & Vázquez, V. (1984). Datos sobre la Presencia del Lince en Asturias desde el siglo XVII. *Acta Biologica Montana*, 4, 361–370.
- Noss, R. F., Quigley, H. B., Hornocker, M. G., Merrill, T., & Paquet, P. C. (1996). Conservation Biology and Carnivore Conservation in the Rocky Mountains. *Conservation Biology*, 10(4), 949–963. <https://doi.org/10.1046/j.1523-1739.1996.10040949.x>
- Odden, J., Linnell, J. D. C., & Andersen, R. (2006). Diet of Eurasian lynx, *Lynx lynx*, in the boreal forest of southeastern Norway: The relative importance of livestock and hares at low roe deer density. *European Journal of Wildlife Research*, 52(4), 237–244. <https://doi.org/10.1007/s10344-006-0052-4>

- Odden, J., Linnell, J. D. C., Moa, P. F., Herfindal, I., Kvam, T., & Andersen, R. (2002). Lynx Depredation on Domestic Sheep in Norway. *The Journal of Wildlife Management*, 66(1), 98. <https://doi.org/10.2307/3802876>
- Oeser, J., Heurich, M., Kramer-Schadt, S., Mattisson, J., Krofel, M., Krojerová-Prokešová, J., Zimmermann, F., Anders, O., Andrén, H., Bagrade, G., Belotti, E., Breitenmoser-Würsten, C., Bufka, L., Černe, R., Drouet-Hoguet, N., Duřa, M., Fuxjäger, C., Gomerčić, T., Jędrzejewski, W., ... Kuemmerle, T. (2023). Integrating animal tracking datasets at a continental scale for mapping Eurasian lynx habitat. *Diversity and Distributions*, 29(12), 1546–1560. <https://doi.org/10.1111/ddi.13784>
- Oeser, J., Heurich, M., Senf, C., Pflugmacher, D., Belotti, E., & Kuemmerle, T. (2020). Habitat metrics based on multi-temporal Landsat imagery for mapping large mammal habitat. *Remote Sensing in Ecology and Conservation*, 6(1), 52–69. <https://doi.org/10.1002/rse2.122>
- Oksanen, J., & Minchin, P. R. (2002). Continuum theory revisited: What shape are species responses along ecological gradients? *Ecological Modelling*, 157(2–3), 119–129. [https://doi.org/10.1016/S0304-3800\(02\)00190-4](https://doi.org/10.1016/S0304-3800(02)00190-4)
- Olson, D. M., & Dinerstein, E. (2002). The Global 200: Priority Ecoregions for Global Conservation. *Annals of the Missouri Botanical Garden*, 89(2), 199. <https://doi.org/10.2307/3298564>
- Olson, D. M., Dinerstein, E., Wikramanayake, E. D., Burgess, N. D., Powell, G. V. N., Underwood, E. C., D'amico, J. A., Itoua, I., Strand, H. E., Morrison, J. C., Loucks, C. J., Allnutt, T. F., Ricketts, T. H., Kura, Y., Lamoreux, J. F., Wettengel, W. W., Hedao, P., & Kassem, K. R. (2001). Terrestrial Ecoregions of the World: A New Map of Life on Earth. *BioScience*, 51(11), 933. [https://doi.org/10.1641/0006-3568\(2001\)051\[0933:TEOTWA\]2.0.CO;2](https://doi.org/10.1641/0006-3568(2001)051[0933:TEOTWA]2.0.CO;2)
- Pacifici, M., Rondinini, C., Rhodes, J. R., Burbidge, A. A., Cristiano, A., Watson, J. E. M., Woinarski, J. C. Z., & Di Marco, M. (2020). Global correlates of range contractions and expansions in terrestrial mammals. *Nature Communications*, 11(1), 2840. <https://doi.org/10.1038/s41467-020-16684-w>
- Palomo, L. J., Gisbert, J., & Blanco, J. C. (Eds.). (2007). *Atlas y libro rojo de los mamíferos terrestres de España*. Dirección General para la Biodiversidad-SECEM-SECEMU.
- Papworth, S. K., Rist, J., Coad, L., & Milner-Gulland, E. J. (2009). Evidence for shifting baseline syndrome in conservation. *Conservation Letters*, 2(2), 93–100. <https://doi.org/10.1111/j.1755-263X.2009.00049.x>
- Pebesma, E. (2018). Simple Features for R: Standardized Support for Spatial Vector Data. *The R Journal*, 10(1), 439. <https://doi.org/10.32614/RJ-2018-009>
- Peel, S. L., Hill, N. A., Foster, S. D., Wotherspoon, S. J., Ghiglione, C., & Schiaparelli, S. (2019). Reliable species distributions are obtainable with sparse, patchy and biased data by leveraging over species and data types. *Methods in Ecology and Evolution*, 10(7), 1002–1014. <https://doi.org/10.1111/2041-210X.13196>
- Pellissier, L., Anne Bräthen, K., Pottier, J., Randin, C. F., Vittoz, P., Dubuis, A., Yoccoz, N. G., Alm, T., Zimmermann, N. E., & Guisan, A. (2010). Species distribution models reveal apparent competitive and facilitative effects of a dominant species on the distribution of tundra plants. *Ecography*, 33(6), 1004–1014. <https://doi.org/10.1111/j.1600-0587.2010.06386.x>
- Perret, D. L., & Sax, D. F. (2022). Evaluating alternative study designs for optimal sampling of species' climatic niches. *Ecography*, 2022(1), ecog.06014. <https://doi.org/10.1111/ecog.06014>
- Peterson, B. G., & Carl, P. (2020). *PerformanceAnalytics: Econometric Tools for Performance and Risk Analysis* (Version 2.0.4) [Computer software]. <https://CRAN.R-project.org/package=PerformanceAnalytics>

- Phillips, S. J., Anderson, R. P., & Schapire, R. E. (2006). Maximum entropy modeling of species geographic distributions. *Ecological Modelling*, 190(3–4), 231–259. <https://doi.org/10.1016/j.ecolmodel.2005.03.026>
- Phillips, S. J., & Dudík, M. (2008). Modeling of species distributions with Maxent: New extensions and a comprehensive evaluation. *Ecography*, 31(2), 161–175. <https://doi.org/10.1111/j.0906-7590.2008.5203.x>
- Podgórski, T., Schmidt, K., Kowalczyk, R., & Gulczyńska, A. (2008). Microhabitat selection by Eurasian lynx and its implications for species conservation. *Acta Theriologica*, 53(2), 97–110. <https://doi.org/10.1007/BF03194243>
- Podolski, I., Belotti, E., Bufka, L., Reulen, H., & Heurich, M. (2013). Seasonal and daily activity patterns of free-living Eurasian lynx *Lynx lynx* in relation to availability of kills. *Wildlife Biology*, 19(1), 69–77. <https://doi.org/10.2981/12-049>
- Premier, J., Bastianelli, M. L., Oeser, J., Anders, O., Andren, H., Aronsson, M., Bagrade, G., Belotti, E., Breitenmoser-Würsten, C., Bufka, L., Černe, R., Červený, J., Drouet-Hoguet, N., Ďul'a, M., Fuxjäger, C., Herdtfelder, M., Hočevár, L., Jędrzejewski, W., Kont, R., ... Heurich, M. (2025). Survival of Eurasian lynx in the human-dominated landscape of Europe. *Conservation Biology*, e14439. <https://doi.org/10.1111/cobi.14439>
- QGIS Development Team. (2023). *QGIS Geographic Information System* (Version 3.22) [Computer software]. QGIS Association. <https://www.qgis.org/>
- R Core Team. (2022). *R: A Language and Environment for Statistical Computing* (Version 4.2.1) [Computer software]. R Foundation for Statistical Computing. <https://www.R-project.org/>
- Ramm, T., Gray, J. A., Hipsley, C. A., Hocknull, S., Melville, J., & Müller, J. (2024). Are Modern Cryptic Species Detectable in the Fossil Record? A Case Study on Agamid Lizards. *Systematic Biology*, syae067. <https://doi.org/10.1093/sysbio/syae067>
- Rauset, G. R., Mattisson, J., Andrén, H., Chapron, G., & Persson, J. (2013). When species' ranges meet: Assessing differences in habitat selection between sympatric large carnivores. *Oecologia*, 172(3), 701–711. <https://doi.org/10.1007/s00442-012-2546-y>
- Ribeiro, L. (2023). O gato-bravo pode vir a ser salvo da extinção da mesma forma que o lince-ibérico. *Visão Verde*, Online. [https://visao.pt/visao\\_verde/natureza/2023-05-10-o-gato-bravo-pode-vir-a-ser-salvo-da-extincao-da-mesma-forma-que-o-lince-iberico/](https://visao.pt/visao_verde/natureza/2023-05-10-o-gato-bravo-pode-vir-a-ser-salvo-da-extincao-da-mesma-forma-que-o-lince-iberico/)
- Ripari, L., Premier, J., Belotti, E., Bluhm, H., Breitenmoser-Würsten, C., Bufka, L., Červený, J., Drouet-Hoguet, N., Fuxjäger, C., Jędrzejewski, W., Kont, R., Koubek, P., Kowalczyk, R., Krofel, M., Krojerová-Prokešová, J., Molinari-Jobin, A., Okarma, H., Oliveira, T., Remm, J., ... Heurich, M. (2022). Human disturbance is the most limiting factor driving habitat selection of a large carnivore throughout Continental Europe. *Biological Conservation*, 266, 109446. <https://doi.org/10.1016/j.biocon.2021.109446>
- Ripple, W. J., Estes, J. A., Beschta, R. L., Wilmers, C. C., Ritchie, E. G., Hebblewhite, M., Berger, J., Elmhagen, B., Letnic, M., Nelson, M. P., Schmitz, O. J., Smith, D. W., Wallach, A. D., & Wirsing, A. J. (2014). Status and Ecological Effects of the World's Largest Carnivores. *Science*, 343(6167), 1241484. <https://doi.org/10.1126/science.1241484>
- Ripple, W. J., Wolf, C., Beschta, R. L., Craig, A. D., Curcija, Z. S., Lundgren, E. J., Satterfield, L. C., Woodrich, S. T., & Wirsing, A. J. (2024). A shifting ecological baseline after wolf extirpation. *BioScience*, biae034. <https://doi.org/10.1093/biosci/biae034>
- Rivas-Martínez, S., Penas, Á., Díaz González, T. E., Cantó, P., Del Río, S., Costa, J. C., Herrero, L., & Molero, J. (2017). Biogeographic Units of the Iberian Peninsula and Balearic Islands to District Level. A Concise Synopsis. In J. Loidi (Ed.), *The Vegetation of the Iberian Peninsula* (Vol. 12, pp. 131–188). Springer International Publishing. [https://doi.org/10.1007/978-3-319-54784-8\\_5](https://doi.org/10.1007/978-3-319-54784-8_5)

- Rödger, D., & Engler, J. O. (2012). Disentangling interpolation and extrapolation uncertainties in species distribution models: A novel visualization technique for the spatial variation of predictor variable colinearity. *Biodiversity Informatics*, 8(1). <https://doi.org/10.17161/bi.v8i1.4326>
- Rodrigues, A., Monsarrat, S., Charpentier, A., Brooks, T. M., Hoffmann, M., Reeves, R., Palomares, M. L. D., & Turvey, S. T. (2019). Unshifting the baseline: A framework for documenting historical population changes and assessing long-term anthropogenic impacts. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 374(1788), 20190220. <https://doi.org/10.1098/rstb.2019.0220>
- Rodríguez, A. (2024). *Lynx pardinus*. *The IUCN Red List of Threatened Species 2024*, e.T12520A218695618. <https://www.iucnredlist.org/species/12520/218695618>
- Rodríguez, A., & Delibes, M. de C. (1990). *El lince ibérico (Lynx pardina) en España: Distribucion y problemas de conservacion*. ICONA. [https://www.miteco.gob.es/es/biodiversidad/temas/conservacion-de-especies-amenazadas/vertebrados/lince\\_iberico\\_espana.html](https://www.miteco.gob.es/es/biodiversidad/temas/conservacion-de-especies-amenazadas/vertebrados/lince_iberico_espana.html)
- Rodríguez-Varela, R., García, N., Nores, C., Álvarez-Lao, D., Barnett, R., Arsuaga, J. L., & Valdiosera, C. (2015). Ancient DNA reveals past existence of Eurasian lynx in Spain. *Journal of Zoology*, 298(2), 94–102. <https://doi.org/10.1111/jzo.12289>
- Román, J., & Aguilar-Gómez, C. M. (2025). Until when did beavers historically inhabit the Iberian Peninsula? The importance of consulting primary sources to avoid errors in historical ecology. *Historical Biology*, 37(2), 179–183. <https://doi.org/10.1080/08912963.2023.2297908>
- Sales, L. P., Galetti, M., Carnaval, A., Monsarrat, S., Svenning, J., & Pires, M. M. (2022). The effect of past defaunation on ranges, niches, and future biodiversity forecasts. *Global Change Biology*, 28(11), 3683–3693. <https://doi.org/10.1111/gcb.16145>
- Sanderson, E. W. (2019). A full and authentic reckoning of species' ranges for conservation: Response to Akçakaya et al. 2018. *Conservation Biology*, 33(5), 1208–1210. <https://doi.org/10.1111/cobi.13399>
- Schadt, S., Knauer, F., Kaczensky, P., Revilla, E., Wiegand, T., & Trepl, L. (2002). Rule-based assessment of suitable habitat and patch connectivity for the Eurasian lynx. *Ecological Applications*, 12(5), 1469–1483. [https://doi.org/10.1890/1051-0761\(2002\)012\[1469:RBAOSH\]2.0.CO;2](https://doi.org/10.1890/1051-0761(2002)012[1469:RBAOSH]2.0.CO;2)
- Seddon, P. J., & Armstrong, D. P. (2019). The role of translocation in rewilding. In N. Pettorelli, S. M. Durant, & J. T. Du Toit (Eds.), *Rewilding* (1st ed., pp. 303–324). Cambridge University Press. <https://doi.org/10.1017/9781108560962.015>
- Seebens, H., Blackburn, T. M., Dyer, E. E., Genovesi, P., Hulme, P. E., Jeschke, J. M., Pagad, S., Pyšek, P., Winter, M., Arianoutsou, M., Bacher, S., Blasius, B., Brundu, G., Capinha, C., Celesti-Grapow, L., Dawson, W., Dullinger, S., Fuentes, N., Jäger, H., ... Essl, F. (2017). No saturation in the accumulation of alien species worldwide. *Nature Communications*, 8(1), 14435. <https://doi.org/10.1038/ncomms14435>
- Senay, S. D., Worner, S. P., & Ikeda, T. (2013). Novel Three-Step Pseudo-Absence Selection Technique for Improved Species Distribution Modelling. *PLoS ONE*, 8(8), e71218. <https://doi.org/10.1371/journal.pone.0071218>
- Seo, C.-W., Park, Y.-R., & Choi, Y.-S. (2008). Comparison of species distribution models according to location data. *Journal of Korean Society for Geospatial Information Science*, 16(4), 59–64.
- Serva, D., Iannella, M., Cittadino, V., & Biondi, M. (2023). A shifting carnivore's community: Habitat modeling suggests increased overlap between the golden jackal and the Eurasian lynx in Europe. *Frontiers in Ecology and Evolution*, 11, 1165968. <https://doi.org/10.3389/fevo.2023.1165968>
- Shelton, S. L., & Weckerly, F. W. (2007). Inconsistencies in historical geographic range maps: The gray wolf as example. *California Fish and Game*, 93(4), 224–227.

- 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). <https://doi.org/10.2981/wlb.00489>
- Sillero, N., Arenas-Castro, S., Enriquez-Urzelai, U., Vale, C. G., Sousa-Guedes, D., Martínez-Freiría, F., Real, R., & Barbosa, A. M. (2021). Want to model a species niche? A step-by-step guideline on correlative ecological niche modelling. *Ecological Modelling*, 456, 109671. <https://doi.org/10.1016/j.ecolmodel.2021.109671>
- Silva, A. P., Thorn, F., Zurell, D., & Cabral, J. (2021, March 4). *Land-use change effects on biodiversity through mechanistic simulations: A case study with South-Asian mammals* [Oral Presentation]. EGU General Assembly 2021, Online. <https://doi.org/10.5194/egusphere-egu21-16051>
- Sofaer, H. R., Hoeting, J. A., & Jarnevič, C. S. (2019). The area under the precision-recall curve as a performance metric for rare binary events. *Methods in Ecology and Evolution*, 10(4), 565–577. <https://doi.org/10.1111/2041-210X.13140>
- Soga, M., & Gaston, K. J. (2018). Shifting baseline syndrome: Causes, consequences, and implications. *Frontiers in Ecology and the Environment*, 16(4), 222–230. <https://doi.org/10.1002/fee.1794>
- Stahl, P., Vandel, J. M., Ruetten, S., Coat, L., Coat, Y., & Balestra, L. (2002). Factors affecting lynx predation on sheep in the French Jura. *Journal of Applied Ecology*, 39(2), 204–216. <https://doi.org/10.1046/j.1365-2664.2002.00709.x>
- Stephenson, P. J., Grace, M. K., Akçakaya, H. R., Rodrigues, A. S. L., Long, B., Mallon, D. P., Meijaard, E., Rodriguez, J. P., Young, R. P., Brooks, T. M., & Hilton-Taylor, C. (2019). Defining the indigenous ranges of species to account for geographic and taxonomic variation in the history of human impacts: Reply to Sanderson 2019. *Conservation Biology*, 33(5), 1211–1213. <https://doi.org/10.1111/cobi.13400>
- Sunde, P., Stener, S. Ø., & Kvam, T. (1998). Tolerance to humans of resting lynxes *Lynx lynx* in a hunted population. *Wildlife Biology*, 4(3), 177–183. <https://doi.org/10.2981/wlb.1998.020>
- Sundseth, K. (2009a). *Natura 2000 in the Alpine Region*. Publications Office. <https://data.europa.eu/doi/10.2779/81263>
- Sundseth, K. (2009b). *Natura 2000 in the Atlantic Region*. Publications Office. <https://data.europa.eu/doi/10.2779/82343>
- Sundseth, K. (2009c). *Natura 2000 in the Mediterranean Region*. Publications Office. <https://data.europa.eu/doi/10.2779/77695>
- Svenning, J.-C., Fløjgaard, C., Marske, K. A., Nógues-Bravo, D., & Normand, S. (2011). Applications of species distribution modeling to paleobiology. *Quaternary Science Reviews*, 30(21–22), 2930–2947. <https://doi.org/10.1016/j.quascirev.2011.06.012>
- Theobald, D. M., Kennedy, C., Chen, B., Oakleaf, J., Baruch-Mordo, S., & Kiesecker, J. (2020). Earth transformed: Detailed mapping of global human modification from 1990 to 2017. *Earth System Science Data*, 12(3), 1953–1972. <https://doi.org/10.5194/essd-12-1953-2020>
- Thornton, D. H., & Murray, D. L. (2024). Modeling range dynamics through time to inform conservation planning: Canada lynx in the contiguous United States. *Biological Conservation*, 292, 110541. <https://doi.org/10.1016/j.biocon.2024.110541>
- Thuiller, W., Georges, D., Gueguen, M., Engler, R., Breiner, F., Lafourcade, B., Patin, R., & Blancheteau, H. (2024). *biomod2: Ensemble Platform for Species Distribution Modeling* (Version 4.2.5) [Computer software]. <https://CRAN.R-project.org/package=biomod2>
- Urruela, J. M. G. (2021). A historical approach to the control of the lynx and wild cat populations in Bizkaia (1600-1940). *Kobie Antropología Cultural*, 23, 13–36.
- Vandel, J.-M., & Stahl, P. (2005). Distribution trend of the Eurasian lynx *Lynx lynx* populations in France. *Mammalia*, 69(2), 145–158. <https://doi.org/doi:10.1515/mamm.2005.013>

- Veloz, S. D., Williams, J. W., Blois, J. L., He, F., Otto-Bliesner, B., & Liu, Z. (2012). No-analog climates and shifting realized niches during the late quaternary: Implications for 21st-century predictions by species distribution models. *Global Change Biology*, 18(5), 1698–1713. <https://doi.org/10.1111/j.1365-2486.2011.02635.x>
- von Arx, M. (2020). *Lynx lynx* (Europe assessment) (errata version published in 2018). *The IUCN Red List of Threatened Species* 2020, e.T12519A177350310. <https://doi.org/10.2305/IUCN.UK.2020-3.RLTS.T12519A177350310.en>
- Wisz, M. S., Pottier, J., Kissling, W. D., Pellissier, L., Lenoir, J., Damgaard, C. F., Dormann, C. F., Forchhammer, M. C., Grytnes, J., Guisan, A., Heikkinen, R. K., Høye, T. T., Kühn, I., Luoto, M., Maiorano, L., Nilsson, M., Normand, S., Öckinger, E., Schmidt, N. M., ... Svenning, J. (2013). The role of biotic interactions in shaping distributions and realised assemblages of species: Implications for species distribution modelling. *Biological Reviews*, 88(1), 15–30. <https://doi.org/10.1111/j.1469-185X.2012.00235.x>
- Wolf, C., & Ripple, W. J. (2016). Prey depletion as a threat to the world's large carnivores. *Royal Society Open Science*, 3(8), 160252. <https://doi.org/10.1098/rsos.160252>
- Wolf, C., & Ripple, W. J. (2017). Range contractions of the world's large carnivores. *Royal Society Open Science*, 4(7), 170052. <https://doi.org/10.1098/rsos.170052>
- Wood, S. N. (2008). Fast Stable Direct Fitting and Smoothness Selection for Generalized Additive Models. *Journal of the Royal Statistical Society Series B: Statistical Methodology*, 70(3), 495–518. <https://doi.org/10.1111/j.1467-9868.2007.00646.x>
- Wood, S. N. (2017). *Generalized Additive Models: An Introduction with R* (2nd ed.). Chapman and Hall/CRC. <https://doi.org/10.1201/9781315370279>
- Woodroffe, R. (2000). Predators and people: Using human densities to interpret declines of large carnivores. *Animal Conservation*, 3(2), 165–173. <https://doi.org/10.1111/j.1469-1795.2000.tb00241.x>
- Woodward, F. I., & Williams, B. G. (1987). Climate and plant distribution at global and local scales. *Vegetatio*, 69(1–3), 189–197. <https://doi.org/10.1007/BF00038700>
- Young, H. S., McCauley, D. J., Galetti, M., & Dirzo, R. (2016). Patterns, Causes, and Consequences of Anthropocene Defaunation. *Annual Review of Ecology, Evolution, and Systematics*, 47(1), 333–358. <https://doi.org/10.1146/annurev-ecolsys-112414-054142>
- Young, T. P. (2000). Restoration ecology and conservation biology. *Biological Conservation*, 92(1), 73–83. [https://doi.org/10.1016/S0006-3207\(99\)00057-9](https://doi.org/10.1016/S0006-3207(99)00057-9)
- Zimmermann, F., & Breitenmoser, U. (2007). Potential distribution and population size of the Eurasian lynx *Lynx lynx* in the Jura Mountains and possible corridors to adjacent ranges. *Wildlife Biology*, 13(4), 406–416. [https://doi.org/10.2981/0909-6396\(2007\)13\[406:PDAPSO\]2.0.CO;2](https://doi.org/10.2981/0909-6396(2007)13[406:PDAPSO]2.0.CO;2)
- Zuur, A. F., Ieno, E. N., & Smith, G. M. (2007). *Analysing Ecological Data*. Springer New York. <https://doi.org/10.1007/978-0-387-45972-1>

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These references follow the citations and referencing rules of the journal *Global Change Biology* (<https://onlinelibrary.wiley.com/journal/13652486>).

## 7. Appendices

### 7.1. List of historical sources

- “A Féra Enigmática”. (1842). *Revista universal lisbonense: jornal dos interesses physicos, moraes e litterarios por uma sociedade estudiosa*, 2(15), 187.
- “Raridade Zoológica”. (1842). *Revista universal lisbonense: jornal dos interesses physicos, moraes e litterarios por uma sociedade estudiosa*, 2(9), 108.
- Abascal, G. (1996). *Las fieras en el imaginario popular alavés*.
- Abreu, B. L. de. (1726). *Portugal Medico ou Monarchia medico-lusitana: Historica, practica, symbolica, ethica, e politica: Vol. Parte I*. Officina de Joam Antunes.
- Acevedo, B. (1898). Boal y su concejo. In *Biblioteca Popular Asturiana* (Vol. 2). Tipografía de Adolfo Brid.
- Acevedo, B. (1921). Boal y su concejo. In *Biblioteca Popular Asturiana* (Vol. 2). Compañía Editorial HERMES.
- Aguirre, J. G. (1897). *Diccionario Geografico y Estadistico de Asturias*. Imp. La Tipografía.
- Álvares, F. (1997). *O Lince-ibérico (Lynx pardinus) no Noroeste de Portugal: Presença Histórica e Situação Actual* (Conservação do lince-ibérico em Portugal, p. 42). Instituto da Conservação da Natureza.
- Andrade, A. R. de. (1878). *Diccionario Chorographico do Reino de Portugal*. Imprensa da Universidade de Coimbra.
- Anonymous. (1730). *Antigas histórias da Freguesia de Salto* (P. J. Barroso, Trans.).
- Anonymous. (1760). Relação verdadeira da espantosa fêra, que ha tempos a esta parte tem apparecido em as visinhanças de Chaves: Os estragos que tem feito, e diligencias que se fazem para a apanharem: Segundo as noticias participadas por cartas de pessoas fidedignas daquella Provincia (Vol. 1). Officina de Joseph Filippe.
- Anonymous. (1760). Relação verdadeira da espantosa fêra, que ha tempos a esta parte tem apparecido em as visinhanças de Chaves: Os estragos que tem feito, e diligencias que se fazem para a apanharem: Segundo as noticias participadas por cartas de pessoas fidedignas daquella Provincia (Vol. 2). Officina de Joseph Filippe.
- Anonymous. (1777, August). *Mercurio histórico y político*, 319.
- Anonymous. (1840). *La Alhambra. Periodico de ciencias, literatura y bellas artes*, 6(2), 33.
- Anonymous. (1840). *Revista Gaditana. Periódico Popular*, 204.
- Anonymous. (1842). Noticia da Freguesia de S. João do Campo. In *Revista Litteraria: Periodico de Litteratura, Philosophia, Viagens, Sciencias, e Bellas-Artes* (Vol. 9, p. 45). Typographia da Revista.
- Anonymous. (1842, October 10). *El Corresponsal*, 1293, 4.
- Anonymous. (1844, October 13). *El Imparcial. Diario de Política, Literatura, Comercio e Industria*, 3(754), 3.
- Anonymous. (1865, May 20). *El Pabellón Nacional, Madrid*, 8.
- Anonymous. (1865, May 20). *La Abeja, Barcelona*, 113.
- Anonymous. (1876, September 10). *Las Maravillas y El Progreso Del Siglo*, 12, 6.
- Anonymous. (1884, October 25). *La Unión, Madrid*, 3(848).
- Anonymous. (1888, August 5). *Diario de Tortosa*.
- Anonymous. (1889, November 18). *La Vanguardia, Barcelona*, 2.
- Anonymous. (1895, December 28). *El Correo Español. Diario Tradicionalista*, 7(2195).
- Anonymous. (1907). *Dicionário de Portugal: Vol. III*.
- Anonymous. (1910, September 28). *El Guadalete: Periódico Político y Literario*, 56(17548), 9.

- Anonymous. (1914, January 24). *La Publicidad: Diario de Avisos, Noticias y Telegramas, Eco Fiel de La Opinión y Verdadero Trasmisor de Los Intereses Morales y Materiales de Granada y Su Provincia*, 34(9350), 3.
- Aranha, P. W. de B. (1871). *Memoria Historico-Chorographica dos Diversos Concelhos do Distrito Administrativo de Coimbra*. Livraria de A. M. Pereira – Editor.
- Arce, J. D. G. (1989). Cuadernos de ordenanzas y otros documentos sevillanos del reinado de Alfonso X. *HISTORIA, INSTITUCIONES, DOCUMENTOS*, 103–132. <https://doi.org/10.12795/hid.1989.i16.04>
- Azua, N. R. de, & Fernández, J. M. (2005). Presencia histórica del lince o “tigre” en el País Vasco. *Avnia*, 10, 82–95.
- Baptista, J. M. (1874). *Chorographia Moderna do Reino de Portugal: Vol. I*. Typographia da Academia Real de Ciências.
- Baptista, J. M. (1875). *Chorographia Moderna do Reino de Portugal: Vol. II*. Typographia da Academia Real de Ciências.
- Baptista, J. M. (1875). *Chorographia Moderna do Reino de Portugal: Vol. III*. Typographia da Academia Real de Ciências.
- Baptista, J. M. (1876). *Chorographia Moderna do Reino de Portugal: Vol. IV*. Typographia da Academia Real de Ciências.
- Baptista, J. M. (1876). *Chorographia Moderna do Reino de Portugal: Vol. V*. Typographia da Academia Real de Ciências.
- Baptista, J. M. (1878). *Chorographia Moderna do Reino de Portugal: Vol. VI*. Typographia da Academia Real de Ciências.
- Baptista, J. M. (1879). *Chorographia Moderna do Reino de Portugal: Vol. VII*. Typographia da Academia Real de Ciências.
- Barahona, A. J. G. de. (1843). Linces (Carta.). *Revista universal lisbonense: jornal dos interesses physicos, moraes e litterarios por uma sociedade estudiosa*, 2(21), 267.
- Becerro, R. (1919). *Descripciones de Álava*. Real Ateneo de Vitoria.
- Bedoya, S. M. y. (1826). *Diccionario Geográfico y Estadístico de España y Portugal*. Im. Pierad – Peralta.
- Bernardo, J. M. de. (1988). *Textos histórico-geográficos de Córdoba y su provincia*. Diputación Provincial de Córdoba.
- Bettencourt, E. A. de. (1885). *Diccionario Chorographico do Reino de Portugal e Ilhas Adjacentes* (3rd ed.). Typographia Universal de Thomaz Quintino Antunes.
- Bowles, G. (1775). *Introduccion a la Historia Natural, y a la Geografía Física de España*. Imprenta de D. Francisco Manuel de Mena.
- Braga, J. (2014). *Memórias Paroquiais: Índice* (1/2014 ed.). Arquivo Nacional da Torre do Tombo.
- Brito, B. de. (1597). *Geographia Antiga de Lusytania*. Antonio Aluarez.
- Camara, P. P. da. (1850). *Diccionario Geographico Historico Politico e Litterario do Reino de Portugal e dos Seus Dominios: Vol. I*.
- Camara, P. P. da. (1850). *Diccionario Geographico Historico Politico e Litterario do Reino de Portugal e dos Seus Dominios: Vol. II*. Eduardo e Henrique Laemmert.
- Campos y Fernández de Sevilla, F. J. (2021). *Los pueblos de la provincia de Ciudad Real en las relaciones geográficas de Tomás López*. Estudios Superiores del Escorial.
- Canella, J. M. J. y. (1932). *Topografia Médica del Término Municipal de Sobrescobio*.
- Capela, J. V. E. (2003). As freguesias do distrito de Braga nas Memórias Paroquiais de 1758: A construção do imaginário minhoto setecentista. Universidade de Minho.
- Capela, J. V. E. (2005). As freguesias do distrito de Viana do Castelo nas Memórias Paroquiais de 1758: A construção do imaginário minhoto setecentista. Universidade de Minho.

- Capela, J. V. E., & Matos, H. (2010). As freguesias do distrito de Viseu nas Memórias Paroquiais de 1758. Universidade do Minho.
- Capela, J. V. E., & Matos, H. (2011). As freguesias dos distritos de Aveiro e Coimbra nas Memórias Paroquiais de 1758: Memórias, história e património. Universidade de Minho.
- Capela, J. V. E., & Matos, H. (2013). As freguesias do distrito da Guarda nas Memórias Paroquiais de 1758. Memória, história e património. Universidade de Minho.
- Capela, J. V. E., Borralheiro, R., & Matos, H. (2006). As freguesias do Distrito de Vila Real nas Memórias Paroquiais de 1758: Memórias, histórica e património. Universidade de Minho.
- Capela, J. V. E., Borralheiro, R., Matos, H., & Oliveira, C. P. de. (2007). As freguesias do Distrito de Bragança nas Memórias Paroquiais de 1758: Memórias, histórica e património. Universidade de Minho.
- Capela, J. V. E., Matos, H., & Castro, S. M. G. M. (2016). As freguesias dos distritos de Lisboa e Setúbal nas Memórias Paroquiais de 1758. Memórias, história e património. Universidade de Minho.
- Capela, J. V. E., Matos, H., & Castro, S. M. G. M. (2019). As freguesias do Distrito de Castelo Branco, Portalegre e Olivença nas Memórias Paroquiais de 1758. Memórias, história e património. Universidade de Minho.
- Capela, J. V. E., Matos, H., & Castro, S. M. G. M. (2021). As freguesias dos distritos de Leiria e Santarém nas Memórias Paroquiais de 1758: Memórias história e património. Universidade de Minho.
- Cardoso, L. (1747). *Diccionario Geografico ou Noticia Historica de Todas as Cidades, Villas, Lugares, e Aldeas, Rios, Ribeiras, e Serras dos Reynos de Portugal, e Algarve, com todas as cousas raras, que nelles se encontrão, assim antigas, como modernas: Vol. I.* Regia Officina Sylviana e da Academia Real.
- Cardoso, L. (1751). *Diccionario Geografico ou Noticia Historica de Todas as Cidades, Villas, Lugares, e Aldeas, Rios, Ribeiras, e Serras dos Reynos de Portugal, e Algarve, com todas as cousas raras, que nelles se encontrão, assim antigas, como modernas: Vol. II.* Regia Officina Sylviana e da Academia Real.
- Cardoso, L. (Ed.). (1758). *Memórias Paroquias de 1758* [Manuscript] (1–44). <https://digitarq.arquivos.pt/details?id=4238720>
- Cassola, J. B. (1855). *Ensayo histórico sobre la antigüedad, honores y privilegios de la muy noble y leal ciudad de Baza y pueblos de su abadía.* Imprenta de Pedro Flores.
- Castrillo, M. C. (2000). *Doñana nombre a nombre. Estudio de la toponimia del Parque Nacional de Doñana.* Diputación Provincial de Huelva.
- Castro, J. B. de. (1762). *Mappa de Portugal Antigo, e Moderno: Vol. I.* Na Officina Patriarcal de Franciíco Luiz Ameno.
- Castro, J. B. de. (1763). *Mappa de Portugal Antigo, e Moderno: Vol. II.* Na Officina Patriarcal de Franciíco Luiz Ameno.
- Castro, J. B. de. (1763). *Mappa de Portugal Antigo, e Moderno: Vol. III.* Na Officina Patriarcal de Franciíco Luiz Ameno.
- Castro, L. M. P. S.-M. (1815). *Mappa Chronologico do Reino de Portugal e seus Dominios.* J. B. Morando.
- Cazurro, M. (1894). Datos para la fauna de la provincia de Madrid. —Mamíferos. *Actas de La Sociedad Española de Historia Natural*, 23, 188–226.
- Cebrián, A., & Cano, J. (1992). *Relaciones Topográficas de los pueblos del Reino de Murcia. Estudio y transcripción.* Universidad de Murcia.
- Chapman, A., & Buck, W. J. (1893). *Wild Spain [Espana agreste].* Gurney and Jackson.
- Clark, W. G. (1996). *Gazpacho o meses de verano en España.* Aljarife-Comares.

- Clavero, M., & Delibes, M. (2013). Using historical accounts to set conservation baselines: The case of *Lynx* species in Spain. *Biodiversity and Conservation*, 22(8), 1691–1702. <https://doi.org/10.1007/s10531-013-0506-4>
- Cosme, J., & Varandas, J. M. H. (Eds.). (2009). Memórias Paroquiais (1758) – Vol. I [Abação-Alcaria] (Vol. 1). Caleidoscópio.
- Cosme, J., & Varandas, J. M. H. (Eds.). (2010). Memórias Paroquiais (1758-1759) – Vol. II [Alcaria-Alijó] (Vol. 2). Universidade de Lisboa : Caleidoscópio.
- Cosme, J., & Varandas, J. M. H. (Eds.). (2011). Memórias Paroquiais (1758-1759) – Vol. III [Almonde-Amorim] (Vol. 3). Universidade de Lisboa : Caleidoscópio.
- Cosme, J., & Varandas, J. M. H. (Eds.). (2012). Memórias Paroquiais (1758) – Vol. IV [Ançi-Amóia] (Vol. 4). Caleidoscópio.
- Cosme, J., & Varandas, J. M. H. (Eds.). (2015). Memórias Paroquiais (1758) – Vol. V [Arões-Azurem] (Vol. 5). Caleidoscópio.
- Cosme, J., & Varandas, J. M. H. (Eds.). (2024). Memórias Paroquiais (1832) – Vol. XLII [Suplemento Aguada de Baixo-(São Pedro do) Sul] (Vol. 42). Caleidoscópio.
- Cosme, J., Varandas, J. M. H., & Pinto, T. (Eds.). (2016). Memórias Paroquiais (1758) – Vol. VII [Benavente-Bustelo] (Vol. 7). Caleidoscópio.
- Costa, A. (1929). *Diccionario Chorographico de Portugal Continental e Insular* (Vol. 1). Tipografia e Encadernação Domingos D'Oliveira.
- Costa, A. (1930). *Diccionário Chorographico de Portugal Continental e Insular* (Vol. 2). Typographia Privativa do Diccionario Chorographico Azurara.
- Costa, A. (1932). *Diccionário Chorographico de Portugal Continental e Insular* (Vol. 3). Typographia Privativa do Diccionario Chorographico Azurara.
- Costa, A. (1934). *Diccionário Chorographico de Portugal Continental e Insular* (Vol. 4). Typographia Privativa do Diccionario Chorographico Azurara.
- Costa, A. (1936). *Diccionário Chorographico de Portugal Continental e Insular* (Vol. 5). Typographia Privativa do Diccionario Chorographico Azurara.
- Costa, A. (1938). *Diccionário Chorographico de Portugal Continental e Insular* (Vol. 6). Typographia Privativa do Diccionario Chorographico Azurara.
- Costa, A. (1940). *Diccionário Chorographico de Portugal Continental e Insular* (Vol. 7). Typographia Privativa do Diccionario Chorographico Azurara.
- Costa, A. (1943). *Diccionario Chorographico de Portugal Continental e Insular* (Vol. 8). Typographia Privativa do Diccionario Chorographico Azurara.
- Costa, A. (1947). *Diccionario Chorographico de Portugal Continental e Insular* (Vol. 9). Tipografia Privativa do Diccionario Corografico.
- Costa, A. (1948). *Diccionario Chorographico de Portugal Continental e Insular* (Vol. 10). Tipografia Privativa do Diccionario Corografico.
- Costa, A. (1948). *Diccionario Chorographico de Portugal Continental e Insular* (Vol. 11). Tipografia Privativa do Diccionario Corografico.
- Costa, A. (1949). *Diccionario Chorographico de Portugal Continental e Insular* (Vol. 12). Tipografia Privativa do Diccionario Corografico.
- Costa, A. C. da. (1706). *Corografia Portuguesa e Descripçam Topográfica do Famoso Reyno de Portugal: Vol. I*. Officina de Valentim da Costa Deslandes.
- Costa, A. C. da. (1708). *Corografia Portuguesa e Descripçam Topográfica do Famoso Reyno de Portugal: Vol. II*. Officina de Valentim da Costa Deslandes.
- Costa, A. C. da. (1712). *Corografia Portuguesa e Descripçam Topográfica do Famoso Reyno de Portugal: Vol. III*. Officina de Valentim da Costa Deslandes.
- Elejalde, J. M. (1989). *Ayer y hoy del valle de Aramayona*. Diputación Foral de Álava.

- Escuer, C. (2008). Lobos y lince en la sierra de Alcubierre. *Montesnegros*, 41, 11–13.
- Fernández, J. A. (1974). *Doñana*. Ediciones Olivo.
- Fernández, J. M., & Azua, N. R. de. (2003). Mastofauna. In *Estudio Faunístico del Parque Natural de Gorbeia* (pp. 361–449). Diputación Foral de Álava / Arabako Foru Aldundia.
- Fernández, J., Sancho, A., & Collantes, F. (1941). *Colección diplomática de Carmona*. Imprenta Editorial de la Gavidia.
- Ferreira, J. M. (1728). *Thesouro de Braga descoberto no Campo do Gerês* (Edição facsimulada de 1994). Camara Municipal de Terras de Bouro.
- Freire, A. de O. (1739). *Descripçam Corografica do Reyno de Portugal*. Officina de Miguel Rodrigues.
- García González, M. José. (1998). *El Bierzo a finales del siglo XVIII: Según las respuestas al interrogatorio de Tomás López*. Instituto de estudios bercianos.
- García, J. S. y. (1885). *Catálogo de los Mamíferos y Aves observados en la Provincia de Granada*. Imprenta de Indalecio Ventura / Real Sociedad Económica de Granada.
- González de Viñaspre, R., & Uribarrena, P. (2009). Osos y tigres en la montaña alavesa. *Herria*, 4, 10–11.
- González, M., & García, M. (1992). *Actas Capitulares de Morón de la Frontera (1402-1426)*. Diputación Provincial de Sevilla.
- Gorosábel, P. de. (1868). *Noticia de las Cosas Memorables de Guipúzcoa: Vol. I*.
- Graells, M. de la P. (1897). Fauna Mastodológica Ibérica. In *Memorias de la Real Academia de Ciencias: Vol. XVII*. Imprenta de Don Luis Aguado. [http://www.archive.org/stream/memoriasdelareal1797real/memoriasdelareal1797real\\_djvu.txt](http://www.archive.org/stream/memoriasdelareal1797real/memoriasdelareal1797real_djvu.txt)
- Grandal d'Anglade, A. M. (2024, March 5). *El último lince boreal de la Península Ibérica: El individuo de Sima Topinoria y su excepcional valor científico* [Oral Presentation].
- Gutiérrez-Alba, V. (2007). Apuntes históricos sobre el lince ibérico en Andalucía. *Galemys, Spanish Journal of Mammalogy*, 19(2), 33–52. <https://doi.org/10.7325/Galemys.2007.2.A3>
- Honorato, M. (1734). *Relacam de huma Formidavel Fera, que Sahio da Montanha de Gerez junto à Villa de Monte-Alegre na Provincia de Tras os Montes, no mez de Mayo deste presente anno de 1734, e dos grandes estragos, que tem cometido na gente, e gados dos Lugares circunvezinhos*. Officina Joaquianna de Musica.
- Irueste, J. F. y T., Vizconde de. (1887, January 23). Una montería. *La Época*, 39(12394), 2.
- Izaguirre, R. de. (1934). Las Ciencias Naturales y los archivos: Katamotz = ¿Tigre? *Revista Internacional de Estudios Vascos*, 25, 707–714.
- Iztueta, J. I. de. (1847). *Guipuzcoaco Provinciaren Condaira edo Historia*. Ignacio Ramon Baroja-ren moldizteguian.
- Jiménez, J., Clavero, M., & Reig-Ferrer, A. (2018). New old news on the “Lobo cervical” (*Lynx lynx*?) in NE Spain. *Galemys, Spanish Journal of Mammalogy*, 30, 31–36. <https://doi.org/10.7325/Galemys.2018.A3>
- Leal, A. S. d'Azevedo B. de P. (1873). *Portugal Antigo e Moderno. Dicionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal: Vol. I*. Livraria Editora de Mattos Moreira & Companhia.
- Leal, A. S. d'Azevedo B. de P. (1874). *Portugal Antigo e Moderno. Dicionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal: Vol. II*. Livraria Editora de Mattos Moreira & Companhia.
- Leal, A. S. d'Azevedo B. de P. (1874). *Portugal Antigo e Moderno. Dicionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de*

- Todas as Cidades, Villas e Freguesias de Portugal: Vol. III.* Livraria Editora de Mattos Moreira & Companhia.
- Leal, A. S. d'Azevedo B. de P. (1874). *Portugal Antigo e Moderno. Diccionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal: Vol. IV.* Livraria Editora de Mattos Moreira & Companhia.
- Leal, A. S. d'Azevedo B. de P. (1875). *Portugal Antigo e Moderno. Diccionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal: Vol. V.* Livraria Editora de Mattos Moreira & Companhia.
- Leal, A. S. d'Azevedo B. de P. (1875). *Portugal Antigo e Moderno. Diccionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal: Vol. VI.* Livraria Editora de Mattos Moreira & Companhia.
- Leal, A. S. d'Azevedo B. de P. (1876). *Portugal Antigo e Moderno. Diccionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal: Vol. VII.* Livraria Editora de Mattos Moreira & Companhia.
- Leal, A. S. d'Azevedo B. de P. (1878). *Portugal Antigo e Moderno. Diccionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal: Vol. VIII.* Livraria Editora de Mattos Moreira & Companhia.
- Leal, A. S. d'Azevedo B. de P. (1880). *Portugal Antigo e Moderno. Diccionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal: Vol. IX.* Livraria Editora de Mattos Moreira & Companhia.
- Leal, A. S. d'Azevedo B. de P. (1882). *Portugal Antigo e Moderno. Diccionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal: Vol. X.* Livraria Editora de Mattos Moreira & Companhia.
- Leão, D. N. do. (1610). *Descrição do Reino de Portugal.* Jorge Rodriguez.
- Lopes, J. B. da S. (1841). *Corografia ou Memoria Economica, Estadistica, e Topografica do Reino do Algarve.* Typografia da Academia Real das Ciências de Lisboa.
- López de Guereñu, G. (1957). La caza en la montaña alavesa. *Munibe*, 9, 226–262.
- López, G., Villalpando-Moreno, A., Sarmiento, P., Garrote, G., López, M., Piñero, P., Fernandes, M., & Salcedo, F. J. (2024). Historical distribution of the Iberian lynx. *The Iberian Lynx – Rescue of an Iconic Species (Special Issue of CATnews)*, 17, 7–12.
- Lopez, T. (1804). *Atlas Geográfico de España, que comprehende el mapa general del reyno, y los particulares de sus provincias (Índice).*
- Maceiras, J. P. (2013). El lobo cerval: Notas Etnográficas. *Argutorio*, 30, 16–20.
- Madoz, P. (1845-1850). *Diccionario Geográfico-Estadístico-Histórico de España y sus posesiones de ultramar* (1–16). Imp. Madoz y Sagasti.
- Maluquer i Sostres, J. (1992). Notícia de la fauna de Catalunya i d'Andorra al final del segle XVIII. *Butlletí de La Institució Catalana d'Història Natural*, 5–21.
- Martinez-Marina, F. (1805). Diccionario Geográfico-Histórico de Asturias. In *Manuscritos. Archivo Real Academia de la Historia (R.A.H. 9-6032/9-6038).*

- Mascarenhas, J. A. D., & Abreu, R. C. de. (1879). *Portugal: Dicionario Chorographico, Historico, Heraldico, Ethologico, Biographico, Estatistico, Arqueologico e Bibliografico: Vol. I.* Typographia Gutierrez.
- Massip, J. M. (2012). L'enigma històric del llop cerver de Salt. *Revista de Girona*, 272, 44–47.
- Mira, J. P. de. (1875). *Um brado contra as monterias de cerco aos Lobos na Provincia do Alemtejo*. Typ. de F. C. Bravo. <https://www.gutenberg.org/files/29039/29039-h/29039-h.htm>
- Moller, A. F. (1893). Notas sobre a fauna da Serra do Suajo. In A. Nobre, *Annaes de Sciencias Naturaes* (Vol. 1, pp. 42–45). Typographia Occidental.
- Monteiro, J. M. de S. (1850). *Diccionario Geographico das Provincias e Possessões Portuguezas no Ultramar*. Typographia Lisbonense de José Carlos de Aguiar Vianna.
- Múgica, S. (1921). Provincia de Guipúzcoa. In *Geografía General del País Vasco-Navarro*. Establecimiento Editorial de Alberto Martín.
- Navarro, A. J. (1798). La ciudad y territorio de Baza. *Boletín de La Real Academia de Historia*, 70, 259–286.
- Navarro, A. J. (2000). *Viajes de un naturalista ilustrado por los reinos de Granada y Murcia* (J. C. Fernández, Ed.). Universidad de Murcia.
- Nores, C. (1999). ¿Es el lobo cervical un linco boreal (*Lynx lynx*)? *IV Jornadas Españolas de Conservación y Estudio de Mamíferos, Libro de resúmenes*, 87.
- Nores, C., & Vázquez, V. (1984). Datos sobre la Presencia del Linco en Asturias desde el siglo XVII. *Acta Biologica Montana*, 4, 361–370.
- Núñez, A. M. y. (1869). *Catálogo metódico y razonado de los mamíferos de Andalucía*. Imp. de Gironés y Orduña.
- Olavarria, J. (1951). Tigres en Gorbea. *Vida Vasca*, 28, 73–75.
- Pacios, A. F. (2013). El linco ibérico en los Montes Aquilanos. *Argutorio*, 30, 21–24.
- Pereira, E., & Rodrigues, G. (1904). *Portugal: Dicionario Historico, Chorographico, Biographico, Bibliographico Heráldico, Numismático e Artístico: Vol. I.* João Romano Torres.
- Pereira, E., & Rodrigues, G. (1906). *Portugal: Dicionario Historico, Chorographico, Biographico, Bibliographico Heráldico, Numismático e Artístico: Vol. II.* João Romano Torres.
- Pereira, E., & Rodrigues, G. (1907). *Portugal: Dicionario Historico, Chorographico, Biographico, Bibliographico Heráldico, Numismático e Artístico: Vol. III.* João Romano Torres.
- Pereira, E., & Rodrigues, G. (1909). *Portugal: Dicionario Historico, Chorographico, Biographico, Bibliographico Heráldico, Numismático e Artístico: Vol. IV.* João Romano Torres.
- Pereira, E., & Rodrigues, G. (1911). *Portugal: Dicionario Historico, Chorographico, Biographico, Bibliographico Heráldico, Numismático e Artístico: Vol. V.* João Romano Torres.
- Pereira, E., & Rodrigues, G. (1912). *Portugal: Dicionario Historico, Chorographico, Biographico, Bibliographico Heráldico, Numismático e Artístico: Vol. VI.* João Romano Torres.
- Pereira, E., & Rodrigues, G. (1915). *Portugal: Dicionario Historico, Chorographico, Biographico, Bibliographico Heráldico, Numismático e Artístico: Vol. VII.* João Romano Torres.
- Pereira, J. F. (1854). *Compendio de Corographia Portuguesa* (5ª Edição). Typographia de A. Martins.
- Pimenta, M. B., & Caetano, P. (2022). *Feras e homens: A Fauna no Portugal Medieval*. Editorial Bizâncio.
- Piñeiro Maceiras, J., Pérez García, P., Pérez García, I., Calderón Reñón, A., Paz Martínez, J. J. de, González Salvador, I., & Piñeiro Maceiras, M. L. (2012). *El Linco del Noroeste y las Montañas Galaico-Leonesas*. Asociación Cultural “Monte Irago.”
- Portal, A. R. de O. y. (1844). *Informe por las causas de la decadencia de la ganaderia en Asturias y medios de mejorarla*. Imprenta de D. Benito Gonzalez y Compañía.
- Portugal 1758. (2024). [Dataset]. CIDEHUS Digital, Universidade de Évora. <https://www.cidehusdigital.uevora.pt/>

- Prieto, P. de M. (1904). *Las Monterías en Sierra Morena á mediados de siglo XIX*. Establecimiento Tipográfico del Colegio de Santiago.
- Puerto, J. S. (2011). El animal feroz y desconocido que en 1760 se vio, se mató y se desolló en El Bierzo. *Revista de Estudios Bercianos*, 35–36, 27–54.
- Ramírez, L. M. (1840). *Corografía Histórico-Estadística de la provincia y obispado de Córdoba: Vol. I&II*. Imprenta de Noguer y Manté.
- Real Academia de La Historia. (1802). Diccionario Geográfico-Histórico de Pais Vasco y Navarra. In *Diccionario Geográfico, Histórico de España, por la Real Academia de La Historia*. Imp. Academia.
- Reguera Rodríguez, A. T. (2012). *Relaciones geográficas de la provincia de León*. Universidad de León.
- Reguera, L. M. y. (1881). *Fauna de Sierra Morena Catálogo de los Mamíferos del Término de Montoro*. Imp. M. Romero.
- Regueras Grande, J. I. (2001). Caza y pesca zamorana en 1850 y en la actualidad. *Brigecio: revista de estudios de Benavente y sus tierras*, II, 177–194.
- Rodríguez-Varela, R., García, N., Nores, C., Álvarez-Lao, D., Barnett, R., Arsuaga, J. L., & Valdiosera, C. (2015). Ancient DNA reveals past existence of Eurasian lynx in Spain. *Journal of Zoology*, 298(2), 94–102. <https://doi.org/10.1111/jzo.12289>
- Roso de Luna, M. (2004). *El tesoro de los Lagos de Somiedo narración ocultista* (1ª ed). Humanistas.
- Rubio, J. O. (1918). *Relaciones Topográficas de los Pueblos de España*. Sociedad Española de Artes Gráficas.
- Ruiz, J. E. (1999). *Los pueblos de Huelva en el siglo XVIII (según el Diccionario del Geógrafo Real D. Tomás López)*. Diputación Provincial de Huelva.
- Sarmiento, M. (with Laserna, Í. M. de A.). (1999). *Sobre el lobo cervical o el lubicán de Galicia*. Marqués de Laula.
- Secco, A. L. de S. H. (1853). *Memoria Historico-Chorographica dos Diversos Concelhos do Distrito Administrativo de Coimbra*. Imprensa da Universidade de Coimbra.
- Seoane, V. L. (1861). *Fáuna Mastológica de Galicia* (pp. 58–226). Imprenta de Manuel Mirás.
- Silveira, F. do N. (1804). *Mappa breve da Lusitania antiga, e Galliza Bracarense: Vol. I*. Officina de Simão Thaddeo Ferreira.
- Suman, M. (1802). *Apuntes para el Diccionario Geográfico del Reino de Aragón. Partido de Cinco Villas* (J. Salvo & A. Capalvo, Eds.). Institución Fernando el Católico.
- Tavares, J. S. (1902). Quatro dias na Estrella. In *Broteria: Revista de Sciencias Naturaes do Collegio de S. Fiel* (Vol. 1, p. 178). La Bécarre.
- Torre, F. R. de la, & Valero, J. C. (1987). *Relaciones geográficas-históricas de Albacete (1786-1789) de Tomás López*. Instituto de Estudios Albacetenses de la Excmá, Diputacion de Albacete and CSIC Confederacion Española de Centros de Estudios Locales.
- Torrente, J. P. (1997). La chasse aux grands carnivores dans les Asturies au XVIIIe siècle. Les papeletas de fieras (billets de bêtes sauvages). *Histoire & Sociétés Rurales*, 8(1), 163–186. <https://doi.org/10.3406/hsr.1997.1039>
- Torrente, J., & Llana, L. (1996). Sobre'l llobu cervical y la so presencia n'Asturies. *Asturies*, 2, 81–86.
- Urruela, J. M. G. (2021). A historical approach to the control of the lynx and wild cat populations in Bizkaia (1600-1940). *Kobie Antropología Cultural*, 23, 13–36.
- Vasconcellos, J. L. de. (1884). *Diccionario da Chorographia de Portugal*. Livraria Portuense de Clavel & C.<sup>a</sup>.
- Vázquez, V. M. (2007, May 6). Muniellos. *La Nueva España*. <https://www.lne.es/opinion/2007/05/06/muniellos-21890116.html>
- Viana, D. S., Blanco-Garrido, F., Delibes, M., & Clavero, M. (2022). A 16th-century biodiversity and crop inventory. *Ecology*, 103(10), e3783. <https://doi.org/10.1002/ecy.3783>

- Victorero, S. (1896). *Descripción geográfico histórica del Conejo de Colunga en el Principado de Asturias*.
- Villalain, J. (1923). *Topografía Médica del Conejo de Illas*.
- Villalain, J. (1925). *Topografía Médica del Conejo de Corvera de Asturias*.
- Villalpando-Moreno, A. (2020). *Lynx* sp. at Spain during XIXth century. A case of study from Ecohistory. *RIPARIA*, 6, 74–150. <https://doi.org/10.25267/Riparia.2020.v6.03>
- Villegas, L. R., & García, R. (1976). Relación de los pueblos de Jaén, de Felipe II. In *Boletín del Instituto de Estudios Giennenses*. Diputación Provincial de Jaén. CSIC.
- Viñas, C., & Paz, R. (1951). Reino de Toledo. In *Relaciones Historico-Geografico-Estadísticas de los Pueblos de España hechas por iniciativa de Felipe II* (Vol. 1). Instituto de Sociología “Balmes”, Instituto de Geografía “Juan Sebastian Elcano”, and Consejo Superior de Investigaciones Científicas.
- Viñas, C., & Paz, R. (1963). Reino de Toledo. In *Relaciones Historico-Geografico-Estadísticas de los Pueblos de España hechas por iniciativa de Felipe II* (Vol. 3). Instituto de Sociología “Balmes”, Instituto de Geografía “Juan Sebastian Elcano”, and Consejo Superior de Investigaciones Científicas.
- Viñas, C., & Paz, R. (1971). Ciudad Real. In *Relaciones Historico-Geografico-Estadísticas de los Pueblos de España hechas por iniciativa de Felipe II*. Instituto de Sociología “Balmes”, Instituto de Geografía “Juan Sebastian Elcano”, and Consejo Superior de Investigaciones Científicas.
- Zaldívar, C. (2008). Apuntes para la desdichada historia del oso, la cabra montés y el lince en La Rioja. *Belezos*, 6, 44–49.

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Note 1: Above, the references that are underlined are those that, despite having been referenced in this or previous works, could not be revised. Some excerpts from these works were included in others references also mentioned above and, therefore, the sightings of lynxes in these references could be included. However, in other cases this did not happen and therefore the lynx sightings contained therein were not included in the final table (Appendix 7.3.) or used in the models (Appendix 7.9.).

Note 2: The list above refers to all works consulted and/or referenced in this and previous works and not just those that include lynx observations. For a curated list of lynx observations, see Appendix 7.3..

## 7.2. List of terms used in word search

The full list of terms is: “cerbal”, “çerual”, “cerval”, “çerval”, “cervate”, “cervato”, “cerver”, “cervir”, “cierval”, “clavo”, “corvato”, “cravo”, “felis”, “felix”, “gato”, “gatto”, “katamotz”, “katamotza”, “leopardo”, “liberne”, “lince”, “lleopardo”, “llob”, “llobo”, “llop”, “lob”, “loba”, “lobo”, “lovo”, “lúbican”, “lubican”, “lynce”, “lynx”, “onça”, “onza”, “pantera”, “pardina”, “pardinus”, “serbal”, “serber”, “serval”, “sorvato”, “tigre”, “tiguere”, and “zerbal”. This list includes terms in Portuguese, Spanish (Castilian), Catalan, and Basque. For a comprehensive list of common and vernacular names for the *Lynx* species in the Iberian Peninsula, see Samblás (2021).

### 7.2.1. References

Samblás, F. J. (2021). *Diccionario etimológico de los nombres vernáculos, populares, comunes y científicos de los mamíferos de España*. Circulo Rojo.

### 7.3. Historical occurrences of lynxes (*Lynx* spp.) in Iberia

Table A.1 – Historical occurrences of lynxes (*Lynx* spp.) in the Iberian Peninsula. The lynx occurrences can be found in the pages identified in the reference section. The coordinate reference system of the longitude and latitude is the ETRS89-extended / LAEA Europe coordinate reference system (EPSG:3035).

| Species              | Term        | Locality                   | Country  | Year      | Century | Longitude   | Latitude    | References                                                                                                                                                                                                                                                                                             |
|----------------------|-------------|----------------------------|----------|-----------|---------|-------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Lynx pardinus</i> | Gato cerval | Agudo                      | Spain    | 1845-1850 | XIX     | 3033746.956 | 1892284.814 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                              |
| <i>Lynx lynx</i>     | Lobo cerval | Alcubierre                 | Spain    | 1704      | XVIII   | 3450504.535 | 2135688.958 | Escuer, C. (2008). Lobos y linces en la sierra de Alcubierre. Montesnegros, 41: 11-13.                                                                                                                                                                                                                 |
| <i>Lynx pardinus</i> | Gato-cravo  | Amareleja                  | Portugal | 1758      | XVIII   | 2815970.698 | 1851368.364 | Cardoso, L. (1758). Amareleja, Moura. In Memórias Paroquiais (Vol. 3, pp. 471–478).                                                                                                                                                                                                                    |
| <i>Lynx lynx</i>     | Tigre       | Antoñana                   | Spain    | 1645-1806 | XVIII   | 3307211.378 | 2260123.039 | González de Viñaspre, R. & Uribarrena, P. (2009). Osos y tigres en la montaña alavesa. Herria 4: 10-11.                                                                                                                                                                                                |
| <i>Lynx lynx</i>     | Tigre       | Antoñana                   | Spain    | 1693      | XVII    | 3307211.378 | 2260123.039 | González de Viñaspre, R. & Uribarrena, P. (2009). Osos y tigres en la montaña alavesa. Herria 4: 10-11.                                                                                                                                                                                                |
| <i>Lynx lynx</i>     | Tigre       | Antoñana                   | Spain    | 1694      | XVII    | 3307211.378 | 2260123.039 | González de Viñaspre, R. & Uribarrena, P. (2009). Osos y tigres en la montaña alavesa. Herria 4: 10-11.                                                                                                                                                                                                |
| <i>Lynx lynx</i>     | Tigre       | Antoñana                   | Spain    | 1708      | XVIII   | 3307211.378 | 2260123.039 | González de Viñaspre, R. & Uribarrena, P. (2009). Osos y tigres en la montaña alavesa. Herria 4: 10-11.                                                                                                                                                                                                |
| <i>Lynx lynx</i>     | Tiguere     | Apellaniz                  | Spain    | 1787      | XVIII   | 3301101.639 | 2265149.177 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                          |
| <i>Lynx lynx</i>     | Tiguere     | Apellaniz                  | Spain    | 1802      | XIX     | 3301101.639 | 2265149.177 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                          |
| <i>Lynx pardinus</i> | Gato cerval | Apellaniz                  | Spain    | 1804      | XIX     | 3301101.639 | 2265149.177 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                          |
| <i>Lynx pardinus</i> | Lobo-cerval | Aranhas                    | Portugal | 1758      | XVIII   | 2867938.229 | 2055637.241 | Cardoso, L. (1758). Aranhas, Penamacor. In Memórias Paroquiais (Vol. 4, pp. 197-207).                                                                                                                                                                                                                  |
| <i>Lynx pardinus</i> | Gato cerval | Aroche                     | Spain    | 1845-1850 | XIX     | 2833624.258 | 1817401.242 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                              |
| <i>Lynx pardinus</i> | Lince       | Aroche                     | Spain    | 1845-1850 | XIX     | 2833624.258 | 1817401.242 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                              |
| <i>Lynx lynx</i>     | Lobo cerval | Arros i Vila (Vall d'Aran) | Spain    | XVIII     | XVIII   | 3564276.83  | 2227906.207 | Maluquer i Sostres, J. (1992). Notícia de la fauna de Catalunya i d'Andorra al final del segle XVIII. Butlletí de La Institució Catalana d'Història Natural, 5–21. <a href="https://raco.cat/index.php/ButlletiICHN/article/view/14340">https://raco.cat/index.php/ButlletiICHN/article/view/14340</a> |
| <i>Lynx lynx</i>     | Tiguere     | Ataun                      | Spain    | 1606      | XVII    | 3330679.612 | 2290732.056 | Izaguirre, R. de. (1934). Las Ciencias Naturales y los archivos: Katamotz = ¿Tigre? Revista Internacional de Estudios Vascos, 25, 707–714. Múgica, S.                                                                                                                                                  |

|                      |              |                               |        |                            |       |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------|--------------|-------------------------------|--------|----------------------------|-------|-------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      |              |                               |        |                            |       |             |             | (1921). Provincia de Guipúzcoa. In Geografía General del País Vasco-Navarro. Establecimiento Editorial de Alberto Martín. Pp. 205.                                                                                                                                                                                                                                                                                           |
| <i>Lynx lynx</i>     | Lobo cerval  | Aure Valley (French Pyrenees) | France | 1775                       | XVIII | 3533771.804 | 2249787.549 | Bowles, G. (1775). Introduccion a la Historia Natural, y a la Geografía Física de España. Imprenta de D. Francisco Manuel de Mena. pp. 395                                                                                                                                                                                                                                                                                   |
| <i>Lynx lynx</i>     | Tigre        | Ausejo                        | Spain  | final XVIII<br>Tomás López | XVIII | 3319836.972 | 2218618.782 | Zaldívar, C. (2008). Apuntes para la desdichada historia del oso, la cabra montés y el lince en La Rioja. Belezos, 6: 44-49.                                                                                                                                                                                                                                                                                                 |
| <i>Lynx lynx</i>     | Lobo corvato | Ausejo                        | Spain  | final XVIII<br>Tomás López | XVIII | 3319836.972 | 2218618.782 | Zaldívar, C. (2008). Apuntes para la desdichada historia del oso, la cabra montés y el lince en La Rioja. Belezos, 6: 44-49.                                                                                                                                                                                                                                                                                                 |
| <i>Lynx lynx</i>     | Lobo cerval  | Aviles                        | Spain  | 1722                       | XVIII | 3041631.799 | 2408979.143 | Sarmiento, M. (1760). Discurso sobre un animal feroz y desconocido que a la vista del Monasterio benedictino de San Pedro de Montes, en El Bierzo, se vió, se mató, se cogió y se desolló; y cuya piel se conserva hoy en el Monasterio. Copy of the unpublished manuscript preserved at the Fundación Universitaria Española, Madrid (edited by José Santos Puerto, 2010-2011, Revista de Estudios Bercianos 35-36: 27-54). |
| <i>Lynx lynx</i>     | Lúbican      | Aviles                        | Spain  | 1722                       | XVIII | 3041631.799 | 2408979.143 | Sarmiento, M. (1760). Discurso sobre un animal feroz y desconocido que a la vista del Monasterio benedictino de San Pedro de Montes, en El Bierzo, se vió, se mató, se cogió y se desolló; y cuya piel se conserva hoy en el Monasterio. Copy of the unpublished manuscript preserved at the Fundación Universitaria Española, Madrid (edited by José Santos Puerto, 2010-2011, Revista de Estudios Bercianos 35-36: 27-54). |
| <i>Lynx pardinus</i> | Gato cerval  | Azuaga                        | Spain  | 1845-1850                  | XIX   | 2950472.447 | 1827860.494 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                                                                                                                                                    |
| <i>Lynx sp.</i>      | Lince        | Babia                         | Spain  | 1916                       | XX    | 3015406.946 | 2346093.953 | "Roso de Luna, M. (2004). El tesoro de los Lagos de Somiedo narración ocultista (1a. ed). Humanistas. Piñeiro Maceiras, J., Pérez García, P., Pérez García, I., Calderón Reñón, A., Paz Martínez, J. J. de, González Salvador, I., & Piñeiro Maceiras, M. L. (2012). El Lince del Noroeste y las Montañas Galaico-Leonesas. Asociación Cultural "Monte Irago."                                                               |
| <i>Lynx lynx</i>     | Tigre        | Baranbio                      | Spain  | 1763                       | XVIII | 3271204.494 | 2306412.348 | Fernández, J. M., & Ruiz de Azua, N. (2003). Mastofauna. In Estudio Faunístico del Parque Natural de Gorbeia (pp. 361–449). Diputación Foral de Álava / Arabako Foru Aldundia. Ruiz de Azua, N., & Fernández, J. M. (2005). Presencia histórica del lince o "tigre" en el País Vasco. Avnia, 10, 82–95. Abascal, G. (1996). Las fieras en el imaginario popular alavés.                                                      |
| <i>Lynx lynx</i>     | Tigre        | Baranbio                      | Spain  | 1773                       | XVIII | 3271204.494 | 2306412.348 | Fernández, J. M., & Ruiz de Azua, N. (2003). Mastofauna. In Estudio Faunístico del Parque Natural de Gorbeia (pp. 361–449). Diputación Foral de                                                                                                                                                                                                                                                                              |

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|----------------------|---------------|--------------------|----------|------|-------|-------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      |               |                    |          |      |       |             |             | Álava / Arabako Foru Aldundia. Ruiz de Azua, N., & Fernández, J. M. (2005). Presencia histórica del lince o “tigre” en el País Vasco. Avnia, 10, 82–95. Abascal, G. (1996). Las fieras en el imaginario popular alavés.                                                                                                                                                                                                                                                                                                                               |
| <i>Lynx lynx</i>     | Tigre         | Baranbio           | Spain    | 1776 | XVIII | 3271204.494 | 2306412.348 | Fernández, J. M., & Ruiz de Azua, N. (2003). Mastofauna. In Estudio Faunístico del Parque Natural de Gorbeia (pp. 361–449). Diputación Foral de Álava / Arabako Foru Aldundia. Ruiz de Azua, N., & Fernández, J. M. (2005). Presencia histórica del lince o “tigre” en el País Vasco. Avnia, 10, 82–95. Abascal, G. (1996). Las fieras en el imaginario popular alavés.                                                                                                                                                                               |
| <i>Lynx lynx</i>     | Tigre         | Baranbio           | Spain    | 1787 | XVIII | 3271204.494 | 2306412.348 | Fernández, J. M., & Ruiz de Azua, N. (2003). Mastofauna. In Estudio Faunístico del Parque Natural de Gorbeia (pp. 361–449). Diputación Foral de Álava / Arabako Foru Aldundia. Ruiz de Azua, N., & Fernández, J. M. (2005). Presencia histórica del lince o “tigre” en el País Vasco. Avnia, 10, 82–95. Abascal, G. (1996). Las fieras en el imaginario popular alavés.                                                                                                                                                                               |
| <i>Lynx lynx</i>     | Tigre         | Baranbio           | Spain    | 1801 | XIX   | 3271204.494 | 2306412.348 | Fernández, J. M., & Ruiz de Azua, N. (2003). Mastofauna. In Estudio Faunístico del Parque Natural de Gorbeia (pp. 361–449). Diputación Foral de Álava / Arabako Foru Aldundia. Ruiz de Azua, N., & Fernández, J. M. (2005). Presencia histórica del lince o “tigre” en el País Vasco. Avnia, 10, 82–95. Abascal, G. (1996). Las fieras en el imaginario popular alavés.                                                                                                                                                                               |
| <i>Lynx lynx</i>     | Tigre         | Barrundia (Larrea) | Spain    | 1815 | XIX   | 3304662.959 | 2282641.626 | González de Viñaspre, R. & Uribarrena, P. (2009). Osos y tigres en la montaña alavesa. Herria 4: 10-11.                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <i>Lynx pardinus</i> | Gato de clavo | Baza               | Spain    | 1798 | XVIII | 3187887.372 | 1696380.838 | Navarro, A. J. (1798). La ciudad y territorio de Baza. Boletín de La Real Academia de Historia, 70, 259–286. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                                                                                                                                                                                                                                |
| <i>Lynx pardinus</i> | Gato çerval   | Beas De Segura     | Spain    | 1575 | XVI   | 3190870.489 | 1780954.595 | Rubio, J. O. (1918). Relaciones Topográficas de los Pueblos de España. Sociedad Española de Artes Gráficas. pp. 127. Villegas, L. R., & García, R. (1976). Relación de los pueblos de Jaén, de Felipe II. In Boletín del Instituto de Estudios Giennenses. Diputación Provincial de Jaén. CSIC. Cebrián, A., & Cano, J. (1992). Relaciones Topográficas de los pueblos del Reino de Murcia. Estudio y transcripción. Universidad de Murcia. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52. |
| <i>Lynx pardinus</i> | Lobo-cerval   | Belver             | Portugal | 1758 | XVIII | 2783539.955 | 2005433.208 | Cardoso, L. (1758). Belver, Portalegre. In Memorias Paroquiais (Vol. 6, pp. 621-635).                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <i>Lynx pardinus</i> | Gato çerval   | Benatae            | Spain    | 1575 | XVI   | 3213334.264 | 1788353.486 | Villegas, L. R., & García, R. (1976). Relación de los pueblos de Jaén, de Felipe II. In Boletín del Instituto de Estudios Giennenses. Diputación Provincial de Jaén. Cebrián, A., & Cano, J. (1992). Relaciones Topográficas de los pueblos del Reino de Murcia. Estudio y transcripción. Universidad de Murcia. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                            |

|                      |              |                           |          |           |       |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------|--------------|---------------------------|----------|-----------|-------|-------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Lynx sp.</i>      | Lince        | Benavente                 | Spain    | 1907      | XX    | 3028001.508 | 2235027.258 | "Regueras Grande, J. I. (2001). Caza y pesca zamorana en 1850 y en la actualidad. Brigecio: Revista de Estudios de Benavente y Sus Tierras, 11, 177–194. Piñeiro Maceiras, J., Pérez García, P., Pérez García, I., Calderón Reñón, A., Paz Martínez, J. J. de, González Salvador, I., & Piñeiro Maceiras, M. L. (2012). El Lince del Noroeste y las Montañas Galaico-Leonesas. Asociación Cultural “Monte Irago.”            |
| <i>Lynx lynx</i>     | Tigre        | Bernedo                   | Spain    | 1572      | XVI   | 3297852.788 | 2254262.458 | González de Viñaspre, R. & Uribarrena, P. (2009). Osos y tigres en la montaña alavesa. Herria 4: 10-11.                                                                                                                                                                                                                                                                                                                      |
| <i>Lynx pardinus</i> | Gato cerval  | Bernedo                   | Spain    | 1752      | XVIII | 3297852.788 | 2254262.458 | Zaldivar, C. (2008). Apuntes para la desdichada historia del oso, la cabra montés y el lince en La Rioja. Belezos, 6: 44-49.                                                                                                                                                                                                                                                                                                 |
| <i>Lynx lynx</i>     | Tiguere      | Bernedo                   | Spain    | 1752      | XVIII | 3297852.788 | 2254262.458 | Zaldivar, C. (2008). Apuntes para la desdichada historia del oso, la cabra montés y el lince en La Rioja. Belezos, 6: 44-49.                                                                                                                                                                                                                                                                                                 |
| <i>Lynx lynx</i>     | Lobo cerval  | Biota                     | Spain    | 1802      | XIX   | 3398435.644 | 2197131.074 | Suman, M. (1802). Apuntes para el Diccionario Geográfico del Reino de Aragón. Partido de Cinco Villas. Según el MS. 9-7523 de la RAH. Ed: Salvo, J. y Capalvo, A, 2015. Institución Fernando el Católico. Zaragoza.                                                                                                                                                                                                          |
| <i>Lynx lynx</i>     | Llobo cerval | Boal                      | Spain    | 1898      | XIX   | 2968570.894 | 2410310.22  | Acevedo, B. (1898). Boal y su concejo. In Biblioteca Popular Asturiana (Vol. 2). Tipografía de Adolfo Brid. Pp. 17. Acevedo, B. (1921). Boal y su concejo. In Biblioteca Popular Asturiana (Vol. 2). Compañía Editorial HERMES. Pp. 31.                                                                                                                                                                                      |
| <i>Lynx lynx</i>     | Lince        | Boal                      | Spain    | 1898      | XIX   | 2968570.894 | 2410310.22  | Acevedo, B. (1898). Boal y su concejo. In Biblioteca Popular Asturiana (Vol. 2). Tipografía de Adolfo Brid. Pp. 17. Acevedo, B. (1921). Boal y su concejo. In Biblioteca Popular Asturiana (Vol. 2). Compañía Editorial HERMES. Pp. 31.                                                                                                                                                                                      |
| <i>Lynx pardinus</i> | Lince        | Bollullos Par del Condado | Spain    | 1845-1850 | XIX   | 2856625.689 | 1743744.129 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                                                                                                                                                    |
| <i>Lynx lynx</i>     | Lobo-cerval  | Brufe                     | Portugal | 1758      | XVIII | 2815343.879 | 2256908.135 | Cardoso, L. (1758). Brufe, Braga. In Memorias Paroquiais (Vol. 7, pp. 1271-1278).                                                                                                                                                                                                                                                                                                                                            |
| <i>Lynx lynx</i>     | Lobo cerval  | Cabo Ortegal              | Spain    | 1750s     | XVIII | 2888575.185 | 2460326.988 | Sarmiento, M. (1760). Discurso sobre un animal feroz y desconocido que a la vista del Monasterio benedictino de San Pedro de Montes, en El Bierzo, se vió, se mató, se cogió y se desolló; y cuya piel se conserva hoy en el Monasterio. Copy of the unpublished manuscript preserved at the Fundación Universitaria Española, Madrid (edited by José Santos Puerto, 2010-2011, Revista de Estudios Bercianos 35-36: 27-54). |
| <i>Lynx lynx</i>     | Gato montés  | Cabrales                  | Spain    | 1845-1850 | XIX   | 3122325.281 | 2364414.756 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                                                                                                                                                    |
| <i>Lynx lynx</i>     | Lobo cervato | Cabrales                  | Spain    | 1826      | XIX   | 3122325.281 | 2364414.756 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (No pages identified)                                                                                                                                                                                                                                                                                           |

|                      |               |                  |          |           |       |             |             |                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------|---------------|------------------|----------|-----------|-------|-------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Lynx lynx</i>     | Lobo cervical | Cabranes         | Spain    | 1751      | XVIII | 3079723.897 | 2384954.118 | Torrente, J., & Llana, L. (1996). Sobre'l llobu cervical y la so presencia n'Asturies. Asturies, 2, 81–86.                                                                                                                                                                                                                                                                                                                      |
| <i>Lynx lynx</i>     | Lobo-cervical | Cabril           | Portugal | 1728      | XVIII | 2830499.387 | 2247264.037 | Leal, A. S. d'Azevedo B. de P. (1874). Portugal Antigo e Moderno. Dicionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal (Vol. 3). 184 pp. Pereira, E., & Rodrigues, G. (1907). Portugal: Dicionario Historico, Chorographico, Biographico, Bibliographico Heráldico, Numismático e Artístico (Vol. 3). 729 pp. |
| <i>Lynx lynx</i>     | Lobo-cervical | Cabril           | Portugal | 1805      | XIX   | 2830499.387 | 2247264.037 | Leal, A. S. d'Azevedo B. de P. (1874). Portugal Antigo e Moderno. Dicionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal (Vol. 3). 184 pp. Pereira, E., & Rodrigues, G. (1907). Portugal: Dicionario Historico, Chorographico, Biographico, Bibliographico Heráldico, Numismático e Artístico (Vol. 3). 729 pp. |
| <i>Lynx lynx</i>     | Tigre         | Calcedónia       | Portugal | 1730      | XVIII | 2817488.4   | 2251837.519 | Ferreira, J. M. (1728) - Thesouro de Braga descoberto no Campo do Gerês. (Edição fac?simulada de 1994) Ed. Camara Municipal de Terras de Bouro, 93pp.                                                                                                                                                                                                                                                                           |
| <i>Lynx lynx</i>     | Lobo-cervical | Campo do Gerês   | Portugal | 1758      | XVIII | 2818817.916 | 2255265.11  | Cardoso, L. (1758). Campo do Gerês, Braga. In Memorias Paroquiais (Vol. 8, pp. 521-540).                                                                                                                                                                                                                                                                                                                                        |
| <i>Lynx lynx</i>     | Tigre         | Campo do Gerês   | Portugal | 1758      | XVIII | 2818817.916 | 2255265.11  | Cardoso, L. (1758). Campo do Gerês, Braga. In Memorias Paroquiais (Vol. 8, pp. 521-540).                                                                                                                                                                                                                                                                                                                                        |
| <i>Lynx pardinus</i> | Lobo cervical | Candeleda        | Spain    | 1845-1850 | XIX   | 3025471.341 | 2026396.281 | Madoz, P. (1845-1850). Dicionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                                                                                                                                                        |
| <i>Lynx lynx</i>     | Lobo cervical | Cangas De Narcea | Spain    | 1754      | XVIII | 2984061.473 | 2378453.124 | Torrente, J., & Llana, L. (1996). Sobre'l llobu cervical y la so presencia n'Asturies. Asturies, 2, 81–86.                                                                                                                                                                                                                                                                                                                      |
| <i>Lynx lynx</i>     | Lobo cervical | Cangas De Narcea | Spain    | 1754      | XVIII | 2984061.473 | 2378453.124 | Torrente, J., & Llana, L. (1996). Sobre'l llobu cervical y la so presencia n'Asturies. Asturies, 2, 81–86.                                                                                                                                                                                                                                                                                                                      |
| <i>Lynx lynx</i>     | Lobo cervical | Cangas De Narcea | Spain    | 1805      | XIX   | 2984061.473 | 2378453.124 | Martinez-Marina, F. (1805). Dicionario Geográfico-Histórico de Asturias. In Manuscritos. Archivo Real Academia de la Historia (R.A.H. 9-6032/9-6038).                                                                                                                                                                                                                                                                           |
| <i>Lynx pardinus</i> | Gato çervual  | Carmona          | Spain    | 1493      | XV    | 2937384.536 | 1741454.009 | Fernández, J., Sancho, A., & Collantes, F. (1941). Colección diplomática de Carmona. Imprenta Editorial de la Gavidia. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                                                                                                |
| <i>Lynx lynx</i>     | Lobo-cervical | Carracedo        | Portugal | 1751      | XVIII | 2923991.997 | 2231725.701 | Cardoso, L. (1751). Dicionario Geografico ou Noticia Historica de Todas as Cidades, Villas, Lugares, e Aldeas, Rios, Ribeiras, e Serras dos Reynos de Portugal, e Algarve, com todas as cousas raras, que nelles se encontrão, assim antigas, como modernas (Vol. 2). 459 pp.                                                                                                                                                   |
| <i>Lynx lynx</i>     | Lobo cervical | Caso             | Spain    | 1805      | XIX   | 3079392.945 | 2357783.19  | Martinez-Marina, F. (1805). Dicionario Geográfico-Histórico de Asturias. In Manuscritos. Archivo Real Academia de la Historia (R.A.H. 9-6032/9-6038).                                                                                                                                                                                                                                                                           |

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| <i>Lynx lynx</i>     | Lobo cerval  | Caso                | Spain    | 1826      | XIX   | 3078928.222 | 2356279.311 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (No pages identified)                                                                                                                                                                                                                                                                                      |
| <i>Lynx lynx</i>     | Lobo cerval  | Castellbó           | Spain    | XVIII     | XVIII | 3608461.497 | 2181974.027 | Maluquer i Sostres, J. (1992). Notícia de la fauna de Catalunya i d'Andorra al final del segle XVIII. Butlletí de La Institució Catalana d'Història Natural, 5–21. <a href="https://raco.cat/index.php/ButlletiICHN/article/view/14340">https://raco.cat/index.php/ButlletiICHN/article/view/14340</a>                                                                                                                  |
| <i>Lynx lynx</i>     | Gato montés  | Castellbó           | Spain    | 1844      | XIX   | 3608461.497 | 2181974.027 | El imparcial. Diario de política, literatura, comercio e industria, Año 3, N° 754, 10/13/1844, 3.                                                                                                                                                                                                                                                                                                                       |
| <i>Lynx pardinus</i> | Gato cerval  | Castellfort         | Spain    | 1845-1850 | XIX   | 3456001.937 | 1991981.691 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                                                                                                                                               |
| <i>Lynx lynx</i>     | Tigre        | Castro Laboreiro    | Portugal | 1861      | XIX   | 2828361.211 | 2283989.385 | Leal, A. S. d'Azevedo B. de P. (1874). Portugal Antigo e Moderno. Diccionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal (Vol. 3). 184 pp. Costa, A. (1938). Dicionário Chorographico de Portugal Continental e Insular: Vol. VI. Typographia Privativa do Diccionario Chorographico Azurara. pp. 735. |
| <i>Lynx pardinus</i> | Gato clavo   | Cazalla-Constantina | Spain    | 1842      | XIX   | 2941251.976 | 1792708.855 | El Corresponsal, 10/10/1842, N° 1293, 4.                                                                                                                                                                                                                                                                                                                                                                                |
| <i>Lynx lynx</i>     | Tigre        | Cegama              | Spain    | 1802      | XIX   | 3320526.056 | 2289695.607 | Real Academia de La Historia. (1802). Diccionario Geografico-Histórico de Pais Vasco y Navarra. In Diccionario Geográfico, Histórico de España, por la Real Academia de La Historia. Imp. Academia. Pp. 206.                                                                                                                                                                                                            |
| <i>Lynx lynx</i>     | Tigre        | Cegama              | Spain    | 1826      | XIX   | 3320526.056 | 2289695.607 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo III, pág 44.)                                                                                                                                                                                                                                                                                        |
| <i>Lynx pardinus</i> | Lynx pardina | Cercedilla          | Spain    | 1894      | XIX   | 3136486     | 2070516     | Cazurro, M. (1894). Datos para la fauna de la provincia de Madrid. — Mamíferos. Actas de La Sociedad Española de Historia Natural, 23, 188–226. <a href="http://bibdigital.rjb.csic.es/spa/Volumenes.php?Libro=1110">http://bibdigital.rjb.csic.es/spa/Volumenes.php?Libro=1110</a>                                                                                                                                     |
| <i>Lynx lynx</i>     | Tigre        | Chaves              | Portugal | 1760      | XVIII | 2875398.1   | 2236668.595 | Sarmiento, M. (with Laserna, Í. M. de A.). (1999). Sobre el lobo cerval o el lubicán de Galicia. Marqués de Laula. <a href="https://books.google.pt/books?id=aUiRYgEACAAJ">https://books.google.pt/books?id=aUiRYgEACAAJ</a>                                                                                                                                                                                            |
| <i>Lynx pardinus</i> | Gato cerval  | Chillon             | Spain    | 1579      | XVI   | 3030215.978 | 1872388.191 | Rubio, J. O. (1918). Relaciones Topográficas de los Pueblos de España. Sociedad Española de Artes Gráficas. pp. 249.                                                                                                                                                                                                                                                                                                    |
| <i>Lynx pardinus</i> | Gato cerval  | Chillon             | Spain    | 1579      | XVI   | 3030215.978 | 1872388.191 | Viñas, C., & Paz, R. (1971). Ciudad Real. In Relaciones Historico-Geografico-Estadísticas de los Pueblos de España hechas por iniciativa de Felipe II. Instituto de Sociología “Balme”, Instituto de Geografía “Juan Sebastian Elcano”, and Consejo Superior de Investigaciones Científicas. pp. 203.                                                                                                                   |
| <i>Lynx lynx</i>     | Tigre        | Contrasta           | Spain    | 1786      | XVIII | 3316749.121 | 2267215.641 | González de Viñaspre, R. & Uribarrena, P. (2009). Osos y tigres en la montaña alavesa. Herria 4: 10-11.                                                                                                                                                                                                                                                                                                                 |
| <i>Lynx lynx</i>     | Tigre        | Contrasta           | Spain    | 1786      | XVIII | 3316749.121 | 2267215.641 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                                                                                                                                           |

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| <i>Lynx lynx</i>     | Tigre        | Contrasta                | Spain    | 1797      | XVIII | 3316749.121 | 2267215.641 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                      |
| <i>Lynx lynx</i>     | Tigre        | Contrasta                | Spain    | 1801      | XIX   | 3316749.121 | 2267215.641 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                      |
| <i>Lynx lynx</i>     | Tigre        | Contrasta                | Spain    | 1803      | XIX   | 3316749.121 | 2267215.641 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                      |
| <i>Lynx pardinus</i> | Gato-cravo   | Coroada                  | Portugal | 1758      | XVIII | 2807449.462 | 1838875.611 | Cardoso, L. (1758). Coroada, Moura. In Memorias Paroquiais (Vol. 11, pp. 2585–2592).                                                                                                                                                               |
| <i>Lynx sp.</i>      | Lince        | Corvera                  | Spain    | 1922      | XX    | 3043944.072 | 2403355.602 | Villalain, J. (1925). Topografía Médica del Conejo de Corvera de Asturias.                                                                                                                                                                         |
| <i>Lynx lynx</i>     | Lobo-cerval  | Covide                   | Portugal | 1758      | XVIII | 2816552.13  | 2253433.628 | Cardoso, L. (1758). Covide, Braga. In Memorias Paroquiais (Vol. 12, pp. 3077-3086).                                                                                                                                                                |
| <i>Lynx pardinus</i> | Gato cerval  | Cumbres de San Bartolomé | Spain    | 1845-1850 | XIX   | 2848186.209 | 1826840.214 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                          |
| <i>Lynx pardinus</i> | Lince        | Doñana                   | Spain    | 1928-1945 | XX    | 2859462.151 | 1709710.986 | Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                                          |
| <i>Lynx pardinus</i> | Gato cerval  | Doñana                   | Spain    | 1840      | XIX   | 2859462.151 | 1709710.986 | Revista Gaditana. Periódico popular, 1840, 204.                                                                                                                                                                                                    |
| <i>Lynx pardinus</i> | Gato clavo   | Doñana                   | Spain    | 1840      | XIX   | 2859462.151 | 1709710.986 | Revista Gaditana. Periódico popular, 1840, 204.                                                                                                                                                                                                    |
| <i>Lynx pardinus</i> | Lince        | Doñana                   | Spain    | 1840      | XIX   | 2859462.151 | 1709710.986 | Revista Gaditana. Periódico popular, 1840, 204.                                                                                                                                                                                                    |
| <i>Lynx pardinus</i> | Lynx         | Doñana                   | Spain    | 1893      | XIX   | 2856370.678 | 1701041.772 | Chapman, A., & Buck, W. J. (1893). Wild Spain [España agreste]. Gurney and Jackson. (Pages of the Chapters in the Index)                                                                                                                           |
| <i>Lynx pardinus</i> | Gato cierval | Doñana                   | Spain    | 1893      | XIX   | 2856370.678 | 1701041.772 | Chapman, A., & Buck, W. J. (1893). Wild Spain [España agreste]. Gurney and Jackson. (Pages of the Chapters in the Index)                                                                                                                           |
| <i>Lynx pardinus</i> | Lince        | Doñana                   | Spain    | 1893      | XIX   | 2856370.678 | 1701041.772 | Chapman, A., & Buck, W. J. (1893). Wild Spain [España agreste]. Gurney and Jackson. (Pages of the Chapters in the Index)                                                                                                                           |
| <i>Lynx pardinus</i> | Lince        | Doñana                   | Spain    | 1924      | XX    | 2859462.151 | 1709710.986 | Fernández, J. A. (1974). Doñana. Ediciones Olivo. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                        |
| <i>Lynx pardinus</i> | Gato zerbal  | Doñana - Coto del Rey    | Spain    | 1774      | XVIII | 2862760.28  | 1719979.183 | Castrillo, M. C. (2000). Doñana nombre a nombre. Estudio de la toponimia del Parque Nacional de Doñana. Diputación Provincial de Huelva. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52. |
| <i>Lynx pardinus</i> | Lince        | Doñana - Coto del Rey    | Spain    | 1850      | XIX   | 2862760.28  | 1719979.183 | Clark, W. G. (1996). Gazpacho o meses de verano en España. Aljarife-Comares. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                             |

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| <i>Lynx pardinus</i> | Gato clavo    | Doñana - Coto Del Rey             | Spain | 1869  | XIX   | 2862760.28  | 1719979.183 | Machado y Nuñez, A. (1869). Catálogo metódico y razonado de los mamíferos de Andalucía. Imp. de Gironés y Orduña.                                                                                                                                                                                                                              |
| <i>Lynx pardinus</i> | Lynx          | Doñana, Algaída de la Pez         | Spain | 1893  | XIX   | 2869704.515 | 1722983.664 | Chapman, A., & Buck, W. J. (1893). Wild Spain [España agreste]. Gurney and Jackson. (Pages of the Chapters in the Index)                                                                                                                                                                                                                       |
| <i>Lynx pardinus</i> | Gato cierval  | Doñana, Algaída de la Pez         | Spain | 1893  | XIX   | 2869704.515 | 1722983.664 | Chapman, A., & Buck, W. J. (1893). Wild Spain [España agreste]. Gurney and Jackson. (Pages of the Chapters in the Index)                                                                                                                                                                                                                       |
| <i>Lynx pardinus</i> | Lince         | Doñana, Algaída de la Pez         | Spain | 1893  | XIX   | 2869704.515 | 1722983.664 | Chapman, A., & Buck, W. J. (1893). Wild Spain [España agreste]. Gurney and Jackson. (Pages of the Chapters in the Index)                                                                                                                                                                                                                       |
| <i>Lynx pardinus</i> | Lince         | El Berrocal (Almadén de la Plata) | Spain | 1977  | XX    | 2909895.526 | 1789467.255 | Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                                                                                                                                      |
| <i>Lynx pardinus</i> | Gato clavo    | El Escorial                       | Spain | 1897  | XIX   | 3125329     | 2055715     | Graells, M. de la P. (1897). Fauna Mastodológica Ibérica. In Memorias de la Real Academia de Ciencias: Vol. XVII. Imprenta de Don Luis Aguado. <a href="http://www.archive.org/stream/memoriasdelareal1797real/memoriasdelareal1797real_djvu.txt">http://www.archive.org/stream/memoriasdelareal1797real/memoriasdelareal1797real_djvu.txt</a> |
| <i>Lynx pardinus</i> | Lynx pardina  | El Pardo                          | Spain | 1894  | XIX   | 3155093     | 2043387     | Cazurro, M. (1894). Datos para la fauna de la provincia de Madrid. — Mamíferos. Actas de La Sociedad Española de Historia Natural, 23, 188–226. <a href="http://bibdigital.rjb.csic.es/spa/Volumenes.php?Libro=1110">http://bibdigital.rjb.csic.es/spa/Volumenes.php?Libro=1110</a>                                                            |
| <i>Lynx pardinus</i> | Gato cervical | El Pedroso                        | Spain | 1910  | XX    | 2934114.435 | 1783911.484 | El Guadalete: Periódico político y literario, Año LVI, N° 17548, 09/28/1910, 9.                                                                                                                                                                                                                                                                |
| <i>Lynx lynx</i>     | Lobo cervical | Encartaciones                     | Spain | 1775  | XVIII | 3253595.805 | 2329801.255 | Bowles, G. (1775). Introduccion a la Historia Natural, y a la Geografía Física de España. Imprenta de D. Francisco Manuel de Mena. pp. 293                                                                                                                                                                                                     |
| <i>Lynx lynx</i>     | Tigre         | Encartaciones                     | Spain | 1802  | XIX   | 3257297.337 | 2331164.104 | Real Academia de La Historia. (1802). Diccionario Geografico-Histórico de Pais Vasco y Navarra. In Diccionario Geográfico, Histórico de España, por la Real Academia de La Historia. Imp. Academia. Pp. 247.                                                                                                                                   |
| <i>Lynx lynx</i>     | Tigre         | Encartaciones                     | Spain | 1826  | XIX   | 3257297.337 | 2331164.104 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo III, pág 345)                                                                                                                                                                                                               |
| <i>Lynx lynx</i>     | Tigre         | Escoriaza                         | Spain | 1802  | XIX   | 3302149.531 | 2297339.324 | Real Academia de La Historia. (1802). Diccionario Geografico-Histórico de Pais Vasco y Navarra. In Diccionario Geográfico, Histórico de España, por la Real Academia de La Historia. Imp. Academia. Pp. 260.                                                                                                                                   |
| <i>Lynx lynx</i>     | Lobo cervical | Espinalbet                        | Spain | XVIII | XVIII | 3642000.882 | 2149171.851 | Maluquer i Sostres, J. (1992). Notícia de la fauna de Catalunya i d'Andorra al final del segle XVIII. Butlletí de La Institució Catalana d'Història Natural, 5–21. <a href="https://raco.cat/index.php/ButlletiICHN/article/view/14340">https://raco.cat/index.php/ButlletiICHN/article/view/14340</a>                                         |
| <i>Lynx lynx</i>     | Onza          | Etxaguen De Aramayona             | Spain | 1597  | XVI   | 3297901.739 | 2302947.856 | Fernández, J. M., & Ruiz de Azua, N. (2003). Mastofauna. In Estudio Faunístico del Parque Natural de Gorbéa (pp. 361–449). Diputación Foral de Álava / Arabako Foru Aldundia. Ruiz de Azua, N., & Fernández, J. M. (2005).                                                                                                                     |

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|----------------------|---------------|-------------------|----------|------|-------|-------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      |               |                   |          |      |       |             |             | Presencia histórica del lince o “tigre” en el País Vasco. Avnia, 10, 82–95. Elejalde, J. M. (1989). Ayer y hoy del valle de Aramayona. Diputación Foral de Álava.                                                                                                                                                                                                                                                               |
| <i>Lynx lynx</i>     | Tigre         | Fiães (Paróquia)  | Portugal | 1861 | XIX   | 2825934.14  | 2293038.859 | Leal, A. S. d’Azevedo B. de P. (1874). Portugal Antigo e Moderno. Dicionario Geographico, Estatístico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal (Vol. 3). 184 pp. Costa, A. (1938). Dicionário Chorographico de Portugal Continental e Insular: Vol. VI. Typographia Privativa do Dicionario Chorographico Azurara. pp. 735.           |
| <i>Lynx lynx</i>     | Tigre         | Gopegui           | Spain    | 1776 | XVIII | 3284894.843 | 2293908.77  | Fernández, J. M., & Ruiz de Azua, N. (2003). Mastofauna. In Estudio Faunístico del Parque Natural de Gorbeia (pp. 361–449). Diputación Foral de Álava / Arabako Foru Aldundia. Ruiz de Azua, N., & Fernández, J. M. (2005). Presencia histórica del lince o “tigre” en el País Vasco. Avnia, 10, 82–95. Abascal, G. (1996). Las fieras en el imaginario popular alavés.                                                         |
| <i>Lynx lynx</i>     | Tigre         | Gorgua            | Spain    | 1861 | XIX   | 2832060.994 | 2291901.953 | Leal, A. S. d’Azevedo B. de P. (1874). Portugal Antigo e Moderno. Dicionario Geographico, Estatístico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal (Vol. 3). 184 pp. Costa, A. (1938). Dicionário Chorographico de Portugal Continental e Insular: Vol. VI. Typographia Privativa do Dicionario Chorographico Azurara. pp. 735.           |
| <i>Lynx lynx</i>     | Lobo-cerval   | Granja            | Portugal | 1825 | XIX   | 2861317.542 | 2237633.342 | Leal, A. S. d’Azevedo B. de P. (1874). Portugal Antigo e Moderno. Dicionario Geographico, Estatístico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal (Vol. 3). 184 pp. Pereira, E., & Rodrigues, G. (1907). Portugal: Dicionario Historico, Chorographico, Biographico, Bibliographico Heráldico, Numismático e Artístico (Vol. 3). 729 pp. |
| <i>Lynx pardinus</i> | Gato clavo    | Guadix            | Spain    | 1826 | XIX   | 3153108.446 | 1681199.472 | Miñano y Bedoya, S. (1826). Dicionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (No pages identified)                                                                                                                                                                                                                                                                                               |
| <i>Lynx pardinus</i> | Gato de clavo | Guadix            | Spain    | 1885 | XIX   | 3153117.981 | 1681070.748 | Sánchez y García, J. (1885). Catálogo de los Mamíferos y Aves observados en la Provincia de Granada. Imprenta de Indalecio Ventura / Real Sociedad Económica de Granada. Pp. 9. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                                       |
| <i>Lynx pardinus</i> | Lince         | Guadix            | Spain    | 1885 | XIX   | 3153117.981 | 1681070.748 | Sánchez y García, J. (1885). Catálogo de los Mamíferos y Aves observados en la Provincia de Granada. Imprenta de Indalecio Ventura / Real Sociedad Económica de Granada. Pp. 9. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                                       |
| <i>Lynx pardinus</i> | Gato cerval   | Herrera Del Duque | Spain    | 1578 | XVI   | 3022102.408 | 1915733.922 | Viñas, C., & Paz, R. (1951). Reino de Toledo. In Relaciones Historico-Geografico-Estadísticas de los Pueblos de España hechas por iniciativa de Felipe II (Vol. 1). Instituto de Sociología “Balmes”, Instituto de Geografía                                                                                                                                                                                                    |

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|                      |               |                       |       |      |       |             |             | “Juan Sebastian Elcano”, and Consejo Superior de Investigaciones Científicas. pp. 447.                                                                                                                                                                                                                                                                                                                                     |
| <i>Lynx pardinus</i> | Gato cervical | Hornachuelos          | Spain | 1914 | XX    | 2978908.933 | 1773890.815 | La Publicidad: Diario de avisos, noticias y telegramas, eco fiel de la opinión y verdadero transmisor de los intereses morales y materiales de Granada y su provincia, Año XXXIV, Nº 9350, 01/24/1914, 3.                                                                                                                                                                                                                  |
| <i>Lynx pardinus</i> | Gato cervical | Hornos Del Segura     | Spain | 1575 | XVI   | 3205124.241 | 1775176.938 | Villegas, L. R., & García, R. (1976). Relación de los pueblos de Jaén, de Felipe II. In Boletín del Instituto de Estudios Giennenses. Diputación Provincial de Jaén. Cebrián, A., & Cano, J. (1992). Relaciones Topográficas de los pueblos del Reino de Murcia. Estudio y transcripción. Universidad de Murcia. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52. |
| <i>Lynx pardinus</i> | Gato clavo    | Hoya de Baza          | Spain | 1840 | XIX   | 3196699.423 | 1707190.42  | La Alhambra. Periodico de ciencias, literatura y bellas artes. Serie 2, Tomo VI, nº 2, 1840, 33.                                                                                                                                                                                                                                                                                                                           |
| <i>Lynx lynx</i>     | Lobo cervical | Ibias                 | Spain | 1755 | XVIII | 2955221.635 | 2367919.649 | Torrente, J., & Llana, L. (1996). Sobre'l llobu cervical y la so presencia n'Asturies. Asturias, 2, 81–86.                                                                                                                                                                                                                                                                                                                 |
| <i>Lynx lynx</i>     | NA            | Ibisate               | Spain | 1957 | XX    | 3307135.811 | 2268540.786 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                                                                                                                                              |
| <i>Lynx lynx</i>     | Tigre         | Idiazabal             | Spain | 1776 | XVIII | 3326014.666 | 2292622.753 | Izaguirre, R. de. (1934). Las Ciencias Naturales y los archivos: Katamotz = ¿Tigre? Revista Internacional de Estudios Vascos, 25, 707–714. Iztueta, J. I. de. (1847). Guipuzcoaco Provinciaren Condairedo Historia. Ignacio Ramon Baroja-ren moldizteguian. Pp. 193.                                                                                                                                                       |
| <i>Lynx sp.</i>      | Lince         | Illas                 | Spain | 1923 | XX    | 3036746.277 | 2402235.984 | Villalain, J. (1923). Topografía Médica del Conejo de Illas.                                                                                                                                                                                                                                                                                                                                                               |
| <i>Lynx pardinus</i> | Gato de clavo | Jayena                | Spain | 1885 | XIX   | 3087226.286 | 1653600.762 | Sánchez y García, J. (1885). Catálogo de los Mamíferos y Aves observados en la Provincia de Granada. Imprenta de Indalecio Ventura / Real Sociedad Económica de Granada. Pp. 9. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                                  |
| <i>Lynx pardinus</i> | Lince         | Jayena                | Spain | 1885 | XIX   | 3087226.286 | 1653600.762 | Sánchez y García, J. (1885). Catálogo de los Mamíferos y Aves observados en la Provincia de Granada. Imprenta de Indalecio Ventura / Real Sociedad Económica de Granada. Pp. 9. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                                  |
| <i>Lynx pardinus</i> | Gato clavo    | La Nava               | Spain | 1798 | XVIII | 2851586.536 | 1815201.609 | Ruiz, J. E. (1999). Los pueblos de Huelva en el siglo XVIII (según el Diccionario del Geógrafo Real D. Tomás López). Diputación Provincial de Huelva. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                                                            |
| <i>Lynx pardinus</i> | Gato cervical | La Nava               | Spain | 1798 | XVIII | 2851586.536 | 1815201.609 | Ruiz, J. E. (1999). Los pueblos de Huelva en el siglo XVIII (según el Diccionario del Geógrafo Real D. Tomás López). Diputación Provincial de Huelva. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                                                            |
| <i>Lynx pardinus</i> | Gato cervical | La Torre De Juan Abad | Spain | 1575 | XVI   | 3181726.687 | 1819511.097 | Viñas, C., & Paz, R. (1971). Ciudad Real. In Relaciones Historico-Geografico-Estadísticas de los Pueblos de España hechas por iniciativa de Felipe II.                                                                                                                                                                                                                                                                     |

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|                      |             |                   |          |                                 |       |             |             | Instituto de Sociología “Balmes”, Instituto de Geografía “Juan Sebastian Elcano”, and Consejo Superior de Investigaciones Científicas. pp. 525.                                                                                                                                                                                                |
| <i>Lynx pardinus</i> | Gato cerval | Lagran            | Spain    | 1675                            | XVII  | 3290898.884 | 2255223.19  | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                                                                  |
| <i>Lynx lynx</i>     | NA          | Laguna de Cameros | Spain    | 1936 (periódico "El Najerilla") | XX    | 3286596.012 | 2205344.456 | Zaldivar, C. (2008). Apuntes para la desdichada historia del oso, la cabra montés y el lince en La Rioja. Belezos, 6: 44-49.                                                                                                                                                                                                                   |
| <i>Lynx lynx</i>     | Lobo cerval | Langreo           | Spain    | 1805                            | XIX   | 3055735.104 | 2376393.018 | Martinez-Marina, F. (1805). Diccionario Geográfico-Histórico de Asturias. In Manuscritos. Archivo Real Academia de la Historia (R.A.H. 9-6032/9-6038).                                                                                                                                                                                         |
| <i>Lynx lynx</i>     | Lobo cerval | Langreo           | Spain    | 1826                            | XIX   | 3054636.883 | 2377548.881 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo V, pág. 63.)                                                                                                                                                                                                                |
| <i>Lynx pardinus</i> | Gato cerval | Lapoblacion       | Spain    | 1591                            | XVI   | 3300550.654 | 2251234.764 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                                                                  |
| <i>Lynx pardinus</i> | Gato clavo  | Las Batuecas      | Spain    | 1897                            | XIX   | 2960222     | 2077968     | Graells, M. de la P. (1897). Fauna Mastodológica Ibérica. In Memorias de la Real Academia de Ciencias: Vol. XVII. Imprenta de Don Luis Aguado. <a href="http://www.archive.org/stream/memoriasdelareal1797real/memoriasdelareal1797real_djvu.txt">http://www.archive.org/stream/memoriasdelareal1797real/memoriasdelareal1797real_djvu.txt</a> |
| <i>Lynx lynx</i>     | Lince       | Lena              | Spain    | 1805                            | XIX   | 3040778.857 | 2363687.035 | Martinez-Marina, F. (1805). Diccionario Geográfico-Histórico de Asturias. In Manuscritos. Archivo Real Academia de la Historia (R.A.H. 9-6032/9-6038).                                                                                                                                                                                         |
| <i>Lynx lynx</i>     | Lobo cerval | Lena              | Spain    | 1805                            | XIX   | 3040778.857 | 2363687.035 | Martinez-Marina, F. (1805). Diccionario Geográfico-Histórico de Asturias. In Manuscritos. Archivo Real Academia de la Historia (R.A.H. 9-6032/9-6038).                                                                                                                                                                                         |
| <i>Lynx lynx</i>     | Lobo cerval | Lena              | Spain    | 1884                            | XIX   | 3038699.092 | 2355528.641 | La Unión, Madrid, Año III, N° 848, 25/ 10/ 1884                                                                                                                                                                                                                                                                                                |
| <i>Lynx lynx</i>     | Lobo-cerval | Lindoso           | Portugal | 1758                            | XVIII | 2820965.248 | 2266885.789 | Cardoso, L. (1758). Lindoso, Viana do Castelo. In Memorias Paroquiais (Vol. 20, pp. 665-672).                                                                                                                                                                                                                                                  |
| <i>Lynx lynx</i>     | Leopardo    | Lizartza          | Spain    | 1777                            | XVIII | 3343618.804 | 2299867.049 | Izaguirre, R. de. (1934). Las Ciencias Naturales y los archivos: Katamotz = ¿Tigre? Revista Internacional de Estudios Vascos, 25, 707–714. Archivo provincial de Guipúzcoa.—Sección 1.ª, Neg. 23, Legs. 25 y 28.                                                                                                                               |
| <i>Lynx lynx</i>     | Leopardo    | Lizartza          | Spain    | 1781                            | XVIII | 3343618.804 | 2299867.049 | Izaguirre, R. de. (1934). Las Ciencias Naturales y los archivos: Katamotz = ¿Tigre? Revista Internacional de Estudios Vascos, 25, 707–714. Archivo provincial de Guipúzcoa.—Sección 1.ª, Neg. 23, Legs. 25 y 28.                                                                                                                               |
| <i>Lynx pardinus</i> | Lince       | Los Aserraderos   | Spain    | 1881                            | XIX   | 3066391.568 | 1788819.401 | Martinez y Reguera, L. (1881). Fauna de Sierra Morena Catálogo de los Mamíferos del Término de Montoro. Imp. M. Romero. pp. 122.                                                                                                                                                                                                               |
| <i>Lynx sp.</i>      | Lobo cerval | Los Ibores        | Spain    | 1887                            | XIX   | 3000023.299 | 1972046.503 | Iruete, J. F. y T., Vizconde de. (1887, January 23). Una montería. La Época, 39(12394), 2.                                                                                                                                                                                                                                                     |
| <i>Lynx lynx</i>     | Lobo cerval | Majones           | Spain    | 1802                            | XIX   | 3430119.502 | 2236863.131 | Suman, M. (1802). Apuntes para el Diccionario Geográfico del Reino de Aragón. Partido de Cinco Villas. Según el MS. 9-7523 de la RAH. Ed: Salvo, J. y Capalvo, A, 2015. Institución Fernando el Católico. Zaragoza.                                                                                                                            |

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| <i>Lynx pardinus</i> | Lince-ibérico | Marquesado del Zenete | Spain    | 1870                    | XIX   | 3157266.324 | 1666921.791 | Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                                                                                                                                                                                                                    |
| <i>Lynx lynx</i>     | Lobo cervical | Mieres                | Spain    | 1775                    | XVIII | 3046823.307 | 2372584.883 | Torrente, J., & Llana, L. (1996). Sobre'l llobu cervical y la so presencia n'Asturies. Asturias, 2, 81–86.                                                                                                                                                                                                                                                                                                                   |
| <i>Lynx lynx</i>     | Lobo cervical | Mieres                | Spain    | 1884                    | XIX   | 3046823.307 | 2372584.883 | La Unión, Madrid, Año III, Nº 848, 25/ 10/ 1884                                                                                                                                                                                                                                                                                                                                                                              |
| <i>Lynx pardinus</i> | Gato cervical | Millares              | Spain    | 1845-1850               | XIX   | 3385300.174 | 1858211.275 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                                                                                                                                                    |
| <i>Lynx lynx</i>     | Lobo cervical | Monasterio San Pedro  | Spain    | 1760                    | XVIII | 2965882.275 | 2299412.345 | Sarmiento, M. (1760). Discurso sobre un animal feroz y desconocido que a la vista del Monasterio benedictino de San Pedro de Montes, en El Bierzo, se vió, se mató, se cogió y se desolló; y cuya piel se conserva hoy en el Monasterio. Copy of the unpublished manuscript preserved at the Fundación Universitaria Española, Madrid (edited by José Santos Puerto, 2010-2011, Revista de Estudios Bercianos 35-36: 27-54). |
| <i>Lynx lynx</i>     | Lobo corvato  | Moncayo               | Spain    | final del XIX (Asensio) | XIX   | 3338831.047 | 2150981.415 | Zaldívar, C. (2008). Apuntes para la desdichada historia del oso, la cabra montés y el lince en La Rioja. Belezos, 6: 44-49.                                                                                                                                                                                                                                                                                                 |
| <i>Lynx lynx</i>     | Tigre         | Montalegre            | Portugal | 1734                    | XVIII | 2853165.087 | 2254500.782 | Honorato, M. (1734). Relacam de huma Formidavel Fera, que Sahio da Montanha de Gerez junto à Villa de Monte-Alegre na Provincia de Tras os Montes, no mez de Mayo deste presente anno de 1734, e dos grandes estragos, que tem cometido na gente, e gados dos Lugares circunvezinhos. Officina Joaquianna de Musica.                                                                                                         |
| <i>Lynx lynx</i>     | Lobo-cerval   | Montalegre            | Portugal | 1734                    | XVIII | 2853165.087 | 2254500.782 | Honorato, M. (1734). Relacam de huma Formidavel Fera, que Sahio da Montanha de Gerez junto à Villa de Monte-Alegre na Provincia de Tras os Montes, no mez de Mayo deste presente anno de 1734, e dos grandes estragos, que tem cometido na gente, e gados dos Lugares circunvezinhos. Officina Joaquianna de Musica.                                                                                                         |
| <i>Lynx pardinus</i> | Gato-cravo    | Montalvo              | Portugal | 1758                    | XVIII | 2799479.894 | 1844236.235 | Cardoso, L. (1758). Montalvo, Moura. In Memorias Paroquiais (Vol. 24, pp. 1403–1406).                                                                                                                                                                                                                                                                                                                                        |
| <i>Lynx lynx</i>     | Tigre         | Monte Arno            | Spain    | 1762                    | XVIII | 3317576.315 | 2323271.054 | Izaguirre, R. de. (1934). Las Ciencias Naturales y los archivos: Katamotz = ¿Tigre? Revista Internacional de Estudios Vascos, 25, 707–714.                                                                                                                                                                                                                                                                                   |
| <i>Lynx lynx</i>     | Tigre         | Monte de Iturrieta    | Spain    | 1807                    | XIX   | 3313243.021 | 2271479.259 | González de Viñaspre, R. & Uribarrena, P. (2009). Osos y tigres en la montaña alavesa. Herria 4: 10-11.                                                                                                                                                                                                                                                                                                                      |
| <i>Lynx lynx</i>     | Tigre         | Monte Gorbea          | Spain    | 1762-1777               | XVIII | 3282278.076 | 2303367.304 | Fernández, J. M., & Ruiz de Azua, N. (2003). Mastofauna. In Estudio Faunístico del Parque Natural de Gorbeia (pp. 361–449). Diputación Foral de Álava / Arabako Foru Aldundia. Ruiz de Azua, N., & Fernández, J. M. (2005). Presencia histórica del lince o “tigre” en el País Vasco. Avnia, 10, 82–95.                                                                                                                      |

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|----------------------|----------------|-------------------|-------|-----------|-------|-------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      |                |                   |       |           |       |             |             | Olavarria, J. (1951). Tigres en Gorbea. Vida Vasca, 28, 73-75.<br><a href="http://hdl.handle.net/10357/2324">http://hdl.handle.net/10357/2324</a>                                                                                                                                                                                                                                                                            |
| <i>Lynx lynx</i>     | Lobo cerval    | Monte Orba        | Spain | 1802      | XIX   | 3422422.895 | 2235224.384 | Suman, M. (1802). Apuntes para el Diccionario Geográfico del Reino de Aragón. Partido de Cinco Villas. Según el MS. 9-7523 de la RAH. Ed: Salvo, J. y Capalvo, A, 2015. Institución Fernando el Católico. Zaragoza.                                                                                                                                                                                                          |
| <i>Lynx lynx</i>     | Tigre          | Monterredo        | Spain | 1861      | XIX   | 2830180.523 | 2292882.836 | Leal, A. S. d'Azevedo B. de P. (1874). Portugal Antigo e Moderno. Diccionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal (Vol. 3). 184 pp. Costa, A. (1938). Dicionário Chorographico de Portugal Continental e Insular: Vol. VI. Typographia Privativa do Diccionario Chorographico Azurara. pp. 735.      |
| <i>Lynx lynx</i>     | Lobo cerval    | Monterrei         | Spain | 1758      | XVIII | 2883477.497 | 2261466.176 | Sarmiento, M. (1760). Discurso sobre un animal feroz y desconocido que a la vista del Monasterio benedictino de San Pedro de Montes, en El Bierzo, se vió, se mató, se cogió y se desolló; y cuya piel se conserva hoy en el Monasterio. Copy of the unpublished manuscript preserved at the Fundación Universitaria Española, Madrid (edited by José Santos Puerto, 2010-2011, Revista de Estudios Bercianos 35-36: 27-54). |
| <i>Lynx lynx</i>     | Lúbican        | Monterrei         | Spain | 1758      | XVIII | 2883477.497 | 2261466.176 | Sarmiento, M. (1760). Discurso sobre un animal feroz y desconocido que a la vista del Monasterio benedictino de San Pedro de Montes, en El Bierzo, se vió, se mató, se cogió y se desolló; y cuya piel se conserva hoy en el Monasterio. Copy of the unpublished manuscript preserved at the Fundación Universitaria Española, Madrid (edited by José Santos Puerto, 2010-2011, Revista de Estudios Bercianos 35-36: 27-54). |
| <i>Lynx pardinus</i> | Lince          | Montes de Gredos  | Spain | 1826      | XIX   | 3041295.367 | 2039426.041 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo VIII, Pág 370.)                                                                                                                                                                                                                                                                                           |
| <i>Lynx pardinus</i> | Felis pardinus | Montes de Gredos  | Spain | 1865      | XIX   | 3041295.367 | 2039426.041 | La Abeja, Barcelona, 20/05/1865, 113.                                                                                                                                                                                                                                                                                                                                                                                        |
| <i>Lynx pardinus</i> | Gato clavo     | Montes Guadarrama | Spain | 1897      | XIX   | 3141105     | 2067394     | Graells, M. de la P. (1897). Fauna Mastodológica Ibérica. In Memorias de la Real Academia de Ciencias: Vol. XVII. Imprenta de Don Luis Aguado. <a href="http://www.archive.org/stream/memoriasdelareal1797real/memoriasdelareal1797real_djvu.txt">http://www.archive.org/stream/memoriasdelareal1797real/memoriasdelareal1797real_djvu.txt</a>                                                                               |
| <i>Lynx lynx</i>     | Lobo cerval    | Moran             | Spain | 1802      | XIX   | 3434061.729 | 2196792.027 | Suman, M. (1802). Apuntes para el Diccionario Geográfico del Reino de Aragón. Partido de Cinco Villas. Según el MS. 9-7523 de la RAH. Ed: Salvo, J. y Capalvo, A, 2015. Institución Fernando el Católico. Zaragoza.                                                                                                                                                                                                          |
| <i>Lynx lynx</i>     | Lobo cerval    | Morcin            | Spain | 1845-1850 | XIX   | 3036756.858 | 2376367.462 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                                                                                                                                                    |
| <i>Lynx lynx</i>     | Lobo cerval    | Morcin            | Spain | 1826      | XIX   | 3036756.858 | 2376367.462 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo VI, pág. 143.)                                                                                                                                                                                                                                                                                            |

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| <i>Lynx lynx</i>     | Lobo cervical  | Morcin               | Spain | 1884                 | XIX   | 3036756.858 | 2376367.462 | La Unión, Madrid, Año III, Nº 848, 25/ 10/ 1884                                                                                                                                                                                                                                                                                                                                                                                                               |
| <i>Lynx lynx</i>     | Lobo cervical  | Morcin               | Spain | 1897                 | XIX   | 3036756.858 | 2376367.462 | Aguirre, J. G. (1897). Diccionario Geografico y Estadístico de Asturias. Imp. La Tipografía. Pp. 206.                                                                                                                                                                                                                                                                                                                                                         |
| <i>Lynx lynx</i>     | Lobo cervical  | Morcín               | Spain | 1805                 | XIX   | 3039431.965 | 2377617.067 | Martínez-Marina, F. (1805). Diccionario Geográfico-Histórico de Asturias. In Manuscritos. Archivo Real Academia de la Historia (R.A.H. 9-6032/9-6038).                                                                                                                                                                                                                                                                                                        |
| <i>Lynx pardinus</i> | Gato cervical  | Morón de la Frontera | Spain | finales del siglo XV | XV    | 2946808.664 | 1700052.902 | González, M., & García, M. (1992). Actas Capitulares de Morón de la Frontera (1402-1426). Diputación Provincial de Sevilla. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                                                                                                                         |
| <i>Lynx pardinus</i> | Lince          | Motril               | Spain | 1845-1850            | XIX   | 3110411.298 | 1626896.422 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                                                                                                                                                                                     |
| <i>Lynx lynx</i>     | Llobo cervical | Muniellos            | Spain | 1754                 | XVIII | 2968494.06  | 2363745.844 | Torrente, J., & Llana, L. (1996). Sobre'l llobo cervical y la so presencia n'Asturies. Asturias, 2, 81–86.                                                                                                                                                                                                                                                                                                                                                    |
| <i>Lynx lynx</i>     | Llobo cervical | Muniellos            | Spain | 1755                 | XVIII | 2968494.06  | 2363745.844 | Torrente, J., & Llana, L. (1996). Sobre'l llobo cervical y la so presencia n'Asturies. Asturias, 2, 81–86.                                                                                                                                                                                                                                                                                                                                                    |
| <i>Lynx sp.</i>      | Lince          | Muniellos            | Spain | 1835                 | XIX   | 2968087.406 | 2363338.055 | "Vázquez, V. M. (2007, May 6). Muniellos. La Nueva España. <a href="https://www.lne.es/opinion/2007/05/06/muniellos-21890116.html">https://www.lne.es/opinion/2007/05/06/muniellos-21890116.html</a> Piñeiro Maceiras, J., Pérez García, P., Pérez García, I., Calderón Reñón, A., Paz Martínez, J. J. de, González Salvador, I., & Piñeiro Maceiras, M. L. (2012). El Lince del Noroeste y las Montañas Galaico-Leonesas. Asociación Cultural "Monte Irago." |
| <i>Lynx sp.</i>      | Lince          | Nanclares de Gamboa  | Spain | 1845-1850            | XIX   | 3296593.424 | 2287593.679 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                                                                                                                                                                                     |
| <i>Lynx lynx</i>     | Lobo cervical  | Navarra              | Spain | 1845-1850            | XIX   | 3365604.877 | 2250907.817 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                                                                                                                                                                                     |
| <i>Lynx lynx</i>     | Lobo cervical  | Navarra              | Spain | 1802                 | XIX   | 3365604.877 | 2250907.817 | Real Academia de La Historia. (1802). Diccionario Geografico-Histórico de Pais Vasco y Navarra. In Diccionario Geográfico, Histórico de España, por la Real Academia de La Historia. Imp. Academia. Pp. 63.                                                                                                                                                                                                                                                   |
| <i>Lynx lynx</i>     | Tigre          | Oñate                | Spain | 1645                 | XVII  | 3311356.876 | 2297767.751 | González de Viñaspre, R. & Uribarrena, P. (2009). Osos y tigres en la montaña alavesa. Herria 4: 10-11.                                                                                                                                                                                                                                                                                                                                                       |
| <i>Lynx lynx</i>     | Lobo cervical  | Oñate                | Spain | 1802                 | XIX   | 3311356.876 | 2297767.751 | Real Academia de La Historia. (1802). Diccionario Geografico-Histórico de Pais Vasco y Navarra. In Diccionario Geográfico, Histórico de España, por la Real Academia de La Historia. Imp. Academia. Pp. 195.                                                                                                                                                                                                                                                  |
| <i>Lynx lynx</i>     | Lobo cervical  | Oñate                | Spain | 1826                 | XIX   | 3311356.876 | 2297767.751 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo VI, pág. 527.)                                                                                                                                                                                                                                                                                                                             |

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|----------------------|---------------|-------------------|----------|-----------|-------|-------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Lynx lynx</i>     | Lince         | Orazo             | Spain    | 1861      | XIX   | 2830722.445 | 2364684.466 | Seoane, V. L. (1861). Fauna Mastológica de Galicia (pp. 118–122). Imprenta de Manuel Mirás.                                                                                                                                                                                                                                                                                                                                |
| <i>Lynx lynx</i>     | Lobo cervical | Orazo             | Spain    | 1861      | XIX   | 2830722.445 | 2364684.466 | Seoane, V. L. (1861). Fauna Mastológica de Galicia (pp. 118–122). Imprenta de Manuel Mirás.                                                                                                                                                                                                                                                                                                                                |
| <i>Lynx lynx</i>     | Tigre         | Orazo             | Spain    | 1861      | XIX   | 2830722.445 | 2364684.466 | Seoane, V. L. (1861). Fauna Mastológica de Galicia (pp. 118–122). Imprenta de Manuel Mirás.                                                                                                                                                                                                                                                                                                                                |
| <i>Lynx lynx</i>     | Lince         | Orbaiceta         | Spain    | 1895      | XIX   | 3406124.479 | 2276035.953 | El Correo Español. Diario Tradicionalista, Año VIII, N° 2195, 28/12/1895.                                                                                                                                                                                                                                                                                                                                                  |
| <i>Lynx lynx</i>     | Lobo cerbal   | Orbaiceta         | Spain    | 1895      | XIX   | 3406124.479 | 2276035.953 | El Correo Español. Diario Tradicionalista, Año VIII, N° 2195, 28/12/1895.                                                                                                                                                                                                                                                                                                                                                  |
| <i>Lynx lynx</i>     | Tigre         | Orbiso            | Spain    | 1803      | XIX   | 3312146.36  | 2259579.478 | González de Viñaspre, R. & Uribarrena, P. (2009). Osos y tigres en la montaña alavesa. Herria 4: 10-11.                                                                                                                                                                                                                                                                                                                    |
| <i>Lynx lynx</i>     | NA            | Orbiso            | Spain    | 1957      | XX    | 3312146.36  | 2259579.478 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                                                                                                                                              |
| <i>Lynx pardinus</i> | Gato cervical | Orcera            | Spain    | 1575      | XVI   | 3211107.869 | 1785367.785 | Villegas, L. R., & García, R. (1976). Relación de los pueblos de Jaén, de Felipe II. In Boletín del Instituto de Estudios Giennenses. Diputación Provincial de Jaén. Cebrián, A., & Cano, J. (1992). Relaciones Topográficas de los pueblos del Reino de Murcia. Estudio y transcripción. Universidad de Murcia. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52. |
| <i>Lynx lynx</i>     | Tigre         | Otozco            | Spain    | 1845-1850 | XIX   | 3272928.327 | 2312597.526 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                                                                                                                                                  |
| <i>Lynx lynx</i>     | Tigre         | Padrenda          | Spain    | 1861      | XIX   | 2830880.941 | 2294051.118 | Leal, A. S. d'Azevedo B. de P. (1874). Portugal Antigo e Moderno. Diccionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal (Vol. 3). 184 pp. Costa, A. (1938). Dicionário Chorographico de Portugal Continental e Insular: Vol. VI. Typographia Privativa do Dicionario Chorographico Azurara. pp. 735.     |
| <i>Lynx lynx</i>     | Lince         | Panticosa         | Spain    | 1865      | XIX   | 3479321.611 | 2236917.73  | Martinez y Reguera, L. (1881). Fauna de Sierra Morena Catálogo de los Mamíferos del Término de Montoro. Imp. M. Romero. pp. 123.                                                                                                                                                                                                                                                                                           |
| <i>Lynx lynx</i>     | Lobo-cerval   | Parada do Outeiro | Portugal | 1758      | XVIII | 2839967.043 | 2254333.528 | Cardoso, L. (1758). Parada do Gerês, Montalegre. In Memórias Paroquiais (Vol. 27, pp. 373-378).                                                                                                                                                                                                                                                                                                                            |
| <i>Lynx lynx</i>     | Onca          | Parada do Outeiro | Portugal | 1758      | XVIII | 2839967.043 | 2254333.528 | Cardoso, L. (1758). Parada do Gerês, Montalegre. In Memórias Paroquiais (Vol. 27, pp. 373-378).                                                                                                                                                                                                                                                                                                                            |
| <i>Lynx lynx</i>     | Lobo cervical | Parres            | Spain    | 1805      | XIX   | 3096115.914 | 2375874.005 | Martinez-Marina, F. (1805). Diccionario Geográfico-Histórico de Asturias. In Manuscritos. Archivo Real Academia de la Historia (R.A.H. 9-6032/9-6038).                                                                                                                                                                                                                                                                     |
| <i>Lynx lynx</i>     | Onca          | Passos            | Portugal | 1842      | XIX   | 2887178.839 | 2205280.243 | Raridade Zoológica. (1842). Revista universal lisbonense: jornal dos interesses physicos, moraes e litterarios por uma sociedade estudiosa, 2(9), 108. A Féra Enigmática. (1842). Revista universal lisbonense: jornal dos interesses physicos, moraes e litterarios por uma sociedade estudiosa, 2(15), 187.                                                                                                              |

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| <i>Lynx lynx</i>     | Lince         | Passos           | Portugal | 1842      | XIX   | 2887178.839 | 2205280.243 | Raridade Zoológica. (1842). Revista universal lisbonense: jornal dos interesses physicos, moraes e litterarios por uma sociedade estudiosa, 2(9), 108. A Féra Enigmática. (1842). Revista universal lisbonense: jornal dos interesses physicos, moraes e litterarios por uma sociedade estudiosa, 2(15), 187. |
| <i>Lynx lynx</i>     | Loba cervical | Passos           | Portugal | 1842      | XIX   | 2887178.839 | 2205280.243 | Raridade Zoológica. (1842). Revista universal lisbonense: jornal dos interesses physicos, moraes e litterarios por uma sociedade estudiosa, 2(9), 108. A Féra Enigmática. (1842). Revista universal lisbonense: jornal dos interesses physicos, moraes e litterarios por uma sociedade estudiosa, 2(15), 187. |
| <i>Lynx pardinus</i> | Gato cervical | Peñacerrada      | Spain    | 1625      | XVII  | 3280712.496 | 2259071.158 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                                 |
| <i>Lynx lynx</i>     | Lobo cervical | Perdiguera       | Spain    | 1716      | XVIII | 3436593.524 | 2134570.26  | Escuer, C. (2008). Lobos y linces en la sierra de Alcubierre. Montesnegros, 41: 11-13.                                                                                                                                                                                                                        |
| <i>Lynx lynx</i>     | Lince         | Pirineos         | Spain    | 1845-1850 | XIX   | 3582969.409 | 2217753.322 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                                     |
| <i>Lynx lynx</i>     | Lince         | Pirineos         | Spain    | 1777      | XVIII | 3582969.409 | 2217753.322 | Mercurio histórico y político, Madrid, Imprenta Real de la Gazeta, 8/1777, 319.                                                                                                                                                                                                                               |
| <i>Lynx lynx</i>     | Lobo cerbal   | Pirineos         | Spain    | 1802      | XIX   | 3582969.409 | 2217753.322 | Real Academia de La Historia. (1802). Diccionario Geografico-Histórico de Pais Vasco y Navarra. In Diccionario Geográfico, Histórico de España, por la Real Academia de La Historia. Imp. Academia. Pp. 275.                                                                                                  |
| <i>Lynx lynx</i>     | Lince         | Pirineos         | Spain    | 1826      | XIX   | 3582969.409 | 2217753.322 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo VII, Pág. 40.)                                                                                                                                                                             |
| <i>Lynx lynx</i>     | Lobo cervical | Pirineos         | Spain    | 1826      | XIX   | 3582969.409 | 2217753.322 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo VII, Pág. 40.)                                                                                                                                                                             |
| <i>Lynx lynx</i>     | Lobo cervical | Pirineos         | Spain    | 1865      | XIX   | 3582969.409 | 2217753.322 | La Abeja, Barcelona, 20/05/1865, 113.                                                                                                                                                                                                                                                                         |
| <i>Lynx lynx</i>     | Lobo cervical | Pirineos         | Spain    | 1876      | XIX   | 3582969.409 | 2217753.322 | Las maravillas y el progreso del siglo, N° 12, 10/09/1876, 6.                                                                                                                                                                                                                                                 |
| <i>Lynx pardinus</i> | Lince         | Posadas          | Spain    | 1826      | XIX   | 2990462.771 | 1768160.343 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (No pages identified)                                                                                                                                                                            |
| <i>Lynx pardinus</i> | Gato de clavo | Prados de Lopera | Spain    | 1885      | XIX   | 3093058.14  | 1644694.31  | Sánchez y García, J. (1885). Catálogo de los Mamíferos y Aves observados en la Provincia de Granada. Imprenta de Indalecio Ventura / Real Sociedad Económica de Granada. Pp. 9. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                     |
| <i>Lynx pardinus</i> | Lince         | Prados de Lopera | Spain    | 1885      | XIX   | 3093058.14  | 1644694.31  | Sánchez y García, J. (1885). Catálogo de los Mamíferos y Aves observados en la Provincia de Granada. Imprenta de Indalecio Ventura / Real Sociedad Económica de Granada. Pp. 9. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                     |
| <i>Lynx lynx</i>     | Lobo cervical | Proaza           | Spain    | 1805      | XIX   | 3027665.893 | 2376757.813 | Martínez-Marina, F. (1805). Diccionario Geográfico-Histórico de Asturias. In Manuscritos. Archivo Real Academia de la Historia (R.A.H. 9-6032/9-6038).                                                                                                                                                        |

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| <i>Lynx lynx</i>     | Lobo cervical | Proaza                | Spain    | 1826 | XIX   | 3028305.561 | 2377228.498 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo VII, Pág 129.)                                                                                                                                                                                                           |
| <i>Lynx pardinus</i> | Gato-cravo    | Quintos               | Portugal | 1758 | XVIII | 2769427.387 | 1834476.471 | Cardoso, L. (1758). Quintos, Beja. In Memórias Paroquiais (Vol. 30, pp. 141–144).                                                                                                                                                                                                                                                           |
| <i>Lynx lynx</i>     | Lobo cervical | Quirós                | Spain    | 1805 | XIX   | 3028990.984 | 2362824.025 | Martínez-Marina, F. (1805). Diccionario Geográfico-Histórico de Asturias. In Manuscritos. Archivo Real Academia de la Historia (R.A.H. 9-6032/9-6038).                                                                                                                                                                                      |
| <i>Lynx lynx</i>     | Lobo cervical | Riosa                 | Spain    | 1884 | XIX   | 3037188.637 | 2369820.653 | La Unión, Madrid, Año III, Nº 848, 25/ 10/ 1884                                                                                                                                                                                                                                                                                             |
| <i>Lynx lynx</i>     | Lobo cervical | Rivera de Arriba      | Spain    | 1884 | XIX   | 3040148.708 | 2380637.532 | La Unión, Madrid, Año III, Nº 848, 25/ 10/ 1884                                                                                                                                                                                                                                                                                             |
| <i>Lynx pardinus</i> | Lynx pardina  | Robledo de Chavela    | Spain    | 1894 | XIX   | 3116114     | 2047321     | Cazurro, M. (1894). Datos para la fauna de la provincia de Madrid. — Mamíferos. Actas de La Sociedad Española de Historia Natural, 23, 188–226. <a href="http://bibdigital.rjb.csic.es/spa/Volumenes.php?Libro=1110">http://bibdigital.rjb.csic.es/spa/Volumenes.php?Libro=1110</a>                                                         |
| <i>Lynx lynx</i>     | Lobo cervato  | Roncal                | Spain    | 1826 | XIX   | 3425782.42  | 2254579.374 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo VII, Pág. 359.)                                                                                                                                                                                                          |
| <i>Lynx pardinus</i> | Gato çervual  | Ronda                 | Spain    | 1495 | XV    | 2965239.646 | 1654105.117 | Bernardo, J. M. de. (1988). Textos histórico-geográficos de Córdoba y su provincia. Diputación Provincial de Córdoba. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                             |
| <i>Lynx lynx</i>     | Lobo cervical | Salt                  | Spain    | 1923 | XX    | 3722459.375 | 2124891.232 | Massip, J. M. (2012). L'enigma històric del llop cerver de Salt. Revista de Girona, 272: 44-47.                                                                                                                                                                                                                                             |
| <i>Lynx lynx</i>     | Tigre         | Salto                 | Portugal | XVII | XVII  | 2835827.547 | 2237576.449 | Anónimo (1730) in Álvares, F. (1997). O Lince-ibérico ( <i>Lynx pardinus</i> ) no Noroeste de Portugal: Presença Histórica e Situação Actual (Conservação do lince-ibérico em Portugal). Instituto da Conservação da Natureza/Programa Liberne. 42 pp. Anónimo. (1730). Antigas histórias da Freguesia de Salto (Padre J. Barroso, Trans.). |
| <i>Lynx pardinus</i> | Gato cerbal   | Salvatierra           | Spain    | 1802 | XIX   | 3310489.55  | 2277125.072 | Real Academia de La Historia. (1802). Diccionario Geografico-Histórico de Pais Vasco y Navarra. In Diccionario Geográfico, Histórico de España, por la Real Academia de La Historia. Imp. Academia. Pp. 289.                                                                                                                                |
| <i>Lynx lynx</i>     | NA            | Salvatierra           | Spain    | 1957 | XX    | 3310489.55  | 2277125.072 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                                                               |
| <i>Lynx lynx</i>     | Tigre         | Salvatierra de Aragón | Spain    | 1802 | XIX   | 3419714.453 | 2239641.348 | Suman, M. (1802). Apuntes para el Diccionario Geográfico del Reino de Aragón. Partido de Cinco Villas. Según el MS. 9-7523 de la RAH. Ed: Salvo, J. y Capalvo, A, 2015. Institución Fernando el Católico. Zaragoza.                                                                                                                         |
| <i>Lynx lynx</i>     | Lobo cervical | Salvatierra de Aragón | Spain    | 1802 | XIX   | 3419714.453 | 2239641.348 | Suman, M. (1802). Apuntes para el Diccionario Geográfico del Reino de Aragón. Partido de Cinco Villas. Según el MS. 9-7523 de la RAH. Ed: Salvo, J. y Capalvo, A, 2015. Institución Fernando el Católico. Zaragoza.                                                                                                                         |
| <i>Lynx lynx</i>     | Lobo cervate  | Salvatierra de Aragón | Spain    | 1802 | XIX   | 3419714.453 | 2239641.348 | Suman, M. (1802). Apuntes para el Diccionario Geográfico del Reino de Aragón. Partido de Cinco Villas. Según el MS. 9-7523 de la RAH. Ed: Salvo, J. y Capalvo, A, 2015. Institución Fernando el Católico. Zaragoza.                                                                                                                         |

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| <i>Lynx pardinus</i> | Gato cerbal   | San Calixto                               | Spain | 1840      | XIX   | 2974847.91  | 1787711.72  | Ramírez, L. M. (1840). Corografía Histórico-Estadística de la provincia y obispado de Córdoba: Vol. I & II. Imprenta de Noguer y Manté. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                              |
| <i>Lynx pardinus</i> | Gato clavo    | San Martín de Valdeiglesia                | Spain | 1897      | XIX   | 3100073     | 2034612     | Graells, M. de la P. (1897). Fauna Mastodológica Ibérica. In Memorias de la Real Academia de Ciencias: Vol. XVII. Imprenta de Don Luis Aguado. <a href="http://www.archive.org/stream/memoriasdelareal1797real/memoriasdelareal1797real_djvu.txt">http://www.archive.org/stream/memoriasdelareal1797real/memoriasdelareal1797real_djvu.txt</a> |
| <i>Lynx lynx</i>     | Tigre         | San Vicente de Arana                      | Spain | 1786-1807 | XVIII | 3310939.909 | 2265180.905 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                                                                  |
| <i>Lynx lynx</i>     | Tigre         | San Vicente de Arana                      | Spain | 1744      | XVIII | 3310939.909 | 2265180.905 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                                                                  |
| <i>Lynx lynx</i>     | NA            | San Vicente de Arana                      | Spain | 1807      | XIX   | 3310939.909 | 2265180.905 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                                                                  |
| <i>Lynx sp.</i>      | Lince         | Sant Llorenç de Munt (Vallés Occidental)  | Spain | 1790      | XVIII | 3654797.902 | 2095117.978 | Maluquer i Sostres, J. (1992). Notícia de la fauna de Catalunya i d'Andorra al final del segle XVIII. Butlletí de La Institució Catalana d'Història Natural, 5–21. <a href="https://raco.cat/index.php/ButlletiICHN/article/view/14340">https://raco.cat/index.php/ButlletiICHN/article/view/14340</a>                                         |
| <i>Lynx pardinus</i> | Gato cervical | Santa Cruz de Campezo                     | Spain | 1572      | XVI   | 3310528.453 | 2257041.078 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                                                                  |
| <i>Lynx pardinus</i> | Gato cervical | Santa Cruz de Campezo                     | Spain | 1573      | XVI   | 3310528.453 | 2257041.078 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                                                                  |
| <i>Lynx pardinus</i> | Gato cervical | Santa Cruz de Campezo                     | Spain | 1573      | XVI   | 3310528.453 | 2257041.078 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                                                                  |
| <i>Lynx pardinus</i> | Gato cervical | Santa Cruz de Campezo                     | Spain | 1591      | XVI   | 3310528.453 | 2257041.078 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226-262                                                                                                                                                                                                                                                                  |
| <i>Lynx lynx</i>     | Lobo cervical | Santa Eulalia de Oscos                    | Spain | 1826      | XIX   | 2948805.006 | 2395456.658 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo VIII, Pág 94.)                                                                                                                                                                                                              |
| <i>Lynx lynx</i>     | Lubican       | Santa María de Gestoso y Valle de Doresja | Spain | 1826      | XIX   | 2830542.013 | 2356303.832 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo IV, pág. 309)                                                                                                                                                                                                               |
| <i>Lynx lynx</i>     | Lobo cervical | Santa Marina Payares (Llena)              | Spain | 1775      | XVIII | 3040778.857 | 2363687.035 | Torrente, J., & Llana, L. (1996). Sobre'l llobu cervical y la so presencia n'Asturies. Asturias, 2, 81–86.                                                                                                                                                                                                                                     |
| <i>Lynx lynx</i>     | Lobo cervical | Santalla De Oscos                         | Spain | 1805      | XIX   | 2948705.002 | 2395662.488 | Martinez-Marina, F. (1805). Diccionario Geográfico-Histórico de Asturias. In Manuscritos. Archivo Real Academia de la Historia (R.A.H. 9-6032/9-6038).                                                                                                                                                                                         |

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| <i>Lynx pardinus</i> | Liberne       | Santiago do Cacém                  | Portugal | 1880       | XIX   | 2699007.734 | 1851831.505 | Leal, A. S. d'Azevedo B. de P. (1880). Portugal Antigo e Moderno. Dicionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal (Vol. 9). 29 pp.                                                                                                                                                                  |
| <i>Lynx lynx</i>     | Lobo cervical | Santo Adriano                      | Spain    | 1805       | XIX   | 3032734.559 | 2381341.394 | Martinez-Marina, F. (1805). Dicionario Geográfico-Histórico de Asturias. In Manuscritos. Archivo Real Academia de la Historia (R.A.H. 9-6032/9-6038).                                                                                                                                                                                                                                                                      |
| <i>Lynx lynx</i>     | Lobo cervical | Santo Adriano                      | Spain    | 1826       | XIX   | 3031759.613 | 2379783.828 | Miñano y Bedoya, S. (1826). Dicionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo VIII, Pág 147.)                                                                                                                                                                                                                                                                                          |
| <i>Lynx pardinus</i> | Gato-cravo    | São Bartolomeu                     | Portugal | 1758       | XVIII | 2782932.927 | 1992476.898 | Cardoso, L. (1758). Bartolomeu, Portalegre. In Memórias Paroquiais (Vol. 6, pp. 411-413).                                                                                                                                                                                                                                                                                                                                  |
| <i>Lynx pardinus</i> | Lobo sorvato  | São Romão de Panoias               | Portugal | 1842       | XIX   | 2710133.597 | 1830365.967 | Barahona, A. J. G. de. (1843). Lince (Carta.). Revista universal lisbonense: jornal dos interesses physicos, moraes e litterarios por uma sociedade estudiosa, 2(21), 267.                                                                                                                                                                                                                                                 |
| <i>Lynx pardinus</i> | Liberne       | São Romão de Panoias               | Portugal | 1842       | XIX   | 2710133.597 | 1830365.967 | Barahona, A. J. G. de. (1843). Lince (Carta.). Revista universal lisbonense: jornal dos interesses physicos, moraes e litterarios por uma sociedade estudiosa, 2(21), 267.                                                                                                                                                                                                                                                 |
| <i>Lynx lynx</i>     | Lobo cervical | Sarroca de Bellera (Pallars Jussà) | Spain    | XVIII      | XVIII | 3569308.149 | 2185005.768 | Maluquer i Sostres, J. (1992). Notícia de la fauna de Catalunya i d'Andorra al final del segle XVIII. Butlletí de La Institució Catalana d'Història Natural, 5–21. <a href="https://raco.cat/index.php/ButlletiCHN/article/view/14340">https://raco.cat/index.php/ButlletiCHN/article/view/14340</a>                                                                                                                       |
| <i>Lynx lynx</i>     | Lobo cervical | Seara                              | Portugal | XVII-XVIII | XVIII | 2840906.478 | 2232561.039 | Anónimo (1730) in Álvares, F. (1997). O Lince-ibérico ( <i>Lynx pardinus</i> ) no Noroeste de Portugal: Presença Histórica e Situação Actual (Conservação do lince-ibérico em Portugal). Instituto da Conservação da Natureza/Programa Liberne. 42 pp. Anónimo. (1730). Antigas histórias da Freguesia de Salto (Padre J. Barroso, Trans.).                                                                                |
| <i>Lynx lynx</i>     | Lobo cervical | Seara                              | Portugal | XVII-XVIII | XVII  | 2840906.478 | 2232561.039 | Anónimo (1730) in Álvares, F. (1997). O Lince-ibérico ( <i>Lynx pardinus</i> ) no Noroeste de Portugal: Presença Histórica e Situação Actual (Conservação do lince-ibérico em Portugal). Instituto da Conservação da Natureza/Programa Liberne. 42 pp. Anónimo. (1730). Antigas histórias da Freguesia de Salto (Padre J. Barroso, Trans.).                                                                                |
| <i>Lynx pardinus</i> | Gato cervical | Segura De La Sierra                | Spain    | 1575       | XVI   | 3212513.567 | 1782892.725 | Villegas, L. R., & García, R. (1976). Relación de los pueblos de Jaén, de Felipe II. In Boletín del Instituto de Estudios Giennenses. Diputación Provincial de Jaén. Cebrián, A., & Cano, J. (1992). Relaciones Topográficas de los pueblos del Reino de Murcia. Estudio y transcripción. Universidad de Murcia. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52. |
| <i>Lynx lynx</i>     | Lobo-cerval   | Serra Amarela                      | Portugal | 1747       | XVIII | 2817953.176 | 2260348.408 | Cardoso, L. (1747). Dicionario Geografico ou Noticia Historica de Todas as Cidades, Villas, Lugares, e Aldeas, Rios, Ribeiras, e Serras dos Reynos de Portugal, e Algarve, com todas as cousas raras, que nelles se encontrão, assim antigas, como modernas (Vol. 1). 428 pp.                                                                                                                                              |

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| <i>Lynx lynx</i>     | Lobo-cerval   | Serra Amarela       | Portugal | 1762       | XVIII | 2817953.176 | 2260348.408 | Castro, J. B. de. (1762). Parte I - Capitulo VI - Dos Montes, Premontorios e Serras de mayor nome. In Mappa de Portugal Antigo e Moderno (Tomo 1, pp. 85–85).                                                                                                                                                                               |
| <i>Lynx lynx</i>     | Lobo-cerval   | Serra Amarela       | Portugal | 1874       | XIX   | 2817953.176 | 2260348.408 | Baptista, J. M. (1874). Chorographia Moderna do Reino de Portugal (Vol. 1). 186 pp.                                                                                                                                                                                                                                                         |
| <i>Lynx sp.</i>      | Lynce         | Serra da Estrela    | Portugal | 1902       | XX    | 2833247.429 | 2087857.872 | Tavares, J. S. (1902). Quatro dias na Estrella. In Broteria: Revista de Sciencias Naturaes do Collegio de S. Fiel (Vol. 1, p. 178). La Bécarre.                                                                                                                                                                                             |
| <i>Lynx sp.</i>      | Lobo-cerval   | Serra da Estrela    | Portugal | 1902       | XX    | 2833247.429 | 2087857.872 | Tavares, J. S. (1902). Quatro dias na Estrella. In Broteria: Revista de Sciencias Naturaes do Collegio de S. Fiel (Vol. 1, p. 178). La Bécarre.                                                                                                                                                                                             |
| <i>Lynx pardinus</i> | Felis pardina | Serra da Estrela    | Portugal | 1902       | XX    | 2833247.429 | 2087857.872 | Tavares, J. S. (1902). Quatro dias na Estrella. In Broteria: Revista de Sciencias Naturaes do Collegio de S. Fiel (Vol. 1, p. 178). La Bécarre.                                                                                                                                                                                             |
| <i>Lynx pardinus</i> | Gato-cravo    | Serra de Alpedreira | Portugal | 1834       | XIX   | 2763934.657 | 1881554.063 | Mira, J. P. de. (1875). Um brado contra as monerías de cerco aos Lobos na Provincia do Alemtejo. Typ. de F. C. Bravo.<br><a href="https://www.gutenberg.org/files/29039/29039-h/29039-h.htm">https://www.gutenberg.org/files/29039/29039-h/29039-h.htm</a>                                                                                  |
| <i>Lynx lynx</i>     | Lobo-cerval   | Serra de Leiranco   | Portugal | 1874       | XIX   | 2861490.939 | 2241883.152 | Leal, A. S. d'Azevedo B. de P. (1874). Portugal Antigo e Moderno. Diccionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal (Vol. 4). 69 pp.                                                                                  |
| <i>Lynx pardinus</i> | Gato-cravo    | Serra de Monchique  | Portugal | 1943       | XX    | 2677713.292 | 1782651.508 | Costa, A. (1943). Diccionario Chorographico de Portugal Continental e Insular (Vol. 8). Typographia Privativa do Diccionario Chorographico Azurara. pp. 208.                                                                                                                                                                                |
| <i>Lynx lynx</i>     | Tigre         | Serra do Gerês      | Portugal | XVII-XVIII | XVIII | 2832770.845 | 2259424.225 | Anonimo (1730) in Álvares, F. (1997). O Lince-ibérico ( <i>Lynx pardinus</i> ) no Noroeste de Portugal: Presença Histórica e Situação Actual (Conservação do lince-ibérico em Portugal). Instituto da Conservação da Natureza/Programa Liberne. 42 pp. Anónimo. (1730). Antigas histórias da Freguesia de Salto (Padre J. Barroso, Trans.). |
| <i>Lynx lynx</i>     | Tigre         | Serra do Gerês      | Portugal | XVII-XVIII | XVII  | 2832770.845 | 2259424.225 | Anonimo (1730) in Álvares, F. (1997). O Lince-ibérico ( <i>Lynx pardinus</i> ) no Noroeste de Portugal: Presença Histórica e Situação Actual (Conservação do lince-ibérico em Portugal). Instituto da Conservação da Natureza/Programa Liberne. 42 pp. Anónimo. (1730). Antigas histórias da Freguesia de Salto (Padre J. Barroso, Trans.). |
| <i>Lynx lynx</i>     | Lobo-cerval   | Serra do Gerês      | Portugal | 1728       | XVIII | 2832770.845 | 2259424.225 | Anonimo (1907) in Álvares, F. (1997). O Lince-ibérico ( <i>Lynx pardinus</i> ) no Noroeste de Portugal: Presença Histórica e Situação Actual (Conservação do lince-ibérico em Portugal). Instituto da Conservação da Natureza/Programa Liberne. 42 pp. Anónimo. (1907). Dicionário de Portugal: Vol. III.                                   |
| <i>Lynx lynx</i>     | NA            | Serra do Gerês      | Portugal | 1728       | XVIII | 2832770.845 | 2259424.225 | Silveira, F. do Nascimento. (1804). Mappa Breve da Lusitania Antiga e Galicia Bracarense (Tom. 1, pp. 15).                                                                                                                                                                                                                                  |
| <i>Lynx lynx</i>     | Tigre         | Serra do Gerês      | Portugal | 1842       | XIX   | 2832770.845 | 2259424.225 | Noticia da Freguesia de S. João do Campo. (1842). In Revista Litteraria: Periodico de Litteratura, Philosophia, Viagens, Sciencias, e Bellas-Artes (Vol. 9, p. 45). Typographia da Revista. Piñeiro Maceiras, J., Pérez García, P., Pérez                                                                                                   |

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|----------------------|---------------|------------------|----------|------|-------|-------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      |               |                  |          |      |       |             |             | García, I., Calderón Reñón, A., Paz Martínez, J. J. de, González Salvador, I., & Piñeiro Maceiras, M. L. (2012). El Lince del Noroeste y las Montañas Galaico-Leonesas. Asociación Cultural “Monte Irago.”                                                                                                                                                                                                                                           |
| <i>Lynx lynx</i>     | Lobo cerval   | Serra do Gerês   | Portugal | 1842 | XIX   | 2832770.845 | 2259424.225 | Noticia da Freguesia de S. João do Campo. (1842). In Revista Litteraria: Periodico de Litteratura, Philosophia, Viagens, Sciencias, e Bellas-Artes (Vol. 9, p. 45). Typographia da Revista. Piñeiro Maceiras, J., Pérez García, P., Pérez García, I., Calderón Reñón, A., Paz Martínez, J. J. de, González Salvador, I., & Piñeiro Maceiras, M. L. (2012). El Lince del Noroeste y las Montañas Galaico-Leonesas. Asociación Cultural “Monte Irago.” |
| <i>Lynx lynx</i>     | Lobo-cerval   | Serra do Gerês   | Portugal | 1874 | XIX   | 2832770.845 | 2259424.225 | Leal, A. S. d’Azevedo B. de P. (1874). Portugal Antigo e Moderno. Dicionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal (Vol. 3). 274 pp.                                                                                                                                                                                           |
| <i>Lynx lynx</i>     | Lobo-cerval   | Serra do Gerês   | Portugal | 1907 | XX    | 2832770.845 | 2259424.225 | Pereira, E., & Rodrigues, G. (1907). Portugal: Dicionario Historico, Chorographico, Biographico, Bibliographico Heráldico, Numismático e Artístico (Vol. 3). 729 pp.                                                                                                                                                                                                                                                                                 |
| <i>Lynx pardinus</i> | Felix pardina | Serra do Soajo   | Portugal | 1890 | XIX   | 2815134.439 | 2275716.838 | Moller, A. F. (1893). Notas sobre a fauna da Serra do Suajo. In A. Nobre, Annaes de Sciencias Naturaes (Vol. 1, pp. 42–45). Typographia Occidental.                                                                                                                                                                                                                                                                                                  |
| <i>Lynx sp.</i>      | Lynce         | Serra do Soajo   | Portugal | 1890 | XIX   | 2815134.439 | 2275716.838 | Moller, A. F. (1893). Notas sobre a fauna da Serra do Suajo. In A. Nobre, Annaes de Sciencias Naturaes (Vol. 1, pp. 42–45). Typographia Occidental.                                                                                                                                                                                                                                                                                                  |
| <i>Lynx lynx</i>     | Lobo cerval   | Serra do Soajo   | Portugal | 1890 | XIX   | 2815134.439 | 2275716.838 | Moller, A. F. (1893). Notas sobre a fauna da Serra do Suajo. In A. Nobre, Annaes de Sciencias Naturaes (Vol. 1, pp. 42–45). Typographia Occidental.                                                                                                                                                                                                                                                                                                  |
| <i>Lynx pardinus</i> | Gato cerval   | Sevilla          | Spain    | 1826 | XIX   | 2905885.707 | 1738808.725 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo VIII, Pág 235.)                                                                                                                                                                                                                                                                                                                   |
| <i>Lynx pardinus</i> | Gato zerbal   | Sierra de Baza   | Spain    | 1789 | XVIII | 3182077.668 | 1681701.424 | Navarro, A. J. (2000). Viajes de un naturalista ilustrado por los reinos de Granada y Murcia (J. C. Fernández, Ed.). Universidad de Murcia. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                                                                                                |
| <i>Lynx pardinus</i> | Lince         | Sierra de Baza   | Spain    | 1855 | XIX   | 3182077.668 | 1681701.424 | Cassola, J. B. (1855). Ensayo histórico sobre la antigüedad, honores y privilegios de la muy noble y leal ciudad de Baza y pueblos de su abadía. Imprenta de Pedro Flores. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                                                                 |
| <i>Lynx lynx</i>     | Lince         | Sierra De Courel | Spain    | 1861 | XIX   | 2918656.859 | 2326210.695 | Seoane, V. L. (1861). Fáuna Mastológica de Galicia (pp. 118–122). Imprenta de Manuel Mirás.                                                                                                                                                                                                                                                                                                                                                          |
| <i>Lynx lynx</i>     | Lobo cerval   | Sierra De Courel | Spain    | 1861 | XIX   | 2918656.859 | 2326210.695 | Seoane, V. L. (1861). Fáuna Mastológica de Galicia (pp. 118–122). Imprenta de Manuel Mirás.                                                                                                                                                                                                                                                                                                                                                          |
| <i>Lynx lynx</i>     | Tigre         | Sierra De Courel | Spain    | 1861 | XIX   | 2918656.859 | 2326210.695 | Seoane, V. L. (1861). Fáuna Mastológica de Galicia (pp. 118–122). Imprenta de Manuel Mirás.                                                                                                                                                                                                                                                                                                                                                          |

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| <i>Lynx pardinus</i> | Lobo cerval  | Sierra de San Pedro         | Spain    | 1845-1850 | XIX   | 2898089.042 | 1957995.688 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                               |
| <i>Lynx lynx</i>     | Lobo corvato | Sierra del Madero           | Spain    | 1920      | XX    | 3285658.189 | 2159606.792 | Zaldivar, C. (2008). Apuntes para la desdichada historia del oso, la cabra montés y el lince en La Rioja. Belezos, 6: 44-49.                                                                                                                                                                            |
| <i>Lynx lynx</i>     | Lobo cerval  | Sierra del Sueve            | Spain    | 1837      | XIX   | 3094291.352 | 2388731.166 | Victorero, S. (1896). Descripción geográfico histórica del Conejo de Colunga en el Principado de Asturias.                                                                                                                                                                                              |
| <i>Lynx lynx</i>     | Lince        | Sierra del Sueve            | Spain    | 1837      | XIX   | 3094291.352 | 2388731.166 | Victorero, S. (1896). Descripción geográfico histórica del Conejo de Colunga en el Principado de Asturias.                                                                                                                                                                                              |
| <i>Lynx lynx</i>     | Onza         | Sierra Gorbeya              | Spain    | 1845-1850 | XIX   | 3282199.673 | 2302817.713 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                               |
| <i>Lynx lynx</i>     | Tigre        | Sierra Gorbeya              | Spain    | 1845-1850 | XIX   | 3282199.673 | 2302817.713 | Madoz, P. (1845-1850). Diccionario Geográfico- Estadístico- Histórico de España y sus posesiones de ultramar. Imp. Madoz y Sagasti. (No pages identified)                                                                                                                                               |
| <i>Lynx lynx</i>     | Tigre        | Sierra Gorbeya              | Spain    | 1802      | XIX   | 3282199.673 | 2302817.713 | Real Academia de La Historia. (1802). Diccionario Geografico-Histórico de Pais Vasco y Navarra. In Diccionario Geográfico, Histórico de España, por la Real Academia de La Historia. Imp. Academia. Pp. 306.                                                                                            |
| <i>Lynx lynx</i>     | Tigre        | Sierra Gorbeya              | Spain    | 1826      | XIX   | 3282199.673 | 2302817.713 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo IV, pág. 331)                                                                                                                                                                        |
| <i>Lynx pardinus</i> | Gato cerval  | Sierra Morena               | Spain    | 1864      | XIX   | 3087904.914 | 1789262.756 | Morales Prieto, P. (1904). Las Monterias en Sierra Morena á mediados de siglo XIX. Establecimiento Tipográfico del Colegio de Santiago. pp. 80.                                                                                                                                                         |
| <i>Lynx lynx</i>     | Tigre        | Sierras De Elgea Y Altzania | Spain    | 1815      | XIX   | 3311130.892 | 2287217.203 | Fernández, J. M., & Ruiz de Azua, N. (2003). Mastofauna. In Estudio Faunístico del Parque Natural de Gorbéa (pp. 361–449). Diputación Foral de Álava / Arabako Foru Aldundia. Ruiz de Azua, N., & Fernández, J. M. (2005). Presencia histórica del lince o “tigre” en el País Vasco. Avnia, 10, 82–95.  |
| <i>Lynx sp.</i>      | Lince        | Sierras de Guadalupe        | Spain    | 1826      | XIX   | 2996272.173 | 1950730.228 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo IV, pág. 385)                                                                                                                                                                        |
| <i>Lynx sp.</i>      | Lince        | Sigües                      | Spain    | 1802      | XIX   | 3418557.682 | 2235554.43  | Suman, M. (1802). Apuntes para el Diccionario Geográfico del Reino de Aragón. Partido de Cinco Villas. Según el MS. 9-7523 de la RAH. Ed: Salvo, J. y Capalvo, A, 2015. Institución Fernando el Católico. Zaragoza.                                                                                     |
| <i>Lynx lynx</i>     | Lynx lynx    | Sima Pagolusieta            | Spain    | 1445-1631 | XVI   | 3284279.781 | 2300395.197 | Rodríguez-Varela, R., García, N., Nores, C., Álvarez Lao, D., Barnett, R., Arsuaga, J. L., & Valdiosera, C. (2015). Ancient DNA reveals past existence of Eurasian lynx in Spain. Journal of Zoology, 298(2), 94–102. <a href="https://doi.org/10.1111/jzo.12289">https://doi.org/10.1111/jzo.12289</a> |
| <i>Lynx lynx</i>     | Lynx lynx    | Sima Topinoria              | Spain    | 1710-1770 | XVIII | 3133118.601 | 2351395.506 | Grandal d'Anglade, A. M. (2024, March 5). El último lince boreal de la Península Ibérica: El individuo de Sima Topinoria y su excepcional valor científico [Oral Presentation].                                                                                                                         |
| <i>Lynx lynx</i>     | Lobo-cerval  | Soajo                       | Portugal | 1706      | XVIII | 2816105.775 | 2269201     | Carvalho da Costa, A. (1706). Corografia Portuguesa e Descripçam Topográfica do Famoso Reyno de Portugal (Vol. 1). 160 pp.                                                                                                                                                                              |

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| <i>Lynx lynx</i>     | Lobo-cerval | Soajo                   | Portugal | 1875  | XIX   | 2816105.775 | 2269201     | Baptista, J. M. (1875). Chorographia Moderna do Reino de Portugal (Vol. 2). 34 pp.                                                                                                                                                                                                                                                                                                                                       |
| <i>Lynx pardinus</i> | Gato-cravo  | Sobral da Adiça         | Portugal | 1758  | XVIII | 2806891.39  | 1833040.101 | Cardoso, L. (1758). Adiça, Moura. In Memórias Paroquiais (Vol. 1, pp. 247–256).                                                                                                                                                                                                                                                                                                                                          |
| <i>Lynx sp.</i>      | Lince       | Sobrescobio             | Spain    | 1932  | XX    | 3070259.158 | 2360763.491 | Jove y Canella, J. M. (1932). Topografía Médica del Término Municipal de Sobrescobio.                                                                                                                                                                                                                                                                                                                                    |
| <i>Lynx lynx</i>     | Lince       | Somiedo                 | Spain    | 1805  | XIX   | 3006068.068 | 2364432.64  | Martínez-Marina, F. (1805). Diccionario Geográfico-Histórico de Asturias. In Manuscritos. Archivo Real Academia de la Historia (R.A.H. 9-6032/9-6038).                                                                                                                                                                                                                                                                   |
| <i>Lynx lynx</i>     | Lobo cerval | Somiedo                 | Spain    | 1805  | XIX   | 3006068.068 | 2364432.64  | Martínez-Marina, F. (1805). Diccionario Geográfico-Histórico de Asturias. In Manuscritos. Archivo Real Academia de la Historia (R.A.H. 9-6032/9-6038).                                                                                                                                                                                                                                                                   |
| <i>Lynx lynx</i>     | Lobo cerval | Somiedo                 | Spain    | 1826  | XIX   | 3004096.947 | 2367000.217 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo VIII, Pág 322.)                                                                                                                                                                                                                                                                                       |
| <i>Lynx lynx</i>     | Lince       | Somiedo                 | Spain    | 1826  | XIX   | 3004096.947 | 2367000.217 | Miñano y Bedoya, S. (1826). Diccionario Geográfico y Estadístico de España y Portugal. Im. Pierad – Peralta. (Tomo VIII, Pág 322.)                                                                                                                                                                                                                                                                                       |
| <i>Lynx lynx</i>     | Lobo cerval | Tauste                  | Spain    | 1802  | XIX   | 3387608.07  | 2160571.658 | Suman, M. (1802). Apuntes para el Diccionario Geográfico del Reino de Aragón. Partido de Cinco Villas. Según el MS. 9-7523 de la RAH. Ed: Salvo, J. y Capalvo, A, 2015. Institución Fernando el Católico. Zaragoza.                                                                                                                                                                                                      |
| <i>Lynx lynx</i>     | Lob serber  | Tirvia (Pallars Sobirà) | Spain    | XVIII | XVIII | 3601013.158 | 2198528.207 | Maluquer i Sostres, J. (1992). Notícia de la fauna de Catalunya i d'Andorra al final del segle XVIII. Butlletí de La Institució Catalana d'Història Natural, 5–21. <a href="https://raco.cat/index.php/ButlletiICHN/article/view/14340">https://raco.cat/index.php/ButlletiICHN/article/view/14340</a>                                                                                                                   |
| <i>Lynx pardinus</i> | Lince       | Torreldones             | Spain    | 1865  | XIX   | 3143482.634 | 2050790.941 | El Pabellón Nacional, Madrid, 20/05/1865, 8.                                                                                                                                                                                                                                                                                                                                                                             |
| <i>Lynx pardinus</i> | Lobo cerval | Torreldones             | Spain    | 1865  | XIX   | 3143482.634 | 2050790.941 | El Pabellón Nacional, Madrid, 20/05/1865, 8.                                                                                                                                                                                                                                                                                                                                                                             |
| <i>Lynx lynx</i>     | Tigre       | Truchillas              | Spain    | 1790  | XVIII | 2969809.661 | 2274217.941 | "García González, M. José. (1998). El Bierzo a finales del siglo XVIII: Según las respuestas al interrogatorio de Tomás López. Instituto de estudios bercianos. Piñeiro Maceiras, J., Pérez García, P., Pérez García, I., Calderón Reñón, A., Paz Martínez, J. J. de, González Salvador, I., & Piñeiro Maceiras, M. L. (2012). El Lince del Noroeste y las Montañas Galaico-Leonesas. Asociación Cultural “Monte Irago.” |
| <i>Lynx lynx</i>     | Tigre       | Trucios                 | Spain    | 1815  | XIX   | 3245527.237 | 2335754.621 | Fernández, J. M., & Ruiz de Azua, N. (2003). Mastofauna. In Estudio Faunístico del Parque Natural de Gorbeia (pp. 361–449). Diputación Foral de Álava / Arabako Foru Aldundia. Ruiz de Azua, N., & Fernández, J. M. (2005). Presencia histórica del lince o “tigre” en el País Vasco. Avnia, 10, 82–95.                                                                                                                  |
| <i>Lynx lynx</i>     | Tigre       | Trucios                 | Spain    | 1816  | XIX   | 3245527.237 | 2335754.621 | Fernández, J. M., & Ruiz de Azua, N. (2003). Mastofauna. In Estudio Faunístico del Parque Natural de Gorbeia (pp. 361–449). Diputación Foral de Álava / Arabako Foru Aldundia. Ruiz de Azua, N., & Fernández, J. M. (2005). Presencia histórica del lince o “tigre” en el País Vasco. Avnia, 10, 82–95.                                                                                                                  |
| <i>Lynx lynx</i>     | Tigre       | Urcabustaiz             | Spain    | 1783  | XVIII | 3269780.827 | 2297647.709 | Fernández, J. M., & Ruiz de Azua, N. (2003). Mastofauna. In Estudio Faunístico del Parque Natural de Gorbeia (pp. 361–449). Diputación Foral de                                                                                                                                                                                                                                                                          |

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|----------------------|---------------|------------------------------|-------|-------|-------|-------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      |               |                              |       |       |       |             |             | Álava / Arabako Foru Aldundia. Ruiz de Azua, N., & Fernández, J. M. (2005). Presencia histórica del lince o “tigre” en el País Vasco. Avnia, 10, 82–95. Abascal, G. (1996). Las fieras en el imaginario popular alavés.                                                                                                                                                     |
| <i>Lynx lynx</i>     | Tigre         | Urcabustaiz                  | Spain | 1803  | XIX   | 3269780.827 | 2297647.709 | Fernández, J. M., & Ruiz de Azua, N. (2003). Mastofauna. In Estudio Faunístico del Parque Natural de Gorbeia (pp. 361–449). Diputación Foral de Álava / Arabako Foru Aldundia. Ruiz de Azua, N., & Fernández, J. M. (2005). Presencia histórica del lince o “tigre” en el País Vasco. Avnia, 10, 82–95.                                                                     |
| <i>Lynx lynx</i>     | Lleopardo     | Vall d'Aneu (Pallars Sobirà) | Spain | XVIII | XVIII | 3592428.663 | 2212209.372 | Maluquer i Sostres, J. (1992). Notícia de la fauna de Catalunya i d'Andorra al final del segle XVIII. Butlletí de La Institució Catalana d'Història Natural, 5–21. <a href="https://raco.cat/index.php/ButlletiICHN/article/view/14340">https://raco.cat/index.php/ButlletiICHN/article/view/14340</a>                                                                      |
| <i>Lynx lynx</i>     | NA            | Valle de Lana                | Spain | 1800  | XIX   | 3318888.98  | 2261363.389 | López de Guereñu, G. (1957). La caza en la montaña alavesa. Munibe 9: 226–262                                                                                                                                                                                                                                                                                               |
| <i>Lynx pardinus</i> | Lobo cervical | Velada                       | Spain | 1578  | XVI   | 3044048.016 | 2002755.501 | Viñas, C., & Paz, R. (1963). Reino de Toledo. In Relaciones Historico-Geografico-Estadísticas de los Pueblos de España hechas por iniciativa de Felipe II (Vol. 3). Instituto de Sociología “Balmes”, Instituto de Geografía “Juan Sebastian Elcano”, and Consejo Superior de Investigaciones Científicas. pp. 667.                                                         |
| <i>Lynx pardinus</i> | Gato clavo    | Vélez-Rubio                  | Spain | 1789  | XVIII | 3251838.087 | 1703771.373 | Navarro, A. J. (2000). Viajes de un naturalista ilustrado por los reinos de Granada y Murcia (J. C. Fernández, Ed.). Universidad de Murcia. Gutiérrez Alba, V. (2007). Apuntes Históricos Sobre el Lince Ibérico en Andalucía. Galemys, 19(2), 33–52.                                                                                                                       |
| <i>Lynx lynx</i>     | Lleopardo     | Viella (Vall d'Arán)         | Spain | XVIII | XVIII | 3566451.135 | 2223653.619 | Maluquer i Sostres, J. (1992). Notícia de la fauna de Catalunya i d'Andorra al final del segle XVIII. Butlletí de La Institució Catalana d'Història Natural, 5–21. <a href="https://raco.cat/index.php/ButlletiICHN/article/view/14340">https://raco.cat/index.php/ButlletiICHN/article/view/14340</a>                                                                      |
| <i>Lynx lynx</i>     | Lince         | Vilalba                      | Spain | 1861  | XIX   | 2897572.011 | 2412345.804 | Seoane, V. L. (1861). Fauna Mastológica de Galicia (pp. 118–122). Imprenta de Manuel Mirás.                                                                                                                                                                                                                                                                                 |
| <i>Lynx lynx</i>     | Lobo cervical | Vilalba                      | Spain | 1861  | XIX   | 2897572.011 | 2412345.804 | Seoane, V. L. (1861). Fauna Mastológica de Galicia (pp. 118–122). Imprenta de Manuel Mirás.                                                                                                                                                                                                                                                                                 |
| <i>Lynx lynx</i>     | Tigre         | Vilalba                      | Spain | 1861  | XIX   | 2897572.011 | 2412345.804 | Seoane, V. L. (1861). Fauna Mastológica de Galicia (pp. 118–122). Imprenta de Manuel Mirás.                                                                                                                                                                                                                                                                                 |
| <i>Lynx lynx</i>     | Onza          | Villafranca de Ordizia       | Spain | 1603  | XVII  | 3330713.215 | 2296348.801 | Izaguirre, R. de. (1934). Las Ciencias Naturales y los archivos: Katamotz = ¿Tigre? Revista Internacional de Estudios Vascos, 25, 707–714. Múgica, S. (1921). Provincia de Guipúzcoa. In Geografía General del País Vasco-Navarro. Establecimiento Editorial de Alberto Martín. Pp. 205.                                                                                    |
| <i>Lynx lynx</i>     | Pantera       | Villanañe                    | Spain | 1837  | XIX   | 3255378.574 | 2285523.829 | Fernández, J. M., & Ruiz de Azua, N. (2003). Mastofauna. In Estudio Faunístico del Parque Natural de Gorbeia (pp. 361–449). Diputación Foral de Álava / Arabako Foru Aldundia. Ruiz de Azua, N., & Fernández, J. M. (2005). Presencia histórica del lince o “tigre” en el País Vasco. Avnia, 10, 82–95. Becerro, R. (1919). Descripciones de Álava. Real Ateneo de Vitoria. |

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| <i>Lynx lynx</i>     | Pantera     | Villanañe        | Spain | 1837 | XIX   | 3255258.215 | 2285178.44  | González de Viñaspre, R. & Uribarrena, P. (2009). Osos y tigres en la montaña alavesa. Herria 4: 10-11.                                                                                                                                                                                                                                                                                                                                                                                                                |
| <i>Lynx pardinus</i> | Gato cerval | Viso del Marqués | Spain | 1575 | XVI   | 3137390.813 | 1820794.528 | Rubio, J. O. (1918). Relaciones Topográficas de los Pueblos de España. Sociedad Española de Artes Gráficas. pp. 692.                                                                                                                                                                                                                                                                                                                                                                                                   |
| <i>Lynx lynx</i>     | Tigre       | Zuia             | Spain | 1758 | XVIII | 3276394.275 | 2297625.814 | Fernández, J. M., & Ruiz de Azua, N. (2003). Mastofauna. In Estudio Faunístico del Parque Natural de Gorbeia (pp. 361–449). Diputación Foral de Álava / Arabako Foru Aldundia. Ruiz de Azua, N., & Fernández, J. M. (2005). Presencia histórica del lince o “tigre” en el País Vasco. Avnia, 10, 82–95. Abascal, G. (1996). Las fieras en el imaginario popular alavés. Olavarriá, J. (1951). Tigres en Gorbea. Vida Vasca, 28, 73-75. <a href="http://hdl.handle.net/10357/2324">http://hdl.handle.net/10357/2324</a> |

## 7.4. Sampled regions and sampling effort across the monitored centuries

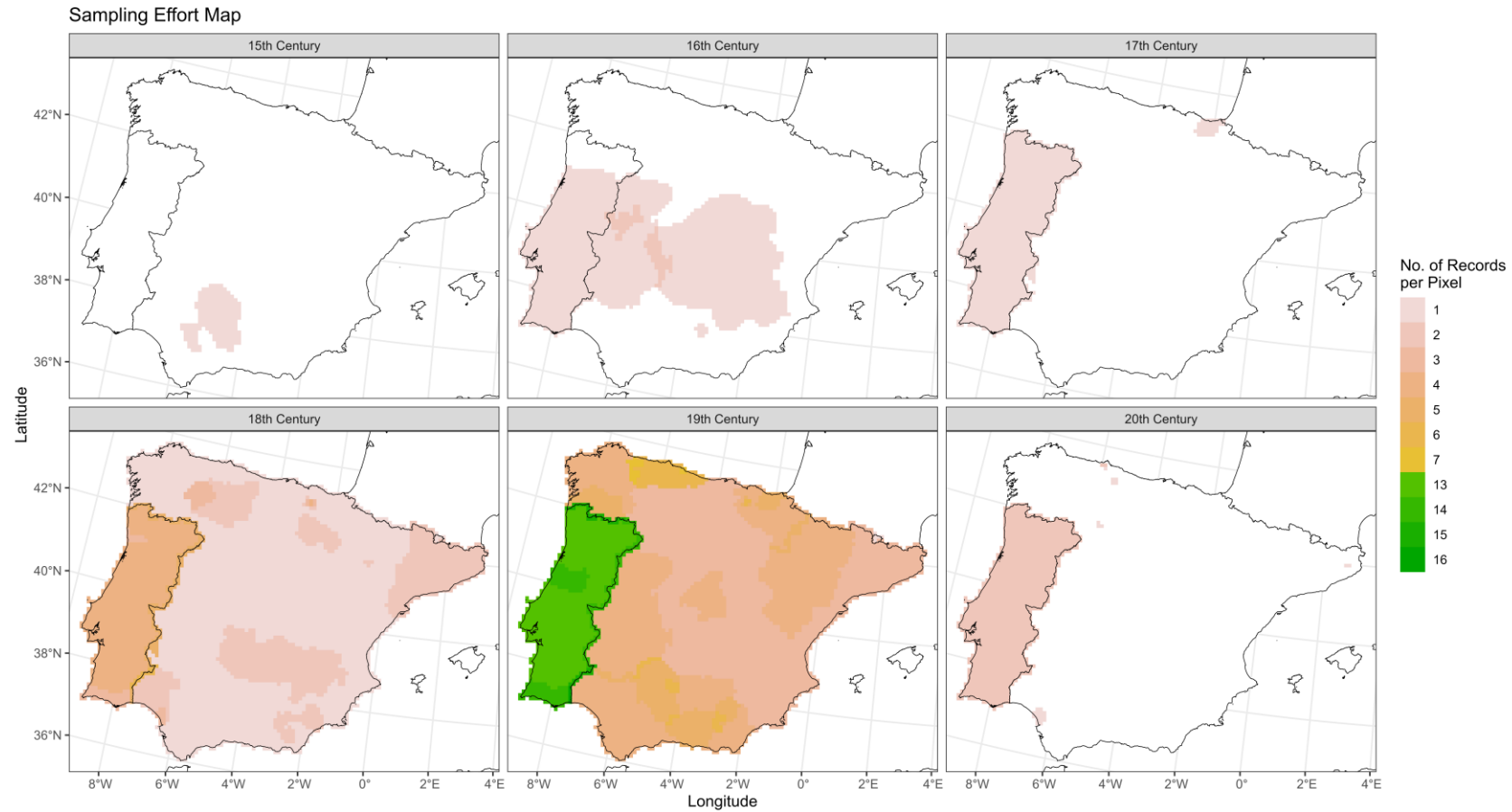


Figure A.1 – Sampling effort across the different sampled centuries.

Table A.2 – Percentage of the Iberian Peninsula sampled over the centuries. Here, the Geographic Sampling Effort is the percentage of the Iberian Peninsula that has been sampled (i.e., has at least one primary historical record).

|                                       | 15 <sup>th</sup> Century | 16 <sup>th</sup> Century | 17 <sup>th</sup> Century | 18 <sup>th</sup> Century | 19 <sup>th</sup> Century | 20 <sup>th</sup> Century |
|---------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <b>Geographic Sampling Effort (%)</b> | 3.381                    | 39.176                   | 17.134                   | 100.000                  | 100.000                  | 16.937                   |

In this work, the sampling effort represents (approximately) how many primary historical records were analysed per pixel in each sampled century (for another method of assessing sampling bias in historical records, see Monsarrat et al., 2019). The sampling effort was estimated by superimposing the maximum geographic possibly covered by each primary record in each century. For example, in the case of Madoz (1845-1850) it was assumed that the covered area would be all of Spain. In Portugal, the borders of administrative districts over the centuries were obtained through the work of Tomás and Valério (2019). However, this estimate of the maximum coverage area should not be seen as an effective measure of sampling effort, being only what, with current information, can be used to inform ourselves about the sampling effort. This assumption means that it is impossible to use these sampling effort layers in models such as MaxEnt, as the true sampling effort is unequal within each range of records (Clavero et al., 2022). To create a bias layer, the maximum sampling range of each record would have to be replaced by a layer of, for example, distances between parishes or settlements for each primary historical record, for which the spatial data is (currently) lacking. Another thing that makes these maps not usable as effective sampling effort measures is the fact that some primary historical records could not be included. Among several reasons, they were excluded, because: (1) inaccessibility to the physical or digital copies of the primary sources; (2) some sources do not cite primary records (although in some cases they transcribe sections thereof); and (3) some primary records are only occasional and sporadic sightings. However, despite being imperfect and incomplete, these sampling effort maps are (currently) the best approximation and quantification of sampling effort over centuries.

#### 7.4.1. References

- Clavero, M., García-Reyes, A., Fernández-Gil, A., Revilla, E., & Fernández, N. (2022). On the misuse of historical data to set conservation baselines: Wolves in Spain as an example. *Biological Conservation*, 276, 109810. <https://doi.org/10.1016/j.biocon.2022.109810>
- Madoz, P. (Ed.). (1845-1850). *Diccionario geográfico-histórico-estadístico de España y sus posesiones de Ultramar* (1–16).
- Monsarrat, S., Boshoff, A. F., & Kerley, G. I. H. (2019). Accessibility maps as a tool to predict sampling bias in historical biodiversity occurrence records. *Ecography*, 42(1), 125–136. <https://doi.org/10.1111/ecog.03944>
- Tomás, A., & Valério, N. (2019). *Autarquias locais e divisões administrativas em Portugal 1836-2013* (63; Série Documentos de Trabalho/Working Papers Series, p. 1007). Gabinete de História Económica e Social, Instituto Superior de Economia e Gestão, Universidade de Lisboa. <http://hdl.handle.net/10400.5/19157>

## 7.5. Review table of factors that influence the distribution of the Eurasian lynx

Table A.3 – Ecologically significant variables for the distribution of the Eurasian lynx (*Lynx lynx*) in the literature.

| Type                             | Variable                                 | Description/Justification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Assessed or used in...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------------|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Anthropogenic Disturbance</b> | Human Population Density                 | Human population density is a variable that is commonly used as a proxy of anthropogenic disturbance (e.g., Cimatti et al., 2021; but see Luck, 2007). Population density may be correlated with human infrastructure density or with human-wildlife conflicts, which may lead to lynx's avoidance of high human population density areas. However, in the specific case of the Eurasian lynx, this may also be due to this species avoiding areas with high human activity (e.g., outdoor activities; Belotti et al., 2012, 2018). | (Zimmermann & Breitenmoser, 2002; Andrén et al., 2006; Bunnefeld et al., 2006; Basille, 2008; Basille et al., 2008, 2009; Bouyer, 2015; Bouyer, Gervasi, et al., 2015; Lelieveld et al., 2018; Hemmingmoore et al., 2020; Dobbert et al., 2021; Cimatti et al., 2021; Milanesi et al., 2022)                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Anthropogenic Disturbance</b> | Road-related                             | The roads are barriers to the dispersal of large carnivores like the Eurasian lynx (Mata et al., 2017). Furthermore, roads are also associated with a high mortality rate in large carnivores, due to road-kills (Červinka et al., 2015). For this reason, they are one of the most used variables in modelling the Eurasian lynx distribution.                                                                                                                                                                                     | (Sunde et al., 1998; Rüdissler & Martys, 2002; Schadt, Revilla, et al., 2002; Zimmermann & Breitenmoser, 2002; Zimmermann, 2004; Kramer-Schadt et al., 2004; Skrbinšek, 2004; Andrén et al., 2006; Niedziałkowska et al., 2006; Doswald et al., 2007; Basille, 2008; Basille et al., 2008; May et al., 2008; Basille et al., 2009, 2013; Becker, 2013; Bouyer, 2015; Bouyer, Gervasi, et al., 2015; Filla et al., 2017; Lelieveld et al., 2018; Hemmingmoore et al., 2020; Potočník et al., 2020; Dobbert et al., 2021; Iosif et al., 2022; Dyck et al., 2022; Ripari et al., 2022; Milanesi et al., 2022; Oeser, Heurich, Kramer-Schadt, Mattisson, et al., 2023; Serva et al., 2023; Čonč, Oliveira, Belotti, et al., 2024; Čonč, Oliveira, Hočevár, et al., 2024) |
| <b>Anthropogenic Disturbance</b> | Infrastructure-related (Excluding roads) | Other anthropogenic infrastructures, such as settlements or railways, are not only a good proxy for anthropogenic disturbances, but can also serve as barriers to the Eurasian lynx's dispersal.                                                                                                                                                                                                                                                                                                                                    | (Sunde et al., 1998; Zimmermann, 2004; Bunnefeld et al., 2006; Niedziałkowska et al., 2006; Doswald et al., 2007; Basille, 2008; Basille et al., 2008; May et al., 2008; Becker, 2013; Magg et al., 2016; Filla et al., 2017; Dobbert et al., 2021; Cimatti et al., 2021; Ripari et al., 2022; Milanesi et al., 2022; Serva                                                                                                                                                                                                                                                                                                                                                                                                                                          |

|                                  |                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                  |                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | et al., 2023; Čonč, Oliveira, Belotti, et al., 2024; Čonč, Oliveira, Hočevár, et al., 2024)                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Anthropogenic Disturbance</b> | Indexes and other proxies for disturbance | In addition to the variables mentioned above, in some of the articles that aim to model the distribution of the lynx, anthropogenic impact indices are used, such as the Human Influence Index (HII; Becker, 2013) and the Human Modification Index (Bouyer, 2015; Bouyer, San Martín, et al., 2015; Oeser, Heurich, Kramer-Schadt, Mattisson, et al., 2023), or proxies impact, such as night-time light (Müller et al., 2014).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | (Becker, 2013; Müller et al., 2014; Bouyer, 2015; Bouyer, San Martín, et al., 2015; Gehr et al., 2017; Milanese et al., 2022; Oeser, Heurich, Kramer-Schadt, Mattisson, et al., 2023; Oeser, Heurich, Kramer-Schadt, Andrén, et al., 2023)                                                                                                                                                                                                                                                      |
| <b>Biotic Interactions</b>       | Competition                               | The Eurasian lynx competes with other large and medium carnivores in Europe including the brown bear ( <i>Ursus arctos</i> ; Krofel et al., 2012; Dobbert et al., 2021), the gray wolf ( <i>Canis lupus</i> ; Lelieveld, 2013; Dobbert et al., 2021; Serva et al., 2023), the red fox ( <i>Vulpes vulpes</i> ; Krofel et al., 2019), the wolverine ( <i>Gluto gluto</i> ; Dobbert et al., 2021), and the golden jackal ( <i>Canis aureus</i> ; Krofel et al., 2022; Serva et al., 2023). The golden jackal, which has recently started to be detected in the Iberian Peninsula (Sáenz De Buruaga et al., 2023; Royo-Vicente & García, 2024), is an interesting case of interaction and kleptoparasitism as its distribution will increasingly overlap with that of the Eurasian lynx (Serva et al., 2023). There are also cases of kleptoparasitism between humans ( <i>Homo sapiens</i> ) and the Eurasian lynx (Krofel et al., 2008). The Eurasian lynx could have also competed with the Iberian lynx whenever they were sympatric (Dobbert et al., 2021).         | (Krofel et al., 2008, 2012; Lelieveld, 2013; Krofel et al., 2019, 2022; Dobbert et al., 2021; Serva et al., 2023)                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Biotic Interactions</b>       | Prey Availability                         | Food availability is one of the limiting factors of the distribution of carnivores (Bateman & Fleming, 2012). Therefore, despite being a difficult variable to obtain, it is a factor that is commonly used when modelling the distribution of the Eurasian lynx, either directly through the use of density or prey presence indices (Herfindal et al., 2005; Doswald et al., 2007; Basille et al., 2009; Müller et al., 2014; Bouyer, Gervasi, et al., 2015; Bouyer, San Martín, et al., 2015; Belotti et al., 2014; Filla et al., 2017; Gehr et al., 2017; Hemmingmoore et al., 2020) or indirectly through indices of productivity (e.g., NDVI; Herfindal et al., 2005; Ripari et al., 2022). For the Eurasian lynx, the main preys in Europe are ungulates, such as roe deer ( <i>Capreolus capreolus</i> ), Alpine chamois ( <i>Rupicapra rupicapra</i> ), red deer ( <i>Cervus elaphus</i> ) and wild goats ( <i>Capra</i> spp.) (Khorozyan & Heurich, 2023). However, in some areas, hares ( <i>Lepus</i> spp.) can represent an important part of the lynx's | (Herfindal et al., 2005; Odden et al., 2006; Bunnefeld et al., 2006; Doswald et al., 2007; Basille, 2008; Basille et al., 2009; Krofel et al., 2011; Müller et al., 2014; Belotti et al., 2014; Gervasi et al., 2014; Bouyer, 2015; Bouyer, Gervasi, et al., 2015; Bouyer, San Martín, et al., 2015; Laze & Gordon, 2016; Filla et al., 2017; Gehr et al., 2017; Mengülluoglu et al., 2018; Hemmingmoore et al., 2020; Milanese et al., 2022; Khorozyan & Heurich, 2023; Andrén & Liberg, 2024) |

|                |                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                       |
|----------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
|                |                      | <p>diet, being even more important than ungulates (Mengüllüoğlu et al., 2018; Khorozyan &amp; Heurich, 2023).</p> <p>There is often a trade-off between the availability of roe deer (and prey in general) and human activity (Basille et al., 2009; Bouyer, Gervasi, et al., 2015; Bouyer, San Martin, et al., 2015; Filla et al., 2017; Gehr et al., 2017). This happens because, although the lynx is attracted to areas with high prey availability, it is repelled by areas with high levels of human activity. Thus, the lynx selects areas with intermediate levels of both prey availability and human activity, since the availability of some prey (e.g., roe deer) is greater closer to human settlements (e.g., Filla et al., 2017; Gehr et al., 2017; see also Appendix 7.5.).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                       |
| <b>Climate</b> | BIO<br>(bio01-bio19) | <p>Although Podolski et al. (2013) showed that Eurasian lynxes become less active as daily temperatures increase, there is little evidence that bioclimatic variables (temperature and precipitation) affect lynx distribution. Therefore, except for studies that try to predict the distribution of the species in the future (Mahdavi et al., 2020; Serva et al., 2023), these are variables rarely used in studies that try to model its current distribution. Nevertheless, the studies that used these variables to model the distribution of the species show that the variables: average annual temperature (bio01; in the final model of 2/3 of the papers); mean diurnal range (bio02; in the final model in 3/3 of the papers); isothermality (bio03; in the final model in 1/3 of the papers); temperature seasonality (bio04; in the final model in 3/3 of the papers); mean temperature of wettest quarter (bio08; in the final model in 2/3 of the papers); mean temperature of driest quarter (bio09; in the final model in 1/3 of the papers); mean temperature of coldest quarter (bio11; in the final model in 2/3 of the papers); annual precipitation (bio12; in the final model in 1/3 of the papers); precipitation of driest month (bio14; in the final model in 2/3 of the papers); precipitation seasonality (bio15; in the final model in 3/3 of the papers); precipitation of driest quarter (bio17; in the final model in 1/3 of the papers); precipitation of warmest quarter (bio18; in the final model in 1/3 of the papers); and precipitation of coldest quarter (bio19; in the final model in 1/3 of the papers); may be useful for modelling Eurasian lynx's distribution. Kiraç (2021) used MaxEnt to model three palaeoclimatic scenarios for the distribution of the Eurasian lynx. In that work, the most important variables were the annual mean temperature (bio01; in 1/3 of the final models), the isothermality (bio03; in 2/3 the final models), the maximum temperature of warmest</p> | (Becker, 2013; Mahdavi et al., 2020; Kiraç, 2021; Serva et al., 2023) |

|                  |                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  |                     | month (bio05; in 1/3 of the final models), the minimum temperature of coldest month (bio06; in 3/3 of the final models), the mean temperature of coldest quarter (bio11; in 1/3 of the final models), the precipitation seasonality (bio15; in 2/3 of the final models), and the precipitation of the warmest month (bio18; in 2/3 of the final models).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Climate</b>   | Snow-related        | Nilsen et al. (2009) showed that Eurasian lynx hunting success increases with snow depth.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | (Nilsen et al., 2009; Oeser, Heurich, Kramer-Schadt, Mattisson, et al., 2023; Serva et al., 2023)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Landscape</b> | Land use/Land cover | <p>Land use and land cover are probably the most used variables for modelling the Eurasian lynx's spatial patterns, despite the ecological link between this drivers' units and lynx's presence not always being direct (see Oeser et al., 2020). These variables are important because, on the one hand, they can be used as a proxy for the anthropogenic impact on the landscape and, on the other hand, they can be used as a proxy for the suitability of the habitat. This is especially true for the Eurasian lynx, a typical forest species (Sidorovich et al., 2018; Sidorovich &amp; Rotenko, 2022; among many others), whose tolerance to anthropogenic disturbances in the landscape is related to proximity to optimal territory and time of day (Filla et al., 2017).</p> <p>The use of the percentage of forest (and its proxies) alone is an excellent explanatory variable for the distribution of the lynx (Basille et al., 2008, 2009; Belotti et al., 2018; Cimatti et al., 2021; Doswald et al., 2007; Dyck et al., 2022; Hemmingmoore et al., 2020; Herrero et al., 2020; Krofel et al., 2007; Lelieveld et al., 2018; Magg et al., 2016; May et al., 2008; Milanesi et al., 2022; Müller et al., 2014; Niedziałkowska et al., 2006; Oeser et al., 2020; Oeser, Heurich, Kramer-Schadt, Andrén, et al., 2023; Oeser, Heurich, Kramer-Schadt, Mattisson, et al., 2023; Podgórski et al., 2008; Rauset et al., 2013; Ripari et al., 2022; Rüdisser &amp; Martys, 2002; Schadt, Knauer, et al., 2002; Schadt, Revilla, et al., 2002; Serva et al., 2023; Zimmermann, 2004; Zimmermann &amp; Breitenmoser, 2002, 2007), and there are even rule-based models that use land cover (forest cover) as a basis for modelling the distribution of the lynx (Schadt, Knauer, et al., 2002). Forest type can also be a relevant factor for the Eurasian lynx distribution (Doswald et al., 2007; Podgórski et al., 2008; Rauset et al., 2013; Belotti et al., 2014; Magg et al., 2016; Herrero et al., 2020; Oeser et al., 2020; Serva et al., 2023).</p> | (Sunde et al., 2000; Rüdisser & Martys, 2002; Schadt, Revilla, et al., 2002; Schadt, Knauer, et al., 2002; Zimmermann & Breitenmoser, 2002; Skrbínšek, 2004; Zimmermann, 2004; Niedziałkowska et al., 2006; Doswald et al., 2007; Krofel et al., 2007; Zimmermann & Breitenmoser, 2007; Podgórski et al., 2008; May et al., 2008; Basille, 2008; Basille et al., 2008, 2009; Signer, 2010; Becker, 2013; Rauset et al., 2013; Samelius et al., 2013; Belotti et al., 2014; Müller et al., 2014; Kowalczyk et al., 2015; Laze & Gordon, 2016; Magg et al., 2016; Lelieveld et al., 2018; Hemmingmoore et al., 2020; Herrero et al., 2020; Potočník et al., 2020; Oeser et al., 2020; Cimatti et al., 2021; Dobbert et al., 2021; Dyck et al., 2022; Iosif et al., 2022; Ripari et al., 2022; Milanesi et al., 2022; Oeser, Heurich, Kramer-Schadt, Mattisson, et al., 2023; Oeser, Heurich, Kramer-Schadt, Andrén, et al., 2023; Serva et al., 2023; Čonč, Oliveira, Belotti, et al., 2024) |

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| <b>Landscape</b>   | Distance-related     | Distance-related variables are those that, such as distance to rocks (Filla et al., 2017), distance to forest (May et al., 2008; Podgórski et al., 2008; Kowalczyk et al., 2015; Hemmingmoore et al., 2020; Ripari et al., 2022), or distance to river, are extracted <i>in situ</i> or through geographic information systems and are a proxy of the proximity to resources providing patches. However, they depend on very exact locations (e.g., GPS locations).                                                                                                                                                                                                                       | (Basille, 2008; Basille et al., 2008; May et al., 2008; Podgórski et al., 2008; Belotti et al., 2014; Filla et al., 2017; Hemmingmoore et al., 2020; Kowalczyk et al., 2015; Ripari et al., 2022; Čonč, Oliveira, Belotti, et al., 2024; Čonč, Oliveira, Hočevár, et al., 2024)                                                     |
| <b>Landscape</b>   | Connectivity-related | Connectivity between different patches of suitable habitat is vital for species such as large carnivores, which have large territory requirements (Noss et al., 1996). The simple presence of a specific patch within a territory might not be sufficient, because it needs to be reachable and/or large enough to fulfil the requirements of the species. Many models include variables that act as proxies for connectivity (or even indices that attempt to quantify it). Other papers work on connectivity and space requirements by large carnivores in a post-processing stage, but all under the assumption that crucial patch connectivity enhances species' presence in an area. | (Schadt, Knauer, et al., 2002; Schadt, Revilla, et al., 2002; Zimmermann & Breitenmoser, 2002; Skrbínšek, 2004; Zimmermann, 2004; Niedziałkowska et al., 2006; Müller et al., 2014; Kowalczyk et al., 2015; Potočník et al., 2020; Cimatti et al., 2021; Dyck et al., 2022; Oeser, Heurich, Kramer-Schadt, Mattisson, et al., 2023) |
| <b>Landscape</b>   | Heterogeneity        | This variable represents only a quantitative measure of the diversity of land use categories/land cover categories available in each pixel, and is often used as a proxy for resource diversity or complementarity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | (Basille, 2008; Basille et al., 2009; Cimatti et al., 2021; Milanese et al., 2022)                                                                                                                                                                                                                                                  |
| <b>Landscape</b>   | Other metrics        | This section includes all metrics obtained by remote sensing that are used to model the distribution of the species and that were not included in the sections above. Sometimes, these metrics are used as a proxy for some other variable, such as productivity, which is used as a proxy for food availability (Herfindal et al., 2005; Ripari et al., 2022). These variables are produced using high-resolution images to integrate fine-scale habitat information into the model (Oeser et al., 2020; Oeser, Heurich, Kramer-Schadt, Mattisson, et al., 2023).                                                                                                                        | (Herfindal et al., 2005; Basille, 2008; Basille et al., 2009; Belotti et al., 2014; Filla et al., 2017; Oeser et al., 2020; Ripari et al., 2022; Oeser, Heurich, Kramer-Schadt, Mattisson, et al., 2023)                                                                                                                            |
| <b>Topographic</b> | Aspect               | The aspect is a commonly used variable to model the Eurasian lynx distribution. However, to our knowledge, there is no direct ecological link between this variable and lynx occurrence. Nevertheless, this variable can be a surrogate for the topographic complexity of the terrain (Bouchet et al., 2015) and for the productivity of the terrain (Kalle et al., 2013). As described below, the topographic complexity of the terrain is a fairly important factor in the distribution of Eurasian                                                                                                                                                                                     | (Zimmermann & Breitenmoser, 2002; Doswald et al., 2007; Filla et al., 2017; Dobbert et al., 2021; Čonč, Oliveira, Belotti, et al., 2024)                                                                                                                                                                                            |

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|                    |            | lynx. As described above, productivity can be used as a proxy for food availability, which is one of the limiting factors for lynx occurrence.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Topographic</b> | Elevation  | Elevation (or altitude) is one of the most used variables in modelling the distribution of the Eurasian lynx. Although this variable does not directly represent any eco-physiological need for most mammal species, it can (1) serve as a surrogate for other variables, both abiotic (e.g., temperature or snow cover) and biotic (e.g., presence or absence of parasites; Sándor et al., 2017), that do, or (2) it can have modular effect on the eco-physiological factors that drive the distribution of the species (Jacquier et al., 2020). Furthermore, elevation is one of the variables with the least degree of uncertainty (Guisan & Zimmermann, 2000), which makes it also a good candidate driver.                        | (Sunde et al., 1998, 2000; Zimmermann & Breitenmoser, 2002; Zimmermann & Breitenmoser, 2007; Doswald et al., 2007; Basille, 2008; Basille et al., 2009; May et al., 2008; Basille et al., 2009; Signer, 2010; Becker, 2013; Belotti et al., 2014; Bouyer, 2015; Bouyer, San Martin, et al., 2015; Laze & Gordon, 2016; Magg et al., 2016; Filla et al., 2017; Gehr et al., 2017; Hemmingmoore et al., 2020; Dobbert et al., 2021; Iosif et al., 2022; Dyck et al., 2022; Milanesi et al., 2022; Čonč, Oliveira, Belotti, et al., 2024)                                                                                                          |
| <b>Topographic</b> | Ruggedness | Terrain ruggedness is also one of the most used variables in modelling the Eurasian lynx's distribution. This explanatory variable (probably) encompasses landscape characteristics that explain the distribution of the lynx at various scales. For example, at the microhabitat scale, rocks and rocky areas are important areas for the Eurasian lynx as they provide resting areas (Signer et al., 2019; Hočevár et al., 2021; Čonč et al., 2022, 2023) as well as good hunting areas (Krofel et al., 2007; among others). On the other hand, on a coarser scale, areas of high ruggedness are associated with reduced human activity, and, thus, are often more used by Eurasian lynxes (Hemmingmoore et al., 2020; among others). | (Krofel et al., 2007; Basille, 2008; May et al., 2008; Basille et al., 2009; Becker, 2013; Rauset et al., 2013; Belotti et al., 2014; Bouyer, 2015; Bouyer, San Martin, et al., 2015; Laze & Gordon, 2016; Filla et al., 2017; Belotti et al., 2018; Signer et al., 2019; Hemmingmoore et al., 2020; Hočevár et al., 2021; Cimatti et al., 2021; Čonč et al., 2022; Iosif et al., 2022; Dyck et al., 2022; Milanesi et al., 2022; Čonč et al., 2023; Oeser, Heurich, Kramer-Schadt, Mattisson, et al., 2023; Oeser, Heurich, Kramer-Schadt, Andrén, et al., 2023; Čonč, Oliveira, Belotti, et al., 2024; Čonč, Oliveira, Hočevár, et al., 2024) |
| <b>Topographic</b> | Slope      | The slope is another topographic variable that can represent relief complexity. Although the use of steep terrain can be energetically costly (Nisi et al., 2022), there are carnivores that actively choose these areas (Morrell et al., 2021), including the Eurasian lynx (Sunde et al., 1998; among others) to reduce the risk of encounters with humans, and thus decrease anthropic disturbance. In the case of the Eurasian lynx, slope can be a proxy for resting sites (Serva et al., 2023).                                                                                                                                                                                                                                   | (Sunde et al., 1998; Zimmermann & Breitenmoser, 2002; Zimmermann & Breitenmoser, 2007; Doswald et al., 2007; Basille, 2008; Basille et al., 2008, 2009; Signer, 2010; Becker, 2013; Filla et al., 2017; Belotti et al., 2018; Dobbert et al., 2021; Hočevár et al., 2021; Cimatti et al., 2021; Ripari et al., 2022; Iosif et al., 2022; Milanesi et al., 2022; Serva et al., 2023; Čonč, Oliveira,                                                                                                                                                                                                                                             |

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|                    |                            |                                                                                                                                                                                                                                                                                                                                                                                                  | Belotti, et al., 2024; Čonč, Oliveira, Hočevár, et al., 2024) |
| <b>Topographic</b> | Topographic Position Index | This variable represents the pixel geographic relief type. Negative values represent valleys, positive values represent ridges, whereas zero-lout values represent flat areas. The relief type, like ruggedness, is considered an important factor for the presence of Eurasian lynx, since the species often uses landscapes with complex topography, probably to reduce anthropic disturbance. | (Čonč, Oliveira, Belotti, et al., 2024)                       |

### 7.5.1. References

- Andrén, H., & Liberg, O. (2024). Numerical response of predator to prey: Dynamic interactions and population cycles in Eurasian lynx and roe deer. *Ecological Monographs*, 94(1), e1594. <https://doi.org/10.1002/ecm.1594>
- Andrén, H., Linnell, J. D. C., Liberg, O., Andersen, R., Danell, A., Karlsson, J., Odden, J., Moa, P. F., Ahlqvist, P., Kvam, T., Franzén, R., & Segerström, P. (2006). Survival rates and causes of mortality in Eurasian lynx (*Lynx lynx*) in multi-use landscapes. *Biological Conservation*, 131(1), 23–32. <https://doi.org/10.1016/j.biocon.2006.01.025>
- Basille, M. (2008). *Lynx habitat selection in a human dominated landscape. From theory to application* [Doctoral Dissertation]. Université Claude Bernard Lyon I.
- Basille, M., Calenge, C., Marboutin, É., Andersen, R., & Gaillard, J.-M. (2008). Assessing habitat selection using multivariate statistics: Some refinements of the ecological-niche factor analysis. *Ecological Modelling*, 211(1–2), 233–240. <https://doi.org/10.1016/j.ecolmodel.2007.09.006>
- Basille, M., Herfindal, I., Santin-Janin, H., Linnell, J. D. C., Odden, J., Andersen, R., Arild Høgda, K., & Gaillard, J. (2009). What shapes Eurasian lynx distribution in human dominated landscapes: Selecting prey or avoiding people? *Ecography*, 32(4), 683–691. <https://doi.org/10.1111/j.1600-0587.2009.05712.x>
- Basille, M., Van Moorter, B., Herfindal, I., Martin, J., Linnell, J. D. C., Odden, J., Andersen, R., & Gaillard, J.-M. (2013). Selecting Habitat to Survive: The Impact of Road Density on Survival in a Large Carnivore. *PLoS ONE*, 8(7), e65493. <https://doi.org/10.1371/journal.pone.0065493>
- Bateman, P. W., & Fleming, P. A. (2012). Big city life: Carnivores in urban environments. *Journal of Zoology*, 287(1), 1–23. <https://doi.org/10.1111/j.1469-7998.2011.00887.x>
- Becker, T. (2013). *Modeling Eurasian lynx (Lynx lynx) distribution and estimation of patch and population size in the Alps* [Master Dissertation, Centre for Development, Environment and Policy (CeDEP), School of Oriental and African Studies (SOAS), University of London]. <https://api.semanticscholar.org/CorpusID:210158949>
- Belotti, E., Heurich, M., Kreisinger, J., Sustr, P., & Bufka, L. (2012). Influence of tourism and traffic on the Eurasian lynx hunting activity and daily movements. *Animal Biodiversity and Conservation*, 35(2), 235–246. <https://doi.org/10.32800/abc.2012.35.0235>
- Belotti, E., Kreisinger, J., Romportl, D., Heurich, M., & Bufka, L. (2014). Eurasian lynx hunting red deer: Is there an influence of a winter enclosure system? *European Journal of Wildlife Research*, 60(3), 441–457. <https://doi.org/10.1007/s10344-014-0801-8>
- Belotti, E., Mayer, K., Kreisinger, J., Heurich, M., & Bufka, L. (2018). Recreational activities affect resting site selection and foraging time of Eurasian lynx. *Hystrix the Italian Journal of Mammalogy*, 29(2), 0. <https://doi.org/10.4404/hystrix-00053-2018>
- Bouchet, P. J., Meeuwig, J. J., Salgado Kent, C. P., Letessier, T. B., & Jenner, C. K. (2015). Topographic determinants of mobile vertebrate predator hotspots: Current knowledge and future directions. *Biological Reviews*, 90(3), 699–728. <https://doi.org/10.1111/brv.12130>
- Bouyer, Y. (2015). *Managing the carnivore comeback: Assessing the adaptative capacity of the Eurasian lynx (Lynx lynx) to cohabit with humans in shared landscapes* [Doctoral Dissertation]. Université de Liège.
- Bouyer, Y., Gervasi, V., Poncin, P., Beudels-Jamar, R. C., Odden, J., & Linnell, J. D. C. (2015). Tolerance to anthropogenic disturbance by a large carnivore: The case of Eurasian lynx in south-eastern Norway. *Animal Conservation*, 18(3), 271–278. <https://doi.org/10.1111/acv.12168>

- Bouyer, Y., San Martin, G., Poncin, P., Beudels-Jamar, R. C., Odden, J., & Linnell, J. D. C. (2015). Eurasian lynx habitat selection in human-modified landscape in Norway: Effects of different human habitat modifications and behavioral states. *Biological Conservation*, 191, 291–299. <https://doi.org/10.1016/j.biocon.2015.07.007>
- Bunnefeld, N., Linnell, J. D. C., Odden, J., Van Duijn, M. A. J., & Andersen, R. (2006). Risk taking by Eurasian lynx (*Lynx lynx*) in a human-dominated landscape: Effects of sex and reproductive status. *Journal of Zoology*, 270(1), 31–39. <https://doi.org/10.1111/j.1469-7998.2006.00107.x>
- Červinka, J., Riegert, J., Grill, S., & Šálek, M. (2015). Large-scale evaluation of carnivore road mortality: The effect of landscape and local scale characteristics. *Mammal Research*, 60(3), 233–243. <https://doi.org/10.1007/s13364-015-0226-0>
- Cimatti, M., Ranc, N., Benítez-López, A., Maiorano, L., Boitani, L., Cagnacci, F., Čengić, M., Ciucci, P., Huijbregts, M. A. J., Krofel, M., López-Bao, J. V., Selva, N., Andren, H., Bautista, C., Ćirović, D., Hemmingmoore, H., Reinhardt, I., Marenče, M., Mertzanis, Y., ... Santini, L. (2021). Large carnivore expansion in Europe is associated with human population density and land cover changes. *Diversity and Distributions*, 27(4), 602–617. <https://doi.org/10.1111/ddi.13219>
- Čonč, Š., Hočevár, L., Oliveira, T., Flezar, Belotti, E., Bufka, L., Heurich, M., Valjavec, M. B., & Krofel, M. (2023). *Importance of rocky landforms for Eurasian lynx (Lynx lynx) ecology in landscapes with different relief types*. LIFE Lynx International Conference: “Together for lynx,” Zadar, Croatia. <https://doi.org/10.13140/RG.2.2.10417.56165>
- Čonč, Š., Oliveira, T., Belotti, E., Bufka, L., Černe, R., Heurich, M., Breg Valjavec, M., & Krofel, M. (2024). Revealing functional responses in habitat selection of rocky features and rugged terrain by Eurasian lynx (*Lynx lynx*) using LiDAR data. *Landscape Ecology*, 39(7), 121. <https://doi.org/10.1007/s10980-024-01923-y>
- Čonč, Š., Oliveira, T., Hočevár, L., Černe, R., Breg Valjavec, M., & Krofel, M. (2024). Integrating geodiversity in animal spatial ecology: Microhabitat selection of Eurasian lynx (*Lynx lynx*) and European wildcat (*Felis silvestris*) in a karst landscape. *Global Ecology and Conservation*, 54, e03138. <https://doi.org/10.1016/j.gecco.2024.e03138>
- Čonč, Š., Oliveira, T., Portas, R., Černe, R., Breg Valjavec, M., & Krofel, M. (2022). Dolines and Cats: Remote Detection of Karst Depressions and Their Application to Study Wild Felid Ecology. *Remote Sensing*, 14(3), 656. <https://doi.org/10.3390/rs14030656>
- Dobbert, S., Pape, R., & Löffler, J. (2021). Continent-wide modelling of potential habitats and connectivity for the Eurasian lynx (*Lynx lynx*) in Europe. *Erdkunde*, 75(2), 69–85. <https://doi.org/10.3112/erdkunde.2021.02.01>
- Doswald, N., Zimmermann, F., & Breitenmoser, U. (2007). Testing expert groups for a habitat suitability model for the lynx *Lynx lynx* in the Swiss Alps. *Wildlife Biology*, 13(4), 430–446. [https://doi.org/10.2981/0909-6396\(2007\)13\[430:TEGFAH\]2.0.CO;2](https://doi.org/10.2981/0909-6396(2007)13[430:TEGFAH]2.0.CO;2)
- Dyck, M. A., Iosif, R., Promberger-Fürpass, B., & Popescu, V. D. (2022). Dracula’s ménagerie: A multispecies occupancy analysis of lynx, wildcat, and wolf in the Romanian Carpathians. *Ecology and Evolution*, 12(5), e8921. <https://doi.org/10.1002/ece3.8921>
- Filla, M., Premier, J., Magg, N., Dupke, C., Khorozyan, I., Waltert, M., Bufka, L., & Heurich, M. (2017). Habitat selection by Eurasian lynx (*Lynx lynx*) is primarily driven by avoidance of human activity during day and prey availability during night. *Ecology and Evolution*, 7(16), 6367–6381. <https://doi.org/10.1002/ece3.3204>
- Gehr, B., Hofer, E. J., Muff, S., Ryser, A., Vimercati, E., Vogt, K., & Keller, L. F. (2017). A landscape of coexistence for a large predator in a human dominated landscape. *Oikos*, 126(10), 1389–1399. <https://doi.org/10.1111/oik.04182>

- Gervasi, V., Nilsen, E. B., Odden, J., Bouyer, Y., & Linnell, J. D. C. (2014). The spatio-temporal distribution of wild and domestic ungulates modulates lynx kill rates in a multi-use landscape. *Journal of Zoology*, 292(3), 175–183. <https://doi.org/10.1111/jzo.12088>
- Guisan, A., & Zimmermann, N. E. (2000). Predictive habitat distribution models in ecology. *Ecological Modelling*, 135(2–3), 147–186. [https://doi.org/10.1016/S0304-3800\(00\)00354-9](https://doi.org/10.1016/S0304-3800(00)00354-9)
- Hemmingmoore, H., Aronsson, M., Åkesson, M., Persson, J., & Andrén, H. (2020). Evaluating habitat suitability and connectivity for a recolonizing large carnivore. *Biological Conservation*, 242, 108352. <https://doi.org/10.1016/j.biocon.2019.108352>
- Herfindal, I., Linnell, J. D. C., Odden, J., Nilsen, E. B., & Andersen, R. (2005). Prey density, environmental productivity and home-range size in the Eurasian lynx (*Lynx lynx*). *Journal of Zoology*, 265(1), 63–71. <https://doi.org/10.1017/S0952836904006053>
- Herrero, A., Heikkinen, J., & Holmala, K. (2020). Movement patterns and habitat selection during dispersal in Eurasian lynx. *Mammal Research*, 65(3), 523–533. <https://doi.org/10.1007/s13364-020-00499-7>
- Hočevár, L., Oliveira, T., & Krofel, M. (2021). Felid bedrooms with a panoramic view: Selection of resting sites by Eurasian lynx (*Lynx lynx*) in a karstic landscape. *Behavioral Ecology and Sociobiology*, 75(2), 34. <https://doi.org/10.1007/s00265-021-02977-7>
- Iosif, R., Popescu, V. D., Ungureanu, L., Șerban, C., Dyck, M. A., & Promberger-Fürpass, B. (2022). Eurasian lynx density and habitat use in one of Europe's strongholds, the Romanian Carpathians. *Journal of Mammalogy*, 103(2), 415–424. <https://doi.org/10.1093/jmammal/gyab157>
- Jacquier, M., Calenge, C., Say, L., Devillard, S., & Ruetten, S. (2020). Altitude shapes the environmental drivers of large-scale variation in abundance of a widespread mammal species. *Ecology and Evolution*, 10(1), 119–130. <https://doi.org/10.1002/ece3.5851>
- Kalle, R., Ramesh, T., Qureshi, Q., & Sankar, K. (2013). Predicting the Distribution Pattern of Small Carnivores in Response to Environmental Factors in the Western Ghats. *PLoS ONE*, 8(11), e79295. <https://doi.org/10.1371/journal.pone.0079295>
- Khorozyan, I., & Heurich, M. (2023). Patterns of predation by the Eurasian lynx *Lynx lynx* throughout its range: Ecological and conservation implications. *Mammal Review*, 53(3), 177–188. <https://doi.org/10.1111/mam.12317>
- Kıraç, A. (2021). Potential distribution of two lynx species in Europe under paleoclimatological scenarios and anthropogenic climate change scenarios. *CERNE*, 27, e-102517. <https://doi.org/10.1590/01047760202127012517>
- Kowalczyk, R., Górny, M., & Schmidt, K. (2015). Edge effect and influence of economic growth on Eurasian lynx mortality in the Białowieża Primeval Forest, Poland. *Mammal Research*, 60(1), 3–8. <https://doi.org/10.1007/s13364-014-0203-z>
- Kramer-Schadt, S., Revilla, E., Wiegand, T., & Breitenmoser, U. (2004). Fragmented landscapes, road mortality and patch connectivity: Modelling influences on the dispersal of Eurasian lynx. *Journal of Applied Ecology*, 41(4), 711–723. <https://doi.org/10.1111/j.0021-8901.2004.00933.x>
- Krofel, M., Hočevár, L., Fležar, U., Topličanec, I., & Oliveira, T. (2022). Golden jackal as a new kleptoparasite for Eurasian lynx in Europe. *Global Ecology and Conservation*, 36, e02116. <https://doi.org/10.1016/j.gecco.2022.e02116>
- Krofel, M., Huber, D., & Kos, I. (2011). Diet of Eurasian lynx *Lynx lynx* in the northern Dinaric Mountains (Slovenia and Croatia): Importance of edible dormouse *Glis glis* as alternative prey. *Acta Theriologica*, 56(4), 315–322. <https://doi.org/10.1007/s13364-011-0032-2>

- Krofel, M., Kos, I., & Jerina, K. (2012). The noble cats and the big bad scavengers: Effects of dominant scavengers on solitary predators. *Behavioral Ecology and Sociobiology*, 66(9), 1297–1304. <https://doi.org/10.1007/s00265-012-1384-6>
- Krofel, M., Kos, I., Linnell, J. D. C., Odden, J., & Teurlings, I. J. M. (2008). Human kleptoparasitism on Eurasian lynx (*Lynx lynx* L.) in Slovenia and Norway. *Varstvo Narave*, 21, 93–103.
- Krofel, M., Potočnik, H., & Kos, I. (2007). Topographical and vegetational characteristics of lynx kill sites in Slovenian Dinaric Mountains. *Natura Sloveniae*, 9(1), 25–36. <https://doi.org/10.14720/ns.9.1.25-36>
- Krofel, M., Skrbinšek, T., & Mohorović, M. (2019). Using video surveillance to monitor feeding behaviour and kleptoparasitism at Eurasian lynx kill sites. *Folia Zoologica*, 68(4), 274. <https://doi.org/10.25225/fozo.037.2019>
- Laze, K., & Gordon, A. (2016). Incorporating natural and human factors in habitat modelling and spatial prioritisation for the *Lynx lynx martinoi*. *Web Ecology*, 16(1), 17–31. <https://doi.org/10.5194/we-16-17-2016>
- Lelieveld, G. (2013). *Meta-analysis on the effect of competition between lynx and wolf on their diets* [Master Dissertation, Vrije Universiteit Amsterdam]. <http://rgdoi.net/10.13140/RG.2.2.26349.23520>
- Lelieveld, G., Bodegom, P. V., & Wamelink, G. W. W. (2018). No place to hide: Limited forest cover hampers the availability of suitable habitat for lynx in the Netherlands. *Lutra, Journal of the Dutch Mammal Society*, 62(1), 31–38.
- Luck, G. W. (2007). A review of the relationships between human population density and biodiversity. *Biological Reviews*, 82(4), 607–645. <https://doi.org/10.1111/j.1469-185X.2007.00028.x>
- Magg, N., Müller, J., Heibl, C., Hackländer, K., Wölfl, S., Wölfl, M., Bufka, L., Červený, J., & Heurich, M. (2016). Habitat availability is not limiting the distribution of the Bohemian–Bavarian lynx *Lynx lynx* population. *Oryx*, 50(4), 742–752. <https://doi.org/10.1017/S0030605315000411>
- Mahdavi, T., Shams-Esfandabad, B., Toranjzar, H., Abdi, N., & Ahmadi, A. (2020). Potential impact of climate change on the distribution of the Eurasian Lynx (*Lynx lynx*) in Iran (Mammalia: Felidae). *Zoology in the Middle East*, 66(2), 107–117. <https://doi.org/10.1080/09397140.2020.1739371>
- Mata, C., Ruiz-Capillas, P., & Malo, J. E. (2017). Small-scale alterations in carnivore activity patterns close to motorways. *European Journal of Wildlife Research*, 63(4), 64. <https://doi.org/10.1007/s10344-017-1118-1>
- May, R., Van Dijk, J., Wabakken, P., Swenson, J. E., Linnell, J. D. C., Zimmermann, B., Odden, J., Pedersen, H. C., Andersen, R., & Landa, A. (2008). Habitat differentiation within the large-carnivore community of Norway's multiple-use landscapes. *Journal of Applied Ecology*, 45(5), 1382–1391. <https://doi.org/10.1111/j.1365-2664.2008.01527.x>
- Mengüllüoğlu, D., Ambarlı, H., Berger, A., & Hofer, H. (2018). Foraging ecology of Eurasian lynx populations in southwest Asia: Conservation implications for a diet specialist. *Ecology and Evolution*, 8(18), 9451–9463. <https://doi.org/10.1002/ece3.4439>
- Milanesi, P., Puopolo, F., & Zellweger, F. (2022). Landscape Features, Human Disturbance or Prey Availability? What Shapes the Distribution of Large Carnivores in Europe? *Land*, 11(10), 1807. <https://doi.org/10.3390/land11101807>
- Morrell, N., Appleton, R. D., & Arcese, P. (2021). Roads, forest cover, and topography as factors affecting the occurrence of large carnivores: The case of the Andean bear (*Tremarctos*

- ornatus*). *Global Ecology and Conservation*, 26, e01473. <https://doi.org/10.1016/j.gecco.2021.e01473>
- Müller, J., Wölfl, M., Wölfl, S., Müller, D. W. H., Hothorn, T., & Heurich, M. (2014). Protected areas shape the spatial distribution of a European lynx population more than 20 years after reintroduction. *Biological Conservation*, 177, 210–217. <https://doi.org/10.1016/j.biocon.2014.07.007>
- Niedziałkowska, M., Jędrzejewski, W., Mysłajek, R. W., Nowak, S., Jędrzejewska, B., & Schmidt, K. (2006). Environmental correlates of Eurasian lynx occurrence in Poland – Large scale census and GIS mapping. *Biological Conservation*, 133(1), 63–69. <https://doi.org/10.1016/j.biocon.2006.05.022>
- Nilsen, E. B., Linnell, J. D. C., Odden, J., & Andersen, R. (2009). Climate, season, and social status modulate the functional response of an efficient stalking predator: The Eurasian lynx. *Journal of Animal Ecology*, 78(4), 741–751. <https://doi.org/10.1111/j.1365-2656.2009.01547.x>
- Nisi, A. C., Suraci, J. P., Ranc, N., Frank, L. G., Oriol-Cotterill, A., Ekwanga, S., Williams, T. M., & Wilmers, C. C. (2022). Temporal scale of habitat selection for large carnivores: Balancing energetics, risk and finding prey. *Journal of Animal Ecology*, 91(1), 182–195. <https://doi.org/10.1111/1365-2656.13613>
- Noss, R. F., Quigley, H. B., Hornocker, M. G., Merrill, T., & Paquet, P. C. (1996). Conservation Biology and Carnivore Conservation in the Rocky Mountains. *Conservation Biology*, 10(4), 949–963. <https://doi.org/10.1046/j.1523-1739.1996.10040949.x>
- Odden, J., Linnell, J. D. C., & Andersen, R. (2006). Diet of Eurasian lynx, *Lynx lynx*, in the boreal forest of southeastern Norway: The relative importance of livestock and hares at low roe deer density. *European Journal of Wildlife Research*, 52(4), 237–244. <https://doi.org/10.1007/s10344-006-0052-4>
- Oeser, J., Heurich, M., Kramer-Schadt, S., Andrén, H., Bagrade, G., Belotti, E., Bufka, L., Breitenmoser-Würsten, C., Černe, R., Duľa, M., Fuxjäger, C., Gomerčić, T., Jędrzejewski, W., Kont, R., Koubek, P., Kowalczyk, R., Krofel, M., Krojerová-Prokešová, J., Kubala, J., ... Kuemmerle, T. (2023). Prerequisites for coexistence: Human pressure and refuge habitat availability shape continental-scale habitat use patterns of a large carnivore. *Landscape Ecology*, 38(7), 1713–1728. <https://doi.org/10.1007/s10980-023-01645-7>
- Oeser, J., Heurich, M., Kramer-Schadt, S., Mattisson, J., Krofel, M., Krojerová-Prokešová, J., Zimmermann, F., Anders, O., Andrén, H., Bagrade, G., Belotti, E., Breitenmoser-Würsten, C., Bufka, L., Černe, R., Drouet-Hoguet, N., Duľa, M., Fuxjäger, C., Gomerčić, T., Jędrzejewski, W., ... Kuemmerle, T. (2023). Integrating animal tracking datasets at a continental scale for mapping Eurasian lynx habitat. *Diversity and Distributions*, 29(12), 1546–1560. <https://doi.org/10.1111/ddi.13784>
- Oeser, J., Heurich, M., Senf, C., Pflugmacher, D., Belotti, E., & Kuemmerle, T. (2020). Habitat metrics based on multi-temporal Landsat imagery for mapping large mammal habitat. *Remote Sensing in Ecology and Conservation*, 6(1), 52–69. <https://doi.org/10.1002/rse2.122>
- Podgórski, T., Schmidt, K., Kowalczyk, R., & Gulczyńska, A. (2008). Microhabitat selection by Eurasian lynx and its implications for species conservation. *Acta Theriologica*, 53(2), 97–110. <https://doi.org/10.1007/BF03194243>
- Podolski, I., Belotti, E., Bufka, L., Reulen, H., & Heurich, M. (2013). Seasonal and daily activity patterns of free-living Eurasian lynx *Lynx lynx* in relation to availability of kills. *Wildlife Biology*, 19(1), 69–77. <https://doi.org/10.2981/12-049>

- Potočník, H., Črtalič, J., Kos, I., & Skrbinšek, T. (2020). Characteristics of spatial use and importance of landscape features for recovering populations of Eurasian lynx (*Lynx lynx*). *Acta Biologica Slovenica*, 63(2), 65–88. <https://doi.org/10.14720/abs.63.2.15938>
- Rauset, G. R., Mattisson, J., Andrén, H., Chapron, G., & Persson, J. (2013). When species' ranges meet: Assessing differences in habitat selection between sympatric large carnivores. *Oecologia*, 172(3), 701–711. <https://doi.org/10.1007/s00442-012-2546-y>
- Ripari, L., Premier, J., Belotti, E., Bluhm, H., Breitenmoser-Würsten, C., Bufka, L., Červený, J., Drouet-Hoguet, N., Fuxjäger, C., Jędrzejewski, W., Kont, R., Koubek, P., Kowalczyk, R., Krofel, M., Krojerová-Prokešová, J., Molinari-Jobin, A., Okarma, H., Oliveira, T., Remm, J., ... Heurich, M. (2022). Human disturbance is the most limiting factor driving habitat selection of a large carnivore throughout Continental Europe. *Biological Conservation*, 266, 109446. <https://doi.org/10.1016/j.biocon.2021.109446>
- Royo-Vicente, A., & García, F. J. (2024). Segunda cita de chacal dorado *Canis aureus* en la Península Ibérica (Zaragoza, Aragón) mediante fototrampeo. *Galemys, Spanish Journal of Mammalogy*, 36, 1–2. <https://doi.org/10.7325/Galemys.2024.O1>
- Rüdisser, J., & Martys, M. (2002). Spatial analysis of potential lynx (*Lynx lynx*) distribution in Western Austria considering ecological and anthropological conflicts. In R. Bottarin & U. Tappeiner (Eds.), *Interdisciplinary Mountain Research* (pp. 248–255). Blackwell Verlag.
- Sáenz De Buruaga, M., Carreras, J., Madeira, M. J., Olalde, M., Mártioda, C. D. F., & Campos, M. Á. (2023). Primera cita de chacal dorado (*Canis aureus*) en la Península Ibérica. *Galemys, Spanish Journal of Mammalogy*, 35, 56–58. <https://doi.org/10.7325/Galemys.2023.N5>
- Samelius, G., Andrén, H., Kjellander, P., & Liberg, O. (2013). Habitat Selection and Risk of Predation: Re-colonization by Lynx had Limited Impact on Habitat Selection by Roe Deer. *PLoS ONE*, 8(9), e75469. <https://doi.org/10.1371/journal.pone.0075469>
- Sándor, A. D., D'Amico, G., Gherman, C. M., Dumitrache, M. O., Domșa, C., & Mihalca, A. D. (2017). Mesocarnivores and macroparasites: Altitude and land use predict the ticks occurring on red foxes (*Vulpes vulpes*). *Parasites & Vectors*, 10(1), 173. <https://doi.org/10.1186/s13071-017-2113-9>
- Schadt, S., Knauer, F., Kaczensky, P., Revilla, E., Wiegand, T., & Trepl, L. (2002). Rule-based assessment of suitable habitat and patch connectivity for the Eurasian lynx. *Ecological Applications*, 12(5), 1469–1483. [https://doi.org/10.1890/1051-0761\(2002\)012\[1469:RBAOSH\]2.0.CO;2](https://doi.org/10.1890/1051-0761(2002)012[1469:RBAOSH]2.0.CO;2)
- Schadt, S., Revilla, E., Wiegand, T., Knauer, F., Kaczensky, P., Breitenmoser, U., Bufka, L., Červený, J., Koubek, P., Huber, T., Staniša, C., & Trepl, L. (2002). Assessing the suitability of central European landscapes for the reintroduction of Eurasian lynx. *Journal of Applied Ecology*, 39(2), 189–203. <https://doi.org/10.1046/j.1365-2664.2002.00700.x>
- Serva, D., Iannella, M., Cittadino, V., & Biondi, M. (2023). A shifting carnivore's community: Habitat modeling suggests increased overlap between the golden jackal and the Eurasian lynx in Europe. *Frontiers in Ecology and Evolution*, 11, 1165968. <https://doi.org/10.3389/fevo.2023.1165968>
- Sidorovich, V., & Rotenko, I. (2022). Distribution patterns and habitat combinations inhabited by lynx in Belarus. In V. Sidorovich, *Behaviour and ecology of the Eurasian lynx: A case of study in Naliboki Forest and Paazierre Forest, Belarus* (pp. 80–84). Four Quarters.
- Sidorovich, V., Gouwy, J., & Rotenko, I. (2018). Pronounced tree related habits of lynxes. In V. Sidorovich, J. Gouwy, & I. Rotenko, *Unknown Eurasian lynx Lynx lynx: New findings on the species ecology and behaviour* (pp. 174–179).

- Signer, J. (2010). *Distribution and Connectivity of Eurasian Lynx (Lynx lynx) in the Alps* (ECONNECT, Austrian Environmental Agency, Vienna, p. 14). [http://www.econnectproject.eu/cms/sites/default/files/Econnect\\_Lynx\\_2011.pdf](http://www.econnectproject.eu/cms/sites/default/files/Econnect_Lynx_2011.pdf)
- 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). <https://doi.org/10.2981/wlb.00489>
- Skrbinšek, T. (2004). Model primernega prostora za risa v Sloveniji. In I. Kos, H. Potočnik, T. Skrbinšek, A. Majić Skrbinšek, M. Jonozovič, & M. Krofel, *Ris v Sloveniji: Strokovna izhodišča za varstvo in upravljanje* (1. izd, pp. 92–111). Biotehniška fakulteta, Oddelek za biologijo.
- Sunde, P., Kvam, T., Moa, P., Negård, A., & Overskaug, K. (2000). Space use by Eurasian lynxes *Lynx lynx* in central Norway. *Acta Theriologica*, 45, 507–524. <https://doi.org/10.4098/AT.arch.00-50>
- Sunde, P., Stener, S. Ø., & Kvam, T. (1998). Tolerance to humans of resting lynxes *Lynx lynx* in a hunted population. *Wildlife Biology*, 4(3), 177–183. <https://doi.org/10.2981/wlb.1998.020>
- Zimmermann, F. (2004). *Conservation of the Eurasian Lynx (Lynx lynx) in a Fragmented Landscape: Habitat Models, Dispersal and Potential Distribution* [Doctoral Dissertation]. Universite de Lausanne, Faculté de Biologie et de Médecine, Département d'Ecologie et Evolution.
- Zimmermann, F., & Breitenmoser, U. (2002). A distribution model for the Eurasian lynx (*Lynx lynx*) in the Jura mountains, Switzerland. In J. M. Scott, P. J. Heglund, F. B. Samson, J. Haufler, M. L. Morrison, M. G. Raphael, & B. Wall (Eds.), *Predicting Species Occurrences: Issues of Accuracy and Scale* (pp. 653–660). Island Press.
- Zimmermann, F., & Breitenmoser, U. (2007). Potential distribution and population size of the Eurasian lynx *Lynx lynx* in the jura Mountains and possible corridors to adjacent ranges. *Wildlife Biology*, 13(4), 406–416. [https://doi.org/10.2981/0909-6396\(2007\)13\[406:PDAPSO\]2.0.CO;2](https://doi.org/10.2981/0909-6396(2007)13[406:PDAPSO]2.0.CO;2)

## 7.6. Eurasian lynx's prey distribution models

The Eurasian lynx's prey – the red deer (*Cervus elaphus*), the roe deer (*Capreolus capreolus*), and the Iberian ibex (*Capra pyrenaica*) – models were generated using binomial GAMs (Wood, 2017). The models used the restricted maximum likelihood (REML) method and additional penalties for the null spaces of all smooths in the current model were allowed (select = TRUE). Unlike the Eurasian lynx's models, the prey models used as pseudo-absences points where in the analysed records (see below) fauna was mentioned as present, but the target species considered was not detected (Figures A2, A6, and A9). The historical records used in these models were also different. Due to the high hunting value of these species, it was assumed that the sampling bias was smaller. Therefore, fewer primary historical records were used to make the models. For Portugal, eight primary historical records were analysed: Silveira (1804), Lopes (1841), Camara (1850), Secco (1853), Pereira (1854), Leal (1873-1882), Baptista (1874-1879), Mascarenhas and Abreu (1879); for Spain, one primary historical record was analysed: Madoz (1845-1850). The predictor variables used were the same as the ones listed in the *Table 1* of the *Methods* section (excluding the *Biotic Interactions* section of the referred table), and variables with a Pearson's correlation higher than 0.7 were excluded using the FUZZYSIM package (Barbosa, 2015).

### 7.6.1. Iberian ibex Distribution Model

Formula: presence ~ s(north) + s(bio03) + s(bio08) + (bio09, k = -1) + s(bio12) + s(bio15) + s(bio18) + s(dem) + s(popd) + s(scd, k = -1) + s(tri)

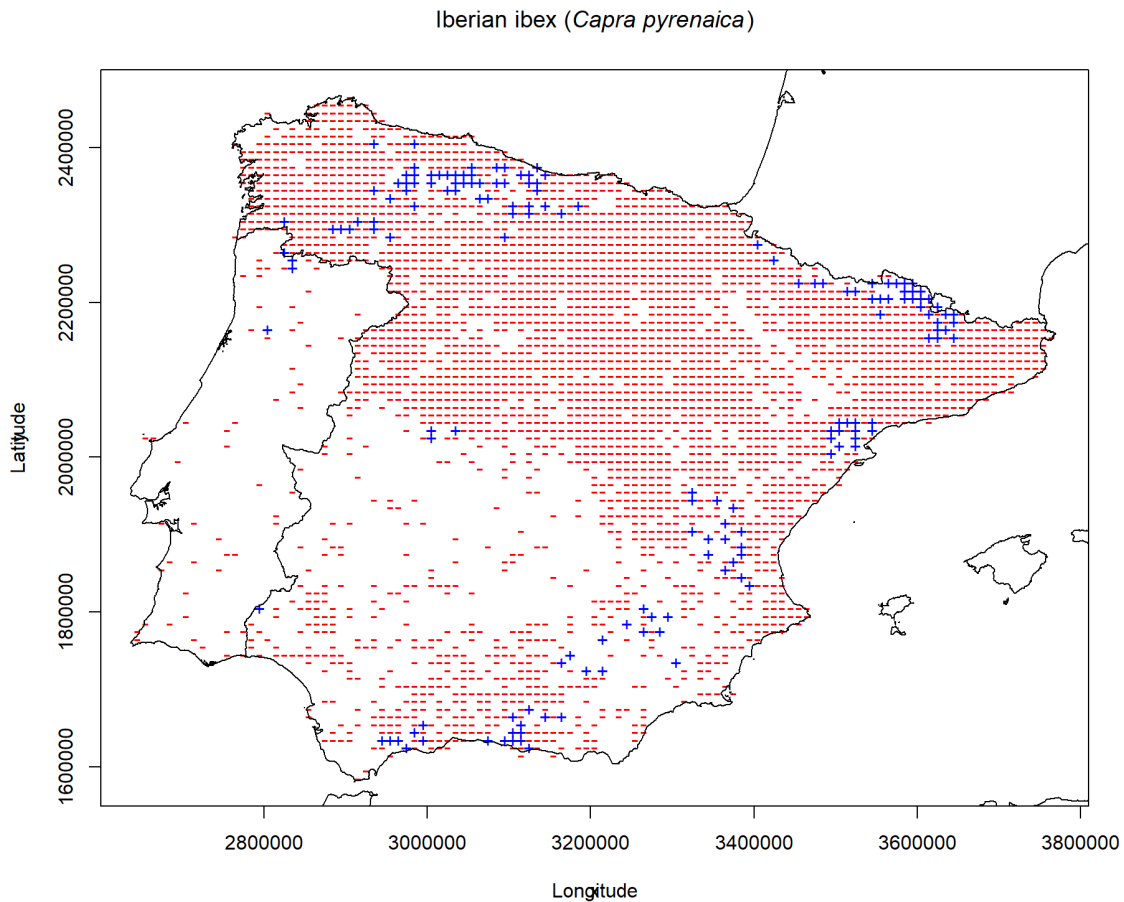


Figure A.2 – Gridded presences (+) and pseudo-absences (-) of the Iberian ibex within the Iberian Peninsula in the 19th century.

Table A.4 – Performance metrics for the Iberian ibex distribution model. To calculate the Boyce index, the predictions were transformed from probability of presence to favourability. Favourability was calculated using the FUZZYSIM package (Barbosa, 2015).

| Fold    | Set   | Sensitivity | Specificity | CCR       | TSS       | AUC-ROC   | AUC-PR    | Boyce Index | DevExp (%) | R <sup>2</sup> (adj.) |
|---------|-------|-------------|-------------|-----------|-----------|-----------|-----------|-------------|------------|-----------------------|
| 1       | train | 0.8492063   | 0.8567335   | 0.8563643 | 0.7059399 | 0.9160803 | 0.4104783 | 0.9694537   | 36.39360   | 0.3610                |
|         | test  | 0.7187500   | 0.8676471   | 0.8602484 | 0.5863971 | 0.8790850 | 0.3118542 | 0.8804916   | NA         |                       |
| 2       | train | 0.8976378   | 0.7703643   | 0.7766537 | 0.6680021 | 0.9087446 | 0.3845402 | 0.9863872   | 33.21089   | 0.3300                |
|         | test  | 0.9354839   | 0.7450980   | 0.7542768 | 0.6805819 | 0.9059667 | 0.3944920 | 0.7891222   | NA         |                       |
| 3       | train | 0.8730159   | 0.8237219   | 0.8261377 | 0.6967378 | 0.9163275 | 0.4157881 | 0.9778338   | 35.58832   | 0.3530                |
|         | test  | 0.6875000   | 0.8065574   | 0.8006231 | 0.4940574 | 0.8472336 | 0.3453017 | 0.9205580   | NA         |                       |
| 4       | train | 0.9055118   | 0.7810966   | 0.7872423 | 0.6866084 | 0.9157023 | 0.4532603 | 0.9454314   | 36.55997   | 0.3630                |
|         | test  | 0.9032258   | 0.7823241   | 0.7881620 | 0.6855499 | 0.8674304 | 0.2546752 | 0.8042906   | NA         |                       |
| 5       | train | 0.8968254   | 0.7635992   | 0.7701284 | 0.6604246 | 0.8991593 | 0.3684734 | 0.9796274   | 31.21883   | 0.3100                |
|         | test  | 0.9062500   | 0.7754098   | 0.7819315 | 0.6816598 | 0.9256660 | 0.3877315 | 0.8978533   | NA         |                       |
| Average | train | 0.8844394   | 0.7991031   | 0.8033053 | 0.6835425 | 0.9112028 | 0.4065081 | 0.9717467   | 34.59432   | 0.3434                |
|         | test  | 0.8302419   | 0.7954073   | 0.7970484 | 0.6256492 | 0.8850763 | 0.3388109 | 0.8584631   | NA         |                       |

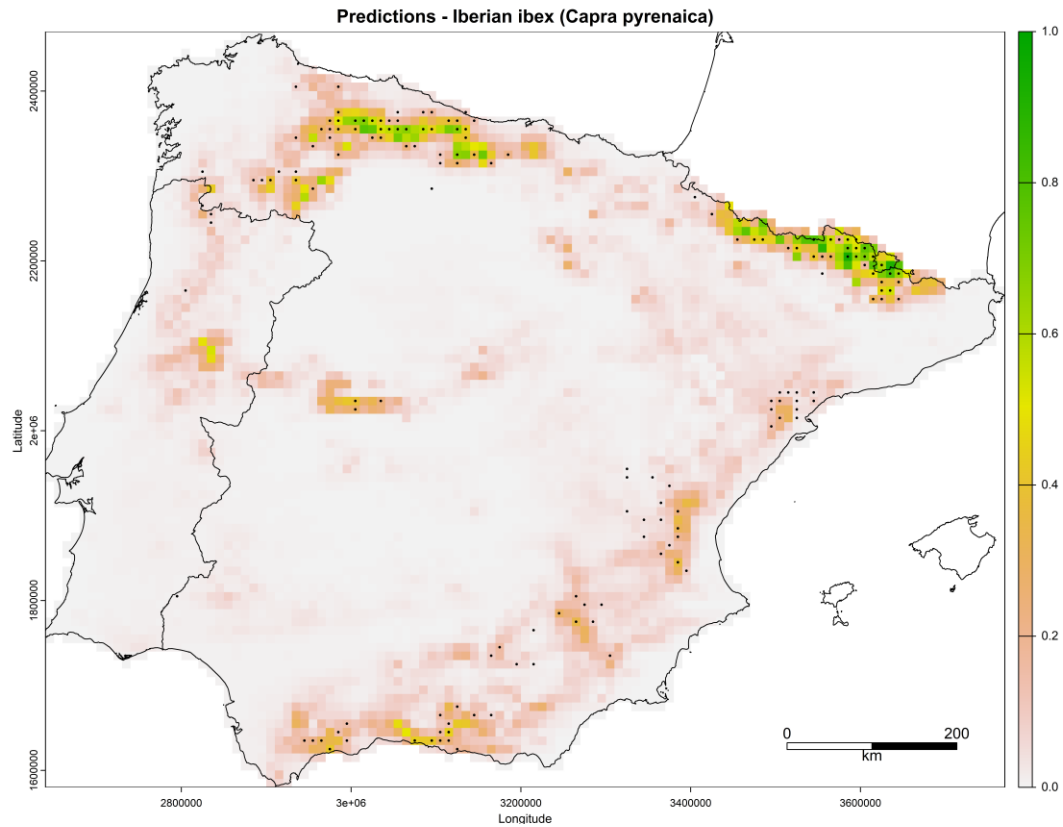


Figure A.3 – Average probability of presence of Iberian ibex in the 19th century in the Iberian Peninsula. The dots represent (gridded) points of Iberian ibex presence.

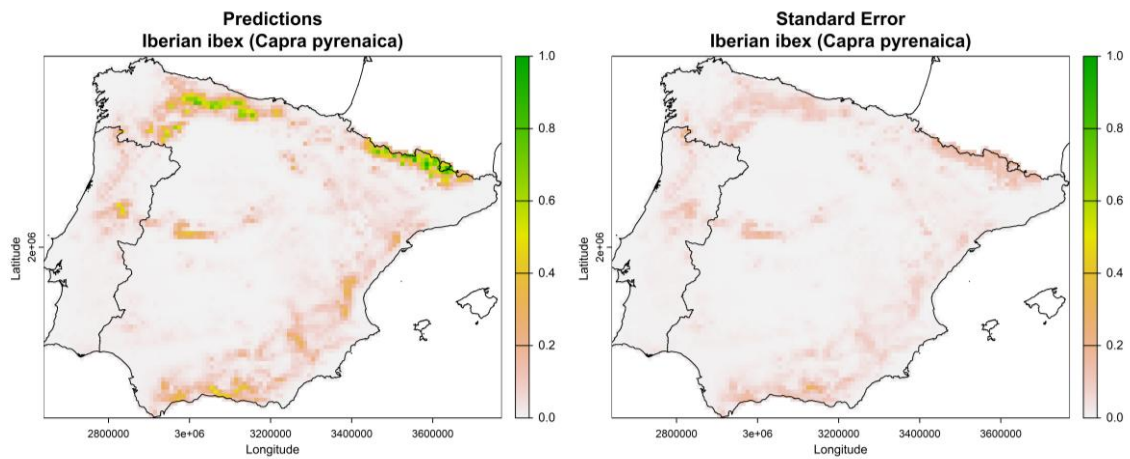


Figure A.4 – Average probability of presence (left panel) and average standard error (right panel) of the Iberian ibex distribution model's prediction in the Iberian Peninsula in the 19th century.

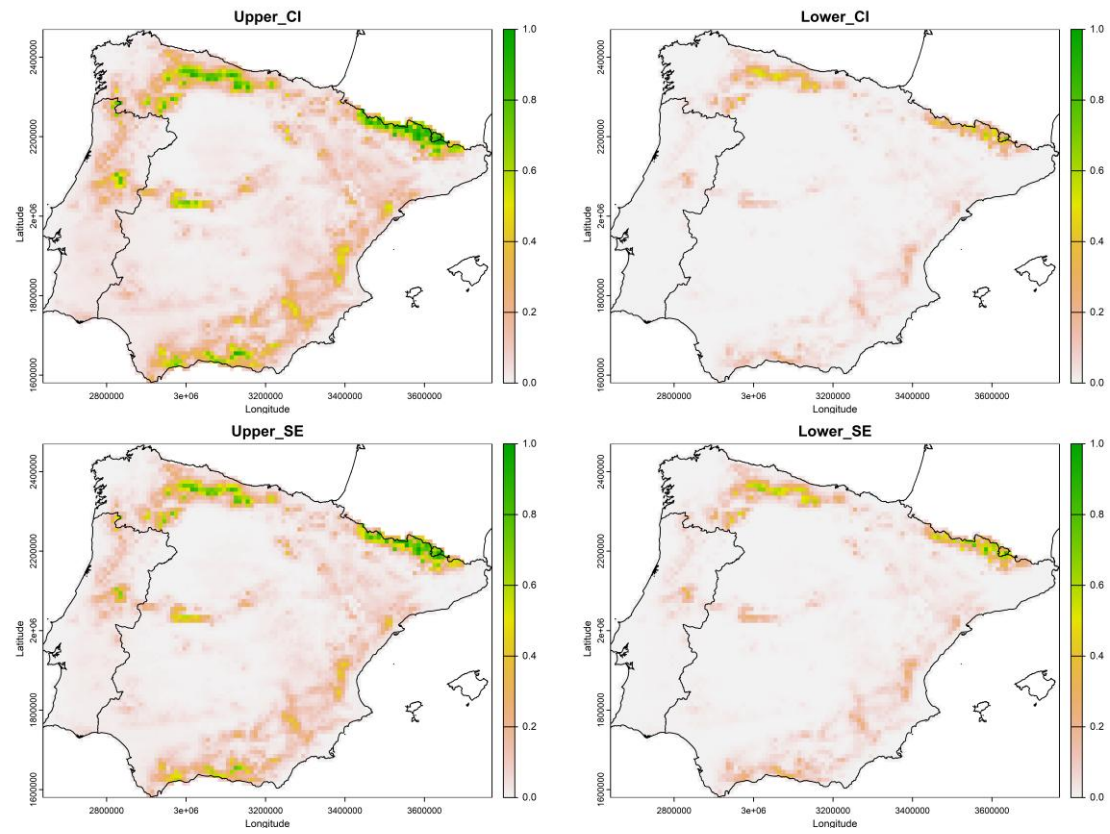


*Figure A.5 – Average upper and lower confidence interval (CI) and standard error (SE) of the Iberian ibex distribution model's prediction in the Iberian Peninsula.*

### 7.6.2. Roe deer Distribution Model

Formula: presence  $\sim$  s(north) + s(bio03) + s(bio08) + s(bio10) + s(bio12) + s(bio14) + s(bio15) + s(dem) + s(popd) + s(scd) + s(tri)

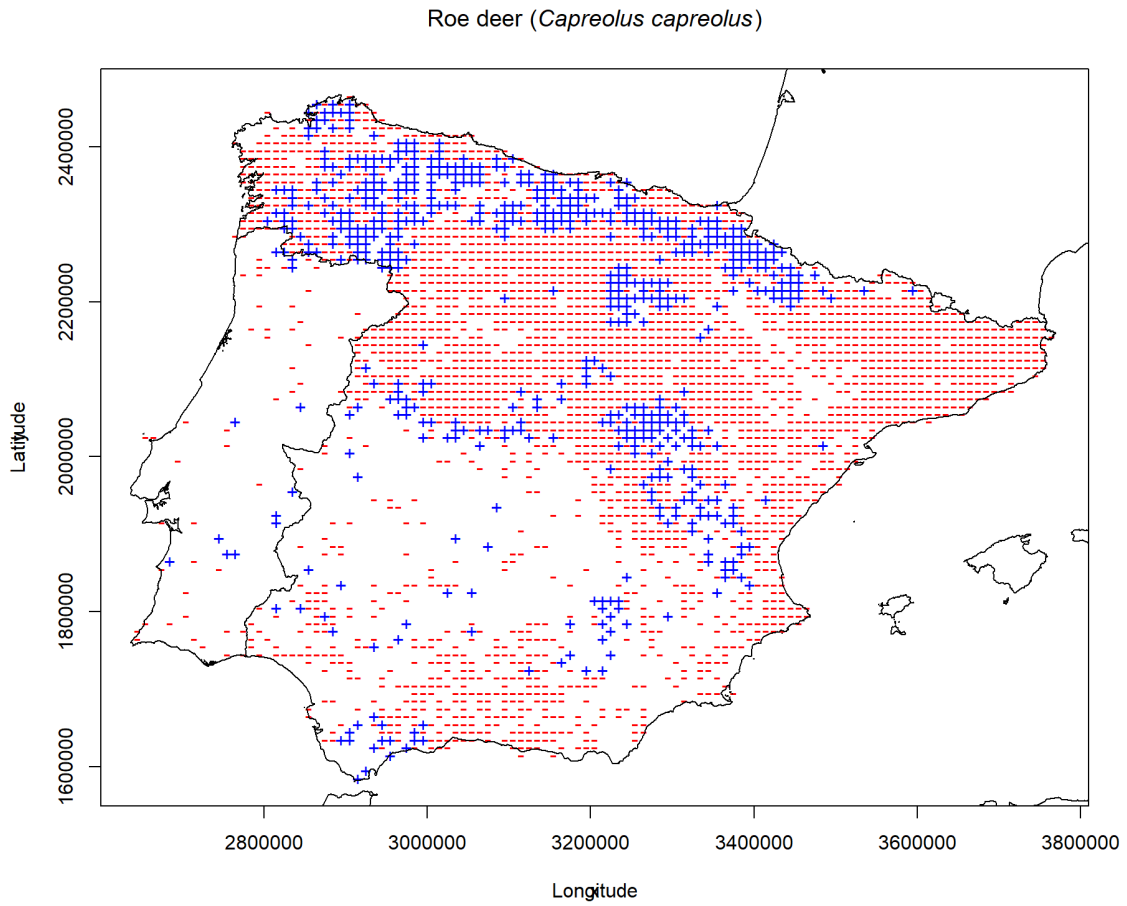


Figure A.6 – Gridded presences (+) and pseudo-absences (-) of roe deer within the Iberian Peninsula in the 19th century.

Table A.5 – Performance metrics of the roe deer distribution model. To calculate the Boyce index, the predictions were transformed from probability of presence to favourability. Favourability was calculated using the FUZZYSIM package (Barbosa, 2015).

| Fold    | Set   | Sensitivity | Specificity | CCR       | TSS       | AUC-ROC   | AUC-PR    | Boyce Index | DevExp (%) | R <sup>2</sup> (adj.) |
|---------|-------|-------------|-------------|-----------|-----------|-----------|-----------|-------------|------------|-----------------------|
| 1       | train | 0.7979167   | 0.7743786   | 0.7787714 | 0.5722953 | 0.8609126 | 0.6026263 | 0.9968437   | 29.70628   | 0.2940                |
|         | test  | 0.7666667   | 0.7715931   | 0.7706708 | 0.5382598 | 0.8493282 | 0.5776076 | 0.9264326   | NA         |                       |
| 2       | train | 0.7770833   | 0.7683102   | 0.7699494 | 0.5453935 | 0.8550383 | 0.5958015 | 0.9887429   | 28.80799   | 0.2850                |
|         | test  | 0.7666667   | 0.7881679   | 0.7841615 | 0.5548346 | 0.8563136 | 0.5721862 | 0.9718178   | NA         |                       |
| 3       | train | 0.7750000   | 0.7717703   | 0.7723735 | 0.5467703 | 0.8543690 | 0.5879212 | 0.9925802   | 28.45975   | 0.2820                |
|         | test  | 0.7666667   | 0.7820268   | 0.7791602 | 0.5486934 | 0.8550829 | 0.5838255 | 0.9736210   | NA         |                       |
| 4       | train | 0.7666667   | 0.8023923   | 0.7957198 | 0.5690590 | 0.8662939 | 0.6149508 | 0.9950045   | 30.98620   | 0.3070                |
|         | test  | 0.6583333   | 0.7973231   | 0.7713841 | 0.4556565 | 0.8091460 | 0.4905815 | 0.9811341   | NA         |                       |
| 5       | train | 0.7812500   | 0.7867049   | 0.7856865 | 0.5679549 | 0.8595558 | 0.5862104 | 0.9981158   | 29.22387   | 0.2890                |
|         | test  | 0.7750000   | 0.7413793   | 0.7476636 | 0.5163793 | 0.8453225 | 0.6054333 | 0.9489669   | NA         |                       |
| Average | train | 0.7795833   | 0.7807113   | 0.7805001 | 0.5602946 | 0.8592339 | 0.5975020 | 0.9942574   | 29.43682   | 0.2914                |
|         | test  | 0.7466667   | 0.7760980   | 0.7706080 | 0.5227647 | 0.8430386 | 0.5659268 | 0.9603945   | NA         |                       |

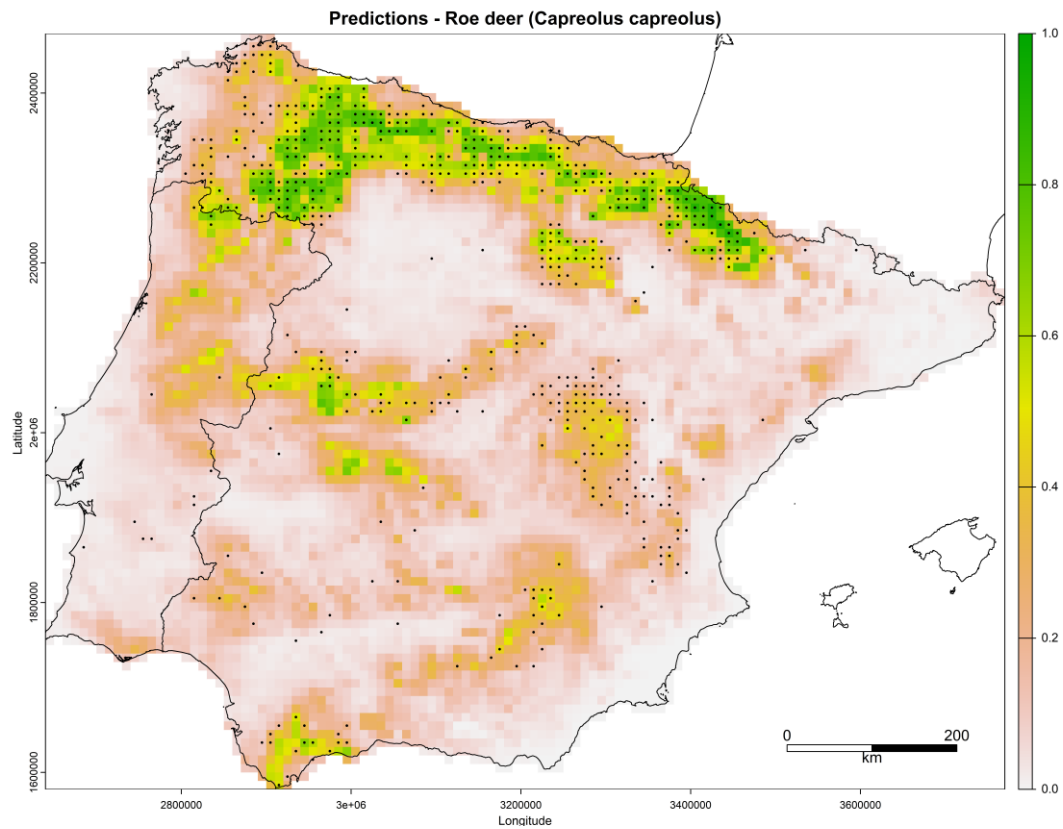


Figure A.7 – Average probability of presence of roe deer in the 19th century in the Iberian Peninsula. The dots represent (gridded) points of roe deer presence.

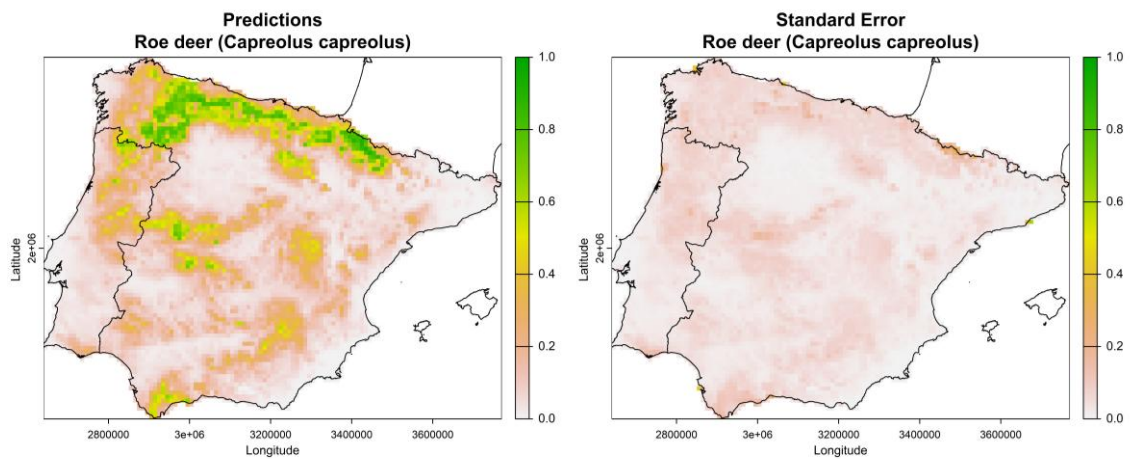


Figure A.8 – Average probability of presence (left panel) and average standard error (right panel) of the roe deer distribution model's prediction in the Iberian Peninsula in the 19th century.

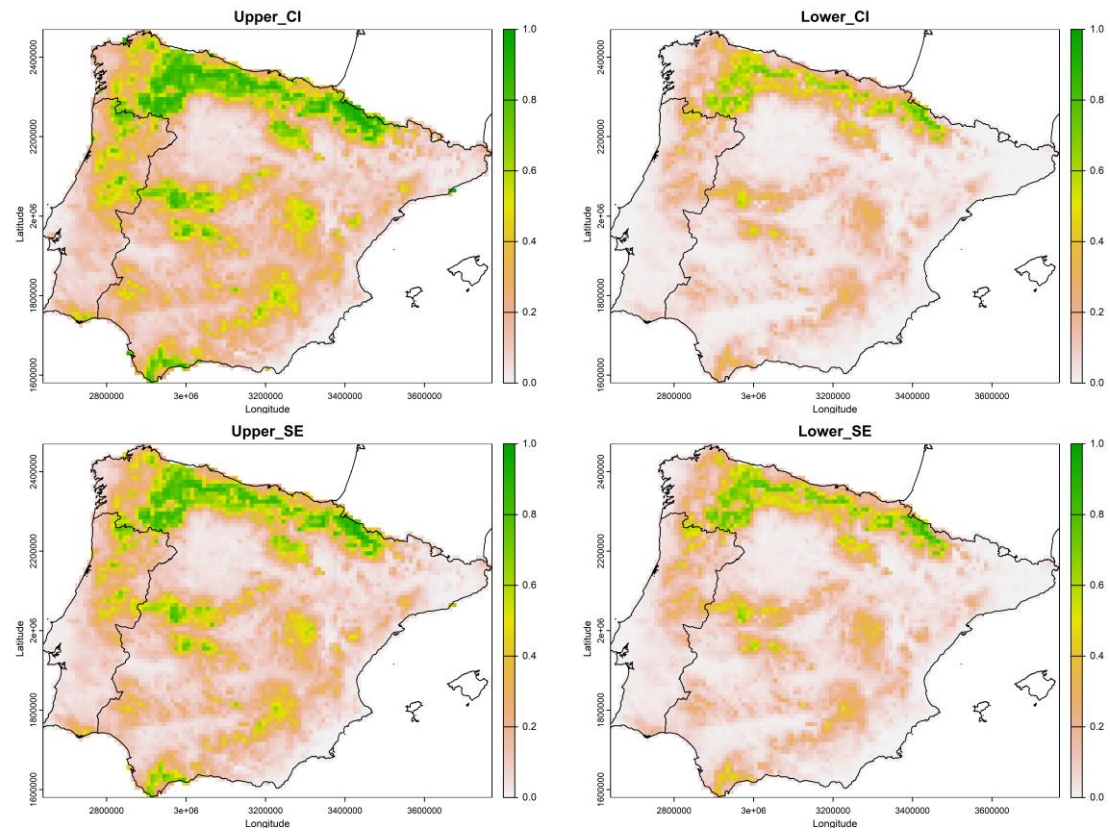


*Figure A.9 – Average upper and lower confidence interval (CI) and standard error (SE) of the roe deer distribution model's prediction in the Iberian Peninsula.*

### 7.6.3. Red deer Distribution Model

Formula: presence  $\sim$  s(north) + s(bio02) + s(bio03) + s(bio08) + s(bio09) + s(bio15) + s(bio18) + s(bio19) + s(dem) + s(popd) + s(scd) + s(tri)

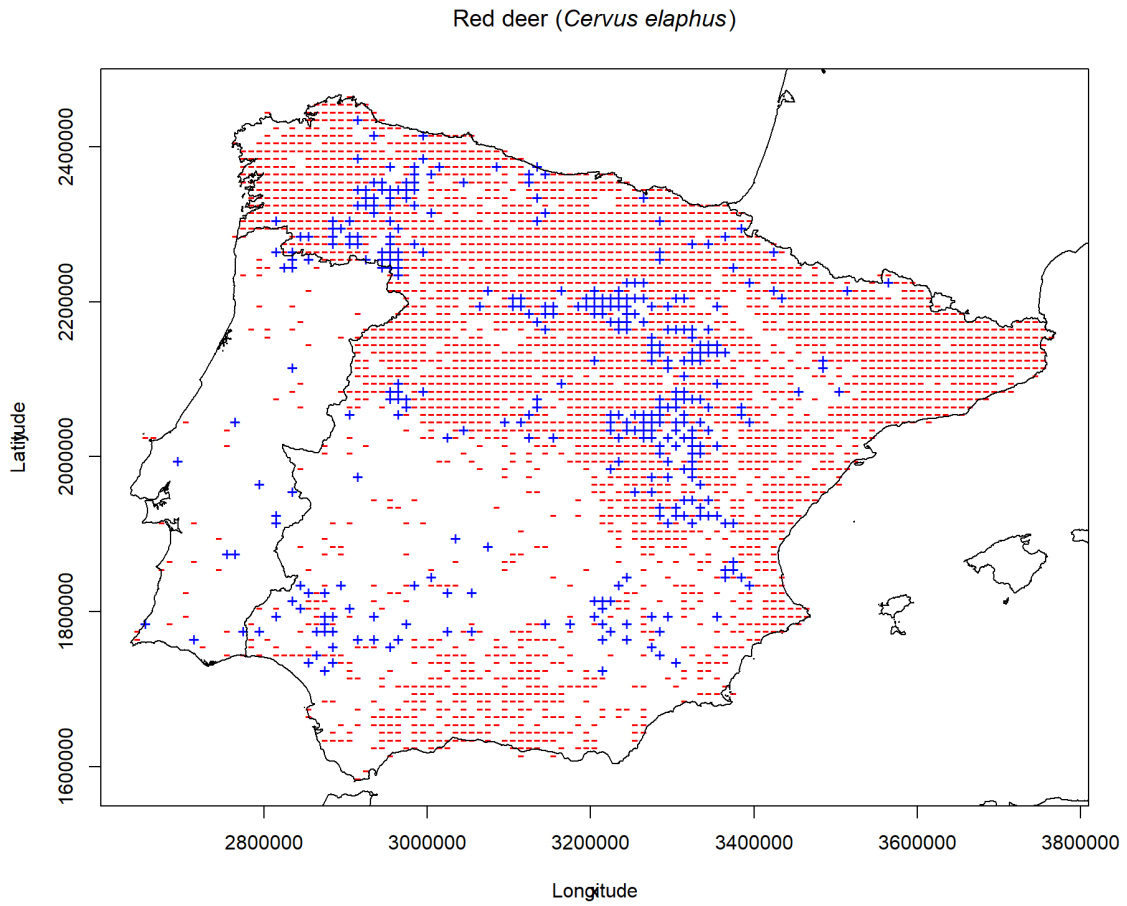


Figure A.10 – Gridded presences (+) and pseudo-absences (-) of red deer within the Iberian Peninsula in the 19th century.

Table A.6 – Performance metrics of the red deer distribution model. To calculate the Boyce index, the predictions were transformed from probability of presence to favourability. Favourability was calculated using the FUZZYSIM package (Barbosa, 2015).

| Fold    | Set   | Sensitivity | Specificity | CCR       | TSS       | AUC-ROC   | AUC-PR    | Boyce Index | DevExp (%) | R <sup>2</sup> (adj.) |
|---------|-------|-------------|-------------|-----------|-----------|-----------|-----------|-------------|------------|-----------------------|
| 1       | train | 0.7949640   | 0.6998255   | 0.7101167 | 0.4947895 | 0.8339219 | 0.3967019 | 0.9786342   | 22.72923   | 0.2240                |
|         | test  | 0.7681159   | 0.6829268   | 0.6920684 | 0.4510428 | 0.7792254 | 0.3230311 | 0.7798380   | NA         |                       |
| 2       | train | 0.7942238   | 0.7657068   | 0.7687816 | 0.5599306 | 0.8482053 | 0.4286805 | 0.9723431   | 24.93680   | 0.2460                |
|         | test  | 0.6142857   | 0.7386760   | 0.7251553 | 0.3529617 | 0.7502987 | 0.2468613 | 0.9142963   | NA         |                       |
| 3       | train | 0.6834532   | 0.7833479   | 0.7725505 | 0.4668011 | 0.8017035 | 0.3472495 | 0.9559373   | 17.65213   | 0.1730                |
|         | test  | 0.7246377   | 0.7849650   | 0.7784711 | 0.5096027 | 0.8158762 | 0.3877540 | 0.7715037   | NA         |                       |
| 4       | train | 0.8231047   | 0.6835222   | 0.6985609 | 0.5066269 | 0.8301219 | 0.4032045 | 0.9849803   | 21.92857   | 0.2160                |
|         | test  | 0.8142857   | 0.6765734   | 0.6915888 | 0.4908591 | 0.8197053 | 0.3322072 | 0.8665211   | NA         |                       |
| 5       | train | 0.6978417   | 0.8023560   | 0.7910506 | 0.5001977 | 0.8202098 | 0.3839228 | 0.9710411   | 20.37018   | 0.2000                |
|         | test  | 0.6666667   | 0.8153310   | 0.7993779 | 0.4819977 | 0.8314902 | 0.3841934 | 0.8935989   | NA         |                       |
| Average | train | 0.7587175   | 0.7469517   | 0.7482121 | 0.5056692 | 0.8268325 | 0.3919518 | 0.9725872   | 21.52338   | 0.2118                |
|         | test  | 0.7175983   | 0.7396945   | 0.7373323 | 0.4572928 | 0.7993191 | 0.3348094 | 0.8451516   | NA         |                       |

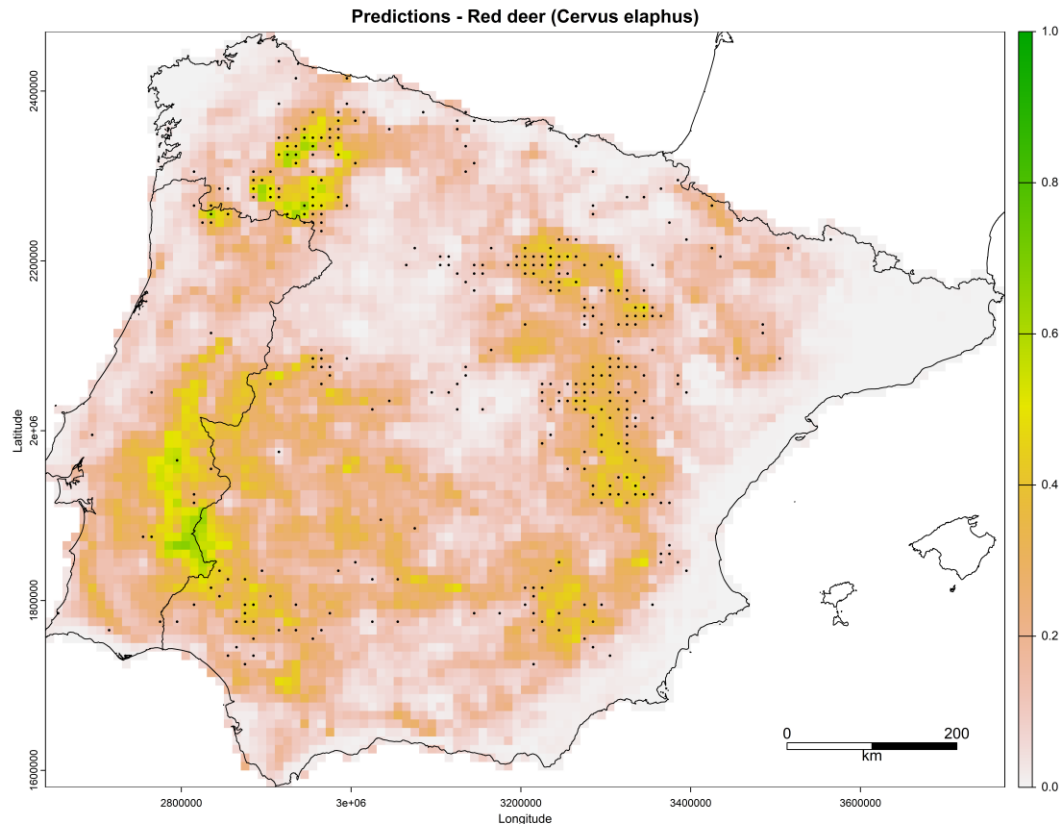


Figure A.11 – Average probability of presence of red deer in the 19th century in the Iberian Peninsula. The dots represent (gridded) points of red deer presence.

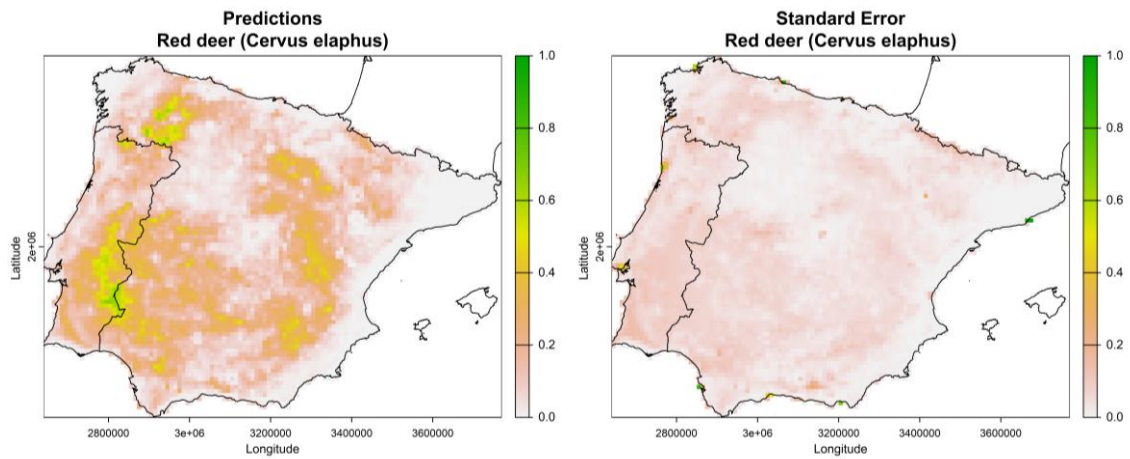


Figure A.12 – Average probability of presence (left panel) and average standard error (right panel) of the red deer distribution model's prediction in the Iberian Peninsula in the 19th century.

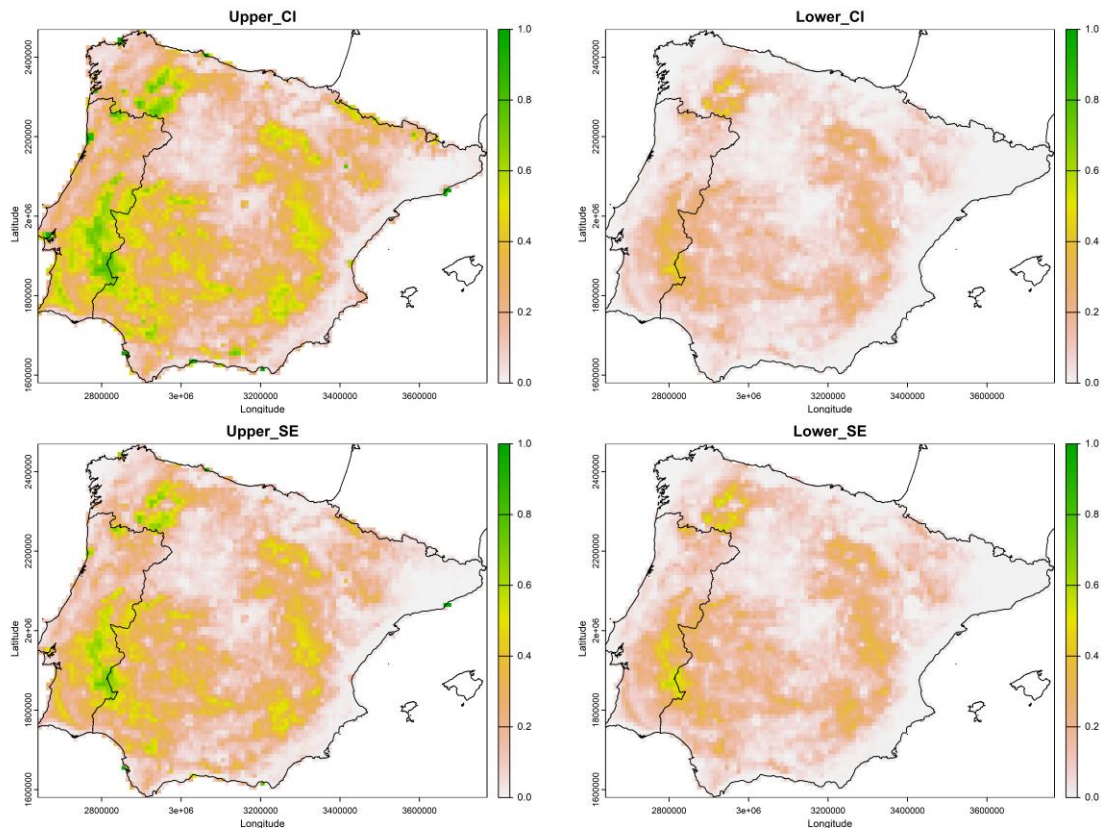


Figure A.13 – Average upper and lower confidence interval (CI) and standard error (SE) of the red deer distribution model's prediction in the Iberian Peninsula in the 19th century.

#### 7.6.4. References

- Baptista, J. M. (1874-1879). *Chorographia Moderna do Reino de Portugal* (1–7). Typographia da Academia Real de Ciências.
- Barbosa, A. M. (2015). fuzzySim: Applying fuzzy logic to binary similarity indices in ecology. *Methods in Ecology and Evolution*, 6(7), 853–858. <https://doi.org/10.1111/2041-210X.12372>
- Camara, P. P. da. (1850). *Diccionario Geographico Historico Politico e Litterario do Reino de Portugal e dos Seus Dominios* (1–2). Eduardo e Henrique Laemmert.
- Leal, A. S. d'Azevedo B. de P. (1873-1882). *Portugal Antigo e Moderno. Diccionario Geographico, Estatistico, Chorographico, Heraldico, Archeologico, Historico, Biographico e Etymologico de Todas as Cidades, Villas e Freguesias de Portugal* (1–10). Livraria Editora de Mattos Moreira & Companhia.
- Lopes, J. B. da S. (1841). *Corografia ou Memoria Economica, Estadistica, e Topografica do Reino do Algarve*. Typografia da Academia Real das Ciências de Lisboa.
- Madoz, P. (Ed.). (1845-1850). *Diccionario geografico-historico-estadistico de España y sus posesiones de Ultramar* (1–16).
- Mascarenhas, J. A. D., & Abreu, R. C. de. (1879). *Portugal: Diccionario Chorographico, Historico, Heraldico, Ethologico, Biographico, Estatistico, Archeologico e Bibliografico: Vol. I*. Typographia Gutierrez.
- Pereira, J. F. (1854). *Compendio de Corographia Portuguesa* (5ª Edição). Typographia de A. Martins.
- Secco, A. L. de S. H. (1853). *Memoria Historico-Chorographica dos Diversos Concelhos do Distrito Administrativo de Coimbra*. Imprensa da Universidade de Coimbra.

- Silveira, F. do N. (1804). *Mappa breve da Lusitania antiga, e Galliza Bracarense: Vol. I.* Officina de Simão Thaddeo Ferreira.
- Wood, S. N. (2017). *Generalized Additive Models: An Introduction with R* (2nd ed.). Chapman and Hall/CRC. <https://doi.org/10.1201/9781315370279>

## 7.7. Variables collinearity test

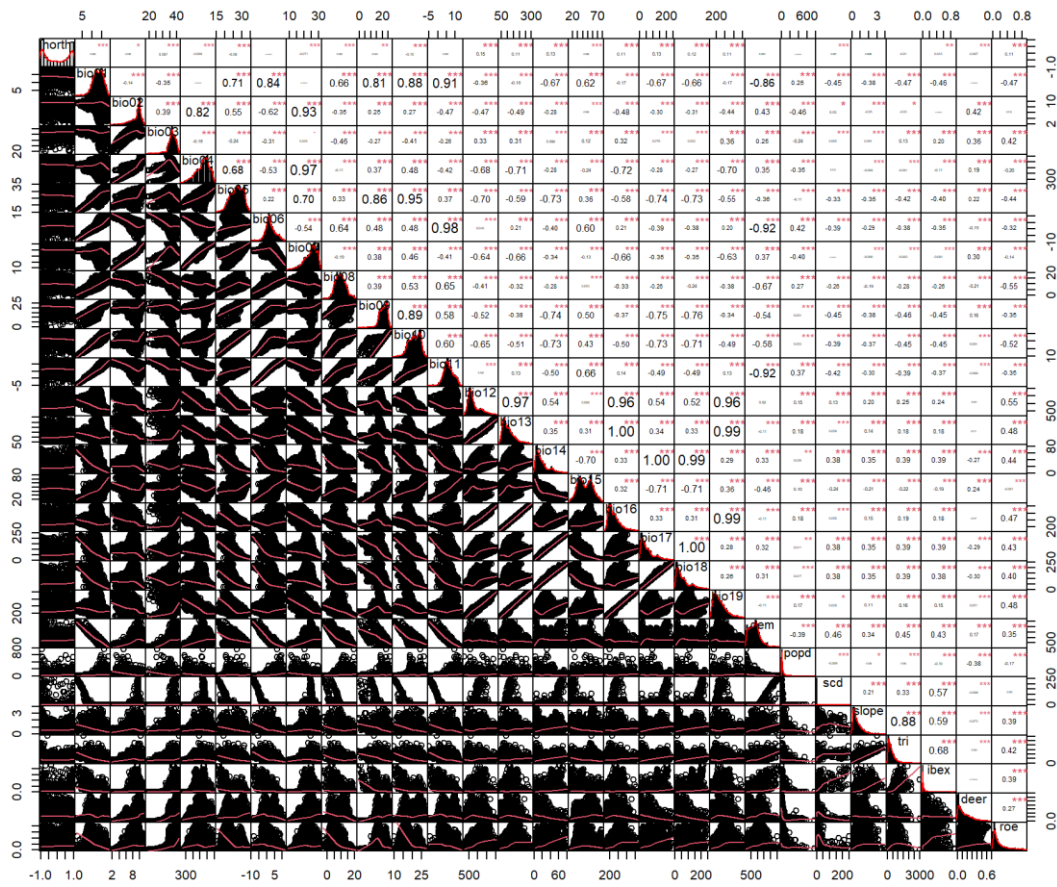


Figure A.14 – Correlation between the candidate predictor variables for the Eurasian lynx's distribution model. In the figure, “north” is short for northness, “bio01” is the annual mean temperature, “bio02” is the mean diurnal range, “bio03” is the isothermality, “bio04” is the temperature seasonality, “bio05” is the maximum temperature of the warmest month, “bio06” is the minimum temperature of the coldest month, “bio07” is the temperature annual range, “bio08” is the mean temperature of the wettest quarter, “bio09” is the mean temperature of the driest quarter, “bio10” is the mean temperature of the warmest quarter, “bio11” is the mean temperature of the coldest quarter, “bio12” is the annual precipitation, “bio13” is the precipitation of the wettest month, “bio14” is the precipitation of the driest month, “bio15” is the precipitation seasonality, “bio16” is the precipitation in the wettest quarter, “bio17” is the precipitation in the driest quarter, “bio18” is the precipitation in the warmest quarter, “bio19” is the precipitation in the coldest quarter, “dem” is the digital elevation model (also known as altitude or elevation), “scd” is the number of snow covered days, “slope” is the terrain's slope, “tri” is the terrain ruggedness index, “ibex” is the probability of presence of Iberian ibex, “deer” is the probability of presence of red deer, and “roe” is the probability of presence of roe deer.

Table A.7 – Candidate variables for Eurasian lynx models with high correlations. The variable codes are explained in Table 1 of the Methods section and in the legend of Figure A.14.

| Variable 1 | Variable 2 | Pearson's Correlation |
|------------|------------|-----------------------|
| bio16      | bio13      | 0.9981791             |
| bio18      | bio17      | 0.9975977             |
| bio17      | bio14      | 0.9971822             |
| bio18      | bio14      | 0.9933704             |
| bio19      | bio16      | 0.9917618             |
| bio19      | bio13      | 0.9892681             |
| bio11      | bio06      | 0.9817692             |
| bio07      | bio04      | 0.9713550             |
| bio13      | bio12      | 0.9683100             |
| bio16      | bio12      | 0.9647532             |
| bio19      | bio12      | 0.9558108             |
| bio10      | bio05      | 0.9509794             |
| bio07      | bio02      | 0.9271239             |
| dem        | bio11      | -0.9247999            |
| dem        | bio06      | -0.9164828            |
| bio11      | bio01      | 0.9104986             |
| bio10      | bio09      | 0.8917668             |
| tri        | slope      | 0.8809216             |
| bio10      | bio01      | 0.8750647             |
| dem        | bio01      | -0.8620263            |
| bio09      | bio05      | 0.8558434             |
| bio06      | bio01      | 0.8383626             |
| bio04      | bio02      | 0.8216237             |
| bio09      | bio01      | 0.8095509             |
| bio18      | bio09      | -0.7551263            |
| bio17      | bio09      | -0.7462620            |
| bio14      | bio09      | -0.7390262            |
| bio17      | bio05      | -0.7388848            |
| bio14      | bio05      | -0.7322819            |
| bio18      | bio05      | -0.7306828            |
| bio17      | bio10      | -0.7278345            |
| bio14      | bio10      | -0.7273319            |
| bio16      | bio04      | -0.7161484            |
| bio18      | bio15      | -0.7148529            |
| bio18      | bio10      | -0.7144519            |
| bio13      | bio04      | -0.7142616            |
| bio05      | bio01      | 0.7127911             |
| bio17      | bio15      | -0.7096998            |
| bio12      | bio05      | -0.7042280            |

Table A.8 – Remaining multicollinearity in the (selected) variables used in the Eurasian lynx models. The variable codes are explained in Table 1 of the Methods section and in the legend of Figure A.14.

| Variables | R <sup>2</sup> | Tolerance | VIF       |
|-----------|----------------|-----------|-----------|
| bio15     | 0.9181986      | 0.0818014 | 12.224726 |
| bio14     | 0.9108148      | 0.0891852 | 11.212622 |
| bio01     | 0.8848802      | 0.1151198 | 8.686603  |
| bio12     | 0.8321526      | 0.1678474 | 5.957791  |
| bio08     | 0.7863012      | 0.2136988 | 4.679484  |
| bio04     | 0.7375005      | 0.2624995 | 3.809531  |
| roe       | 0.7004093      | 0.2995907 | 3.337887  |
| ibex      | 0.6580764      | 0.3419236 | 2.924630  |
| scd       | 0.6504865      | 0.3495135 | 2.861120  |
| tri       | 0.5442539      | 0.4557461 | 2.194204  |
| bio03     | 0.4220053      | 0.5779947 | 1.730120  |
| deer      | 0.4185700      | 0.5814300 | 1.719898  |
| popd      | 0.3035349      | 0.6964651 | 1.435822  |
| north     | 0.0658703      | 0.9341297 | 1.070515  |

## 7.8. Output of the regression-based models using equal weights

### 7.8.1. GLM

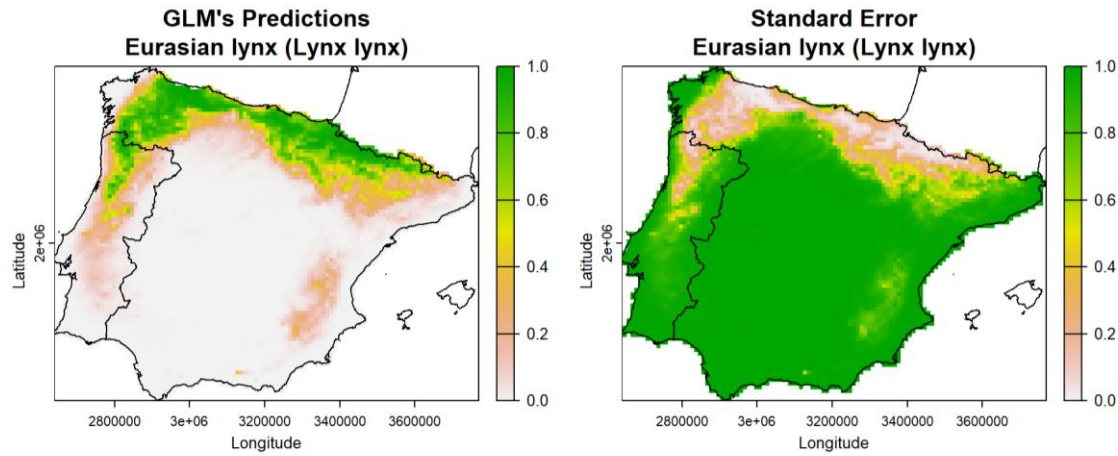


Figure A.15 – Average probability of Eurasian lynx's presence (left panel) and average standard error (right panel) of the lynx distribution model's prediction in the Iberian Peninsula in the 19th century (GLM approach with equal weights for presences and absences).

Table A.9 – Performance metrics of the five cross-validation sets of the Eurasian lynx distribution model (GLM approach with equal weights for presences and absences). To calculate the Boyce index, the predictions were transformed from probability of presence to favourability.

| Replicate Mean | Set   | Sensitivity | Specificity | CCR   | TSS   | AUC-ROC | AUC-PR | Boyce | DevExp (%) | R <sup>2</sup> (adj.) |
|----------------|-------|-------------|-------------|-------|-------|---------|--------|-------|------------|-----------------------|
| 1              | train | 0.971       | 0.819       | 0.828 | 0.790 | 0.940   | 0.412  | 0.618 | 59.761     | 0.591                 |
|                | test  | 0.936       | 0.811       | 0.818 | 0.747 | 0.921   | 0.366  | 0.465 | NA         |                       |
| 2              | train | 0.955       | 0.856       | 0.861 | 0.810 | 0.948   | 0.416  | 0.635 | 61.799     | 0.612                 |
|                | test  | 0.919       | 0.854       | 0.858 | 0.773 | 0.932   | 0.367  | 0.459 | NA         |                       |
| 3              | train | 0.996       | 0.824       | 0.833 | 0.819 | 0.951   | 0.439  | 0.588 | 63.604     | 0.630                 |
|                | test  | 0.951       | 0.817       | 0.825 | 0.768 | 0.938   | 0.418  | 0.494 | NA         |                       |
| 4              | train | 0.988       | 0.839       | 0.847 | 0.827 | 0.952   | 0.420  | 0.592 | 63.712     | 0.632                 |
|                | test  | 0.953       | 0.836       | 0.843 | 0.789 | 0.936   | 0.375  | 0.462 | NA         |                       |
| 5              | train | 0.971       | 0.852       | 0.859 | 0.823 | 0.952   | 0.466  | 0.627 | 64.136     | 0.636                 |
|                | test  | 0.936       | 0.845       | 0.850 | 0.781 | 0.938   | 0.407  | 0.439 | NA         |                       |
| Average        | train | 0.976       | 0.838       | 0.846 | 0.814 | 0.949   | 0.431  | 0.612 | 62.602     | 0.620                 |
|                | test  | 0.939       | 0.833       | 0.839 | 0.772 | 0.933   | 0.387  | 0.464 | NA         |                       |

## 7.8.2. GAM

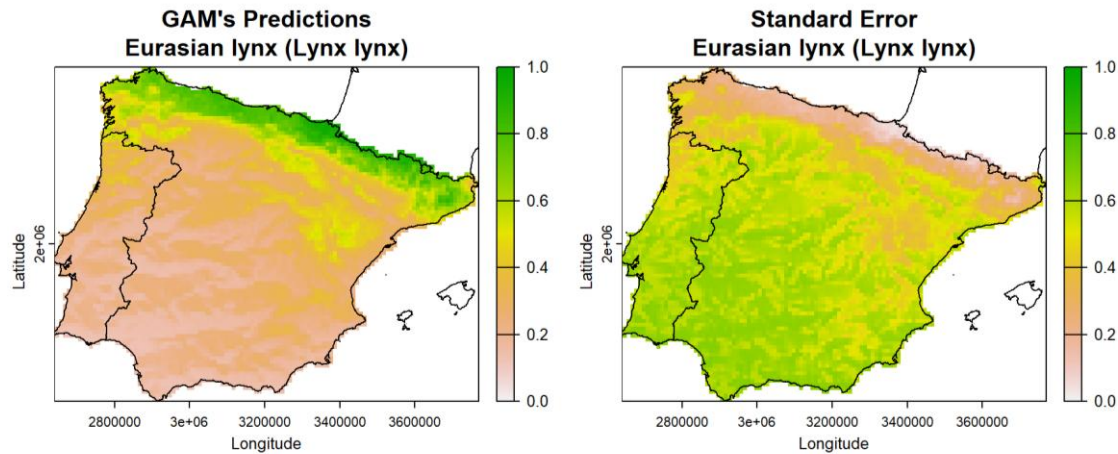


Figure A.16 – Average probability of Eurasian lynx's presence (left panel) and average standard error (right panel) of the lynx distribution model's prediction in the Iberian Peninsula in the 19th century (GAM approach with equal weights for presences and absences).

Table A.10 – Performance metrics of the five cross-validation sets of the Eurasian lynx distribution model (GAM approach with equal weights for presences and absences). To calculate the Boyce index, the predictions were transformed from probability of presence to favourability.

| Replicate Mean | Set   | Sensitivity | Specificity | CCR   | TSS   | AUC-ROC | AUC-PR | Boyce | DevExp (%) | R <sup>2</sup> (adj.) |
|----------------|-------|-------------|-------------|-------|-------|---------|--------|-------|------------|-----------------------|
| 1              | train | 0.840       | 0.801       | 0.803 | 0.641 | 0.875   | 0.236  | 0.943 | 30.143     | 0.291                 |
|                | test  | 0.819       | 0.798       | 0.799 | 0.617 | 0.872   | 0.251  | 0.779 |            | NA                    |
| 2              | train | 0.836       | 0.813       | 0.814 | 0.649 | 0.884   | 0.257  | 0.933 | 32.694     | 0.316                 |
|                | test  | 0.819       | 0.809       | 0.810 | 0.628 | 0.883   | 0.273  | 0.784 |            | NA                    |
| 3              | train | 0.857       | 0.825       | 0.826 | 0.681 | 0.900   | 0.285  | 0.914 | 37.839     | 0.369                 |
|                | test  | 0.851       | 0.828       | 0.829 | 0.679 | 0.900   | 0.287  | 0.734 |            | NA                    |
| 4              | train | 0.795       | 0.832       | 0.830 | 0.627 | 0.869   | 0.245  | 0.943 | 29.251     | 0.281                 |
|                | test  | 0.771       | 0.820       | 0.817 | 0.591 | 0.866   | 0.290  | 0.838 |            | NA                    |
| 5              | train | 0.869       | 0.834       | 0.836 | 0.703 | 0.900   | 0.270  | 0.840 | 37.097     | 0.361                 |
|                | test  | 0.837       | 0.828       | 0.828 | 0.665 | 0.892   | 0.287  | 0.742 |            | NA                    |
| Average        | train | 0.839       | 0.821       | 0.822 | 0.660 | 0.886   | 0.259  | 0.915 | 33.405     | 0.324                 |
|                | test  | 0.819       | 0.817       | 0.817 | 0.636 | 0.883   | 0.277  | 0.775 |            | NA                    |

## 7.9. Eurasian lynx distribution models' results

### 7.9.1. GLM

Formula: presence ~ north + bio01 + bio03 + bio04 + bio08 + bio12 + bio14 + bio15 + popd + scd + tri + ibex + deer + roe

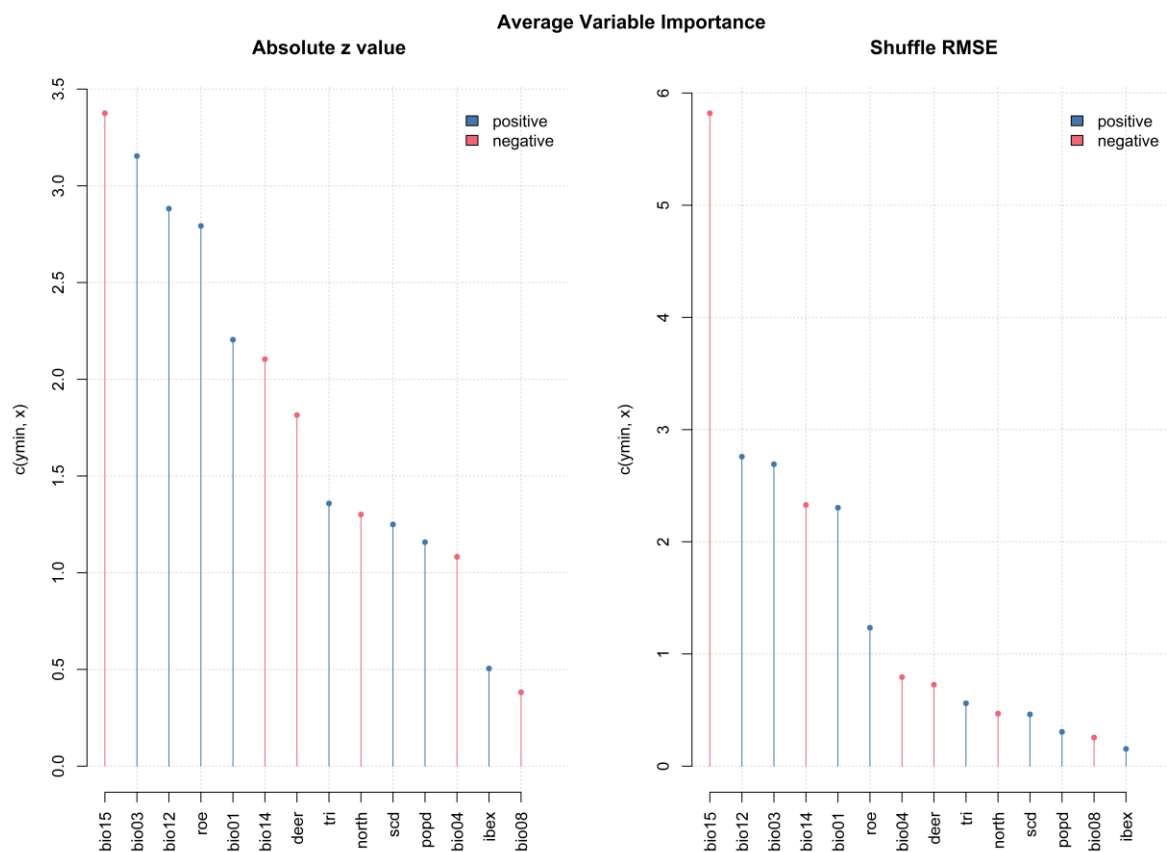


Figure A.17 – Average variable importance in the Eurasian lynx distribution model (GLM). In the plot on the right, the variable importance was calculated using the absolute z-value. On the left, the variable importance was calculated using shuffle RMSE.

Table A.11 – Performance metrics of the five cross-validation sets of the Eurasian lynx distribution model (GLM approach). To calculate the Boyce index, the predictions were transformed from probability of presence to favourability. Favourability was calculated using the FUZZYSIM package (Barbosa, 2015).

| Replicate Mean | Set   | Sensitivity | Specificity | CCR         | TSS         | AUC-ROC     | AUC-PR      | Boyce       | DevExp (%)  | R <sup>2</sup> (adj.) |
|----------------|-------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------|
| <b>1</b>       | train | 0.942261905 | 0.81125     | 0.818818477 | 0.753511905 | 0.942586841 | 0.513880115 | 0.884220013 | 43.91903495 | 0.43040               |
|                | test  | 0.935897436 | 0.80800     | 0.815191780 | 0.743897436 | 0.925762821 | 0.399265326 | 0.616382888 | NA          |                       |
| <b>2</b>       | train | 0.934438776 | 0.83600     | 0.841664166 | 0.770438776 | 0.948476084 | 0.527028735 | 0.876145522 | 46.02983703 | 0.45200               |
|                | test  | 0.902564103 | 0.82600     | 0.830334839 | 0.728564103 | 0.933217949 | 0.448635778 | 0.624065468 | NA          |                       |
| <b>3</b>       | train | 0.954931973 | 0.82500     | 0.832471054 | 0.779931973 | 0.950690051 | 0.564263147 | 0.862561742 | 47.50891599 | 0.46680               |
|                | test  | 0.919230769 | 0.82700     | 0.832265923 | 0.746230769 | 0.936269231 | 0.488575014 | 0.604812619 | NA          |                       |
| <b>4</b>       | train | 0.934268707 | 0.84225     | 0.847557337 | 0.776518707 | 0.951647534 | 0.496306687 | 0.826378369 | 46.62764367 | 0.45800               |
|                | test  | 0.919230769 | 0.83500     | 0.839733369 | 0.754230769 | 0.938743590 | 0.430863453 | 0.631704670 | NA          |                       |
| <b>5</b>       | train | 0.954846939 | 0.84075     | 0.847318988 | 0.795596939 | 0.953991390 | 0.573839045 | 0.784219346 | 48.65530335 | 0.47840               |
|                | test  | 0.935897436 | 0.84500     | 0.850124015 | 0.780897436 | 0.940852564 | 0.498739063 | 0.576924253 | NA          |                       |
| <b>Average</b> | train | 0.944149660 | 0.83105     | 0.837566004 | 0.775199660 | 0.949478380 | 0.535063546 | 0.846704999 | 46.54814700 | 0.45712               |
|                | test  | 0.922564103 | 0.82820     | 0.833529985 | 0.750764103 | 0.934969231 | 0.453215727 | 0.610777980 | NA          |                       |

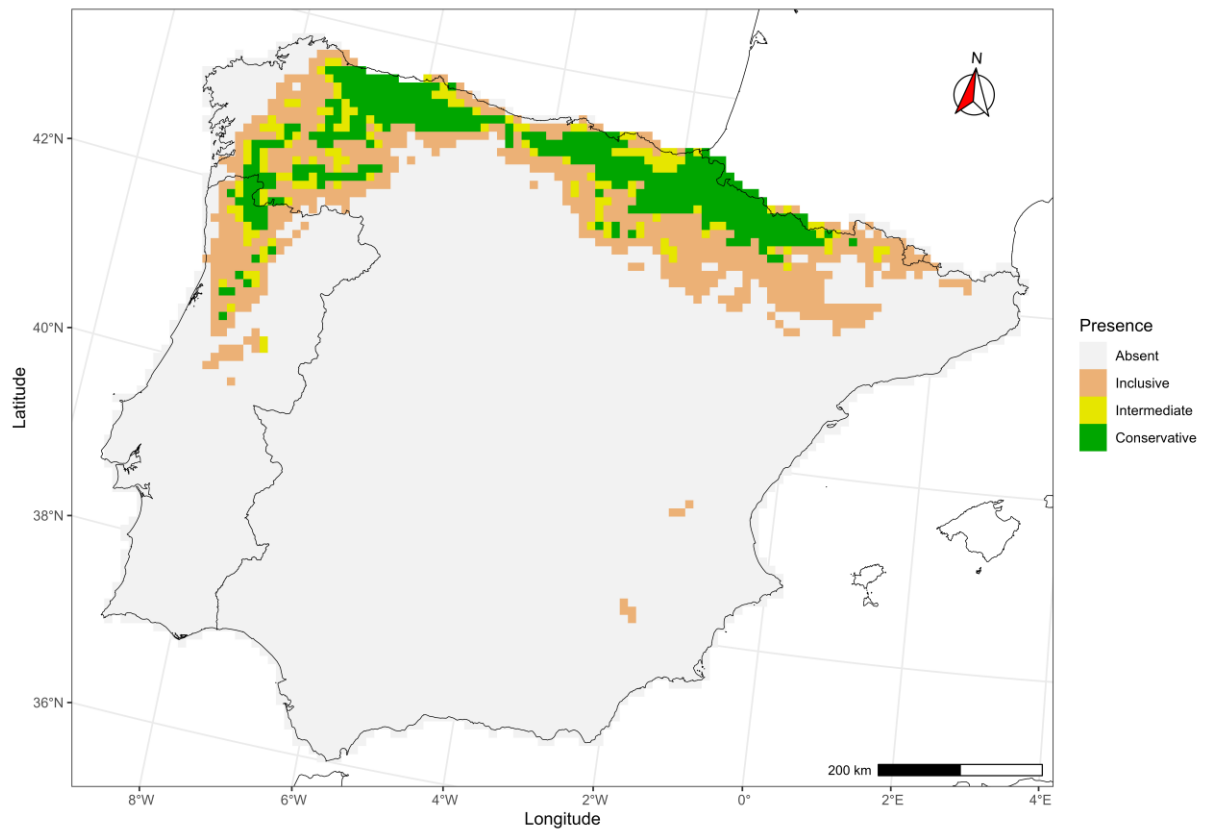


Figure A.18 – Thresholded output of the GLM approach for predicting the Eurasian lynx’s distribution within the Iberian Peninsula. Conservative estimates suggest that the lynx would have been present 36 200 km<sup>2</sup> of the Iberian Peninsula; intermediate estimates suggest that the lynx would have been present in 50 700 km<sup>2</sup> of the Iberian Peninsula; and inclusive estimates suggest that the lynx would have been present in 110 800 km<sup>2</sup> of the Iberian Peninsula.

## 7.9.2. GAM

Formula: presence  $\sim$  s(north) + s(bio01) + s(bio03) + s(bio04) + s(bio08) + s(bio12) + s(bio14) + s(bio15) + s(popd) + s(scd, k = -1) + s(tri) + s(ibex) + s(deer) + s(roe)

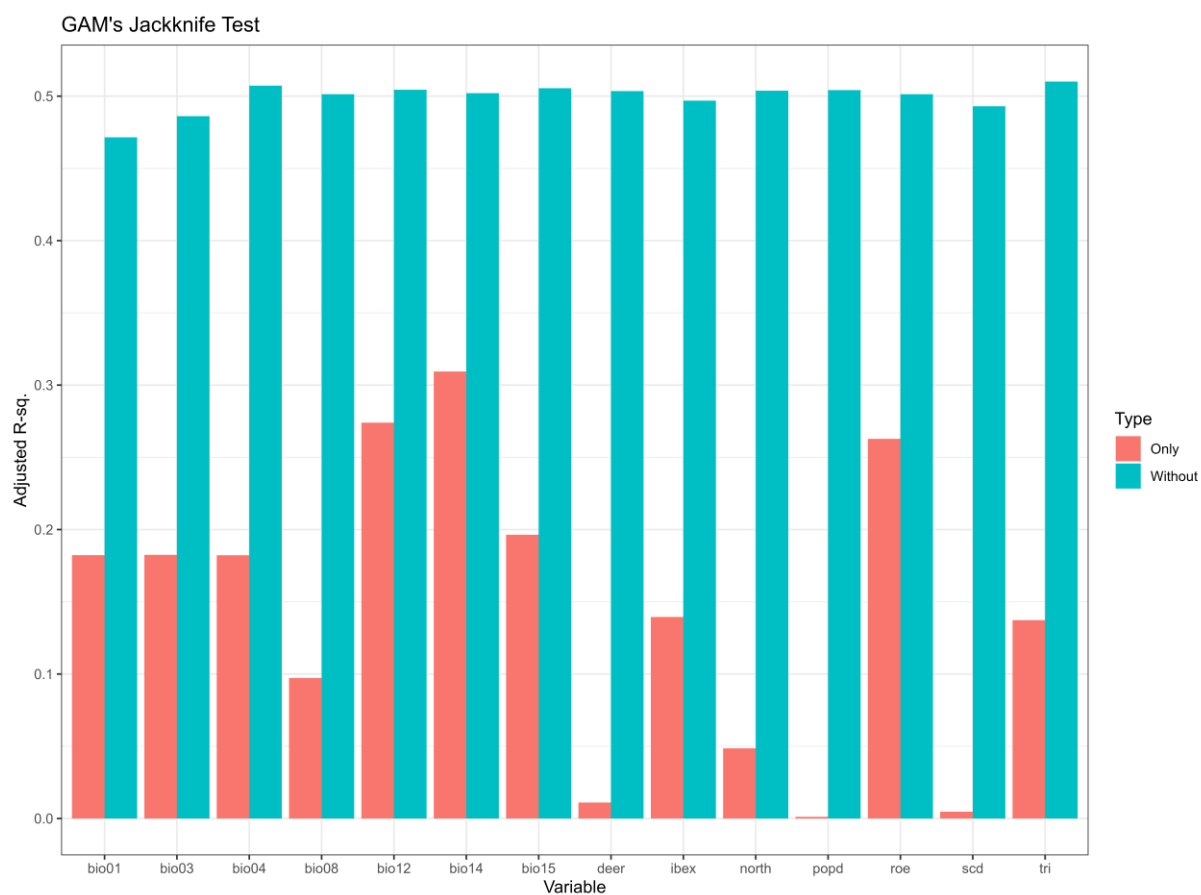


Figure A.19 – Jackknife test of the variables used in the Eurasian lynx distribution model (GAM).

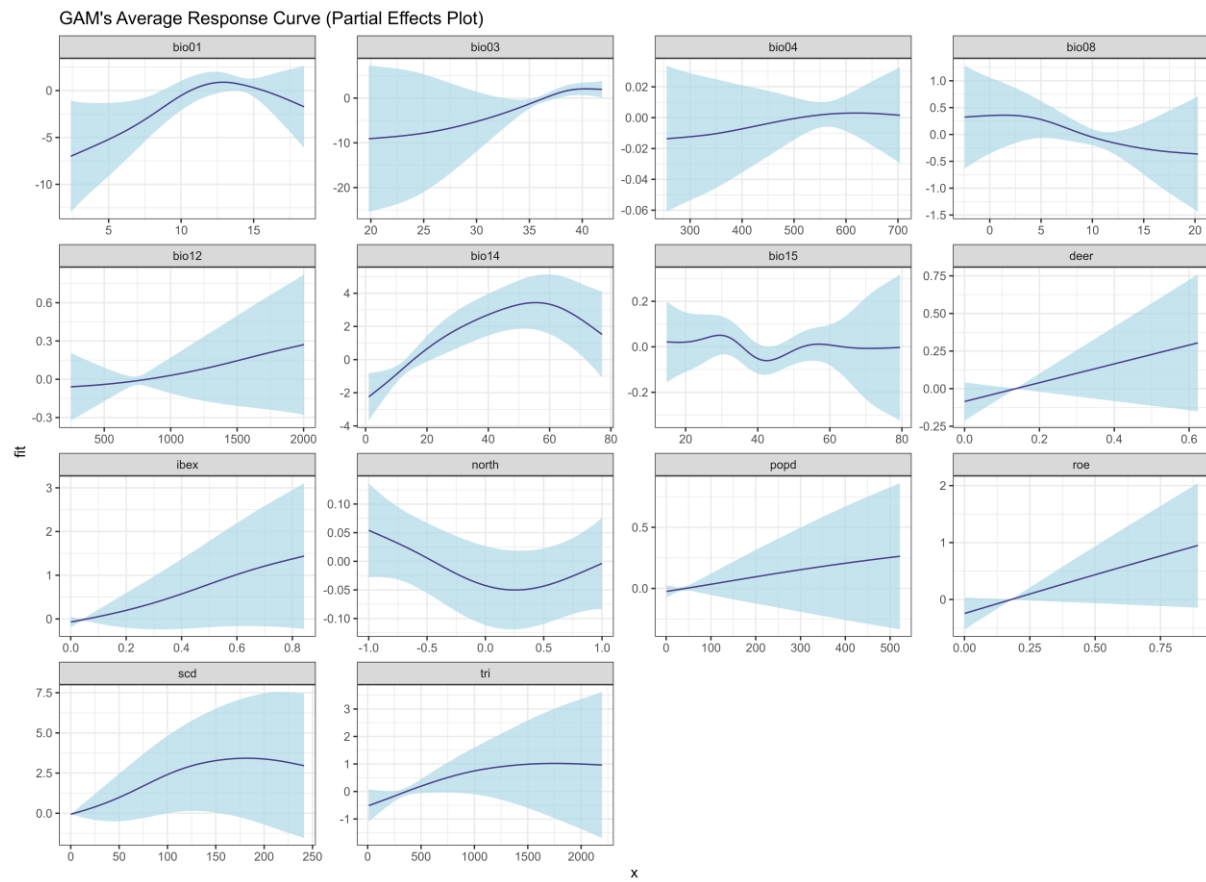


Figure A.20 – Eurasian lynx GAM's variable response curves.

Table A.12 – Concurvity of the variables in all runs using the GAM approach. Concurvity can be viewed as a generalization of collinearity to non-linear smooth terms, and causes similar problems of interpretation. The weighted mean is the mean concurvity of each variable weighted by the adjusted  $R^2$ . This table also includes the convergence of each of the model runs.

| Rep.                     | Fold | north       | bio01 | bio03 | bio04 | bio08 | bio12 | bio14 | bio15 | popd  | scd   | tri   | ibex  | deer  | roe   | adj. R <sup>2</sup> | Convergence |
|--------------------------|------|-------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------------------|-------------|
| 1                        | 1    | 0.486       | 0.998 | 0.926 | 0.948 | 0.936 | 0.984 | 0.992 | 0.990 | 0.828 | 0.998 | 0.919 | 0.957 | 0.912 | 0.976 | 0.492               | FULL        |
|                          | 2    | 0.476       | 0.998 | 0.921 | 0.947 | 0.955 | 0.983 | 0.992 | 0.990 | 0.832 | 0.999 | 0.916 | 0.956 | 0.912 | 0.975 | 0.441               | FULL        |
|                          | 3    | 0.490       | 0.998 | 0.921 | 0.946 | 0.937 | 0.984 | 0.992 | 0.990 | 0.821 | 0.998 | 0.914 | 0.956 | 0.908 | 0.975 | 0.493               | FULL        |
|                          | 4    | 0.466       | 0.999 | 0.928 | 0.946 | 0.946 | 0.984 | 0.992 | 0.990 | 0.838 | 0.999 | 0.912 | 0.954 | 0.919 | 0.976 | 0.451               | FULL        |
|                          | 5    | 0.489       | 0.999 | 0.924 | 0.948 | 0.922 | 0.984 | 0.992 | 0.990 | 0.827 | 0.999 | 0.912 | 0.954 | 0.911 | 0.976 | 0.472               | FULL        |
| 2                        | 1    | 0.438       | 0.996 | 0.929 | 0.942 | 0.909 | 0.983 | 0.990 | 0.987 | 0.846 | 0.996 | 0.930 | 0.963 | 0.912 | 0.976 | 0.498               | FULL        |
|                          | 2    | 0.468       | 0.998 | 0.930 | 0.947 | 0.941 | 0.984 | 0.991 | 0.988 | 0.871 | 0.998 | 0.928 | 0.964 | 0.920 | 0.978 | 0.471               | FULL        |
|                          | 3    | 0.443       | 0.997 | 0.926 | 0.946 | 0.941 | 0.984 | 0.990 | 0.987 | 0.852 | 0.998 | 0.932 | 0.963 | 0.911 | 0.975 | 0.509               | FULL        |
|                          | 4    | 0.437       | 0.997 | 0.929 | 0.946 | 0.928 | 0.984 | 0.991 | 0.988 | 0.849 | 0.998 | 0.925 | 0.963 | 0.912 | 0.975 | 0.476               | FULL        |
|                          | 5    | 0.453       | 0.999 | 0.928 | 0.944 | 0.963 | 0.983 | 0.991 | 0.988 | 0.854 | 0.999 | 0.934 | 0.967 | 0.914 | 0.977 | 0.578               | FULL        |
| 3                        | 1    | 0.442       | 0.997 | 0.932 | 0.951 | 0.942 | 0.984 | 0.992 | 0.989 | 0.827 | 0.998 | 0.926 | 0.963 | 0.910 | 0.979 | 0.468               | FULL        |
|                          | 2    | 0.468       | 0.999 | 0.928 | 0.949 | 0.979 | 0.982 | 0.991 | 0.989 | 0.825 | 0.999 | 0.923 | 0.962 | 0.904 | 0.979 | 0.460               | FULL        |
|                          | 3    | 0.451       | 0.998 | 0.928 | 0.948 | 0.957 | 0.983 | 0.991 | 0.989 | 0.830 | 0.998 | 0.928 | 0.966 | 0.908 | 0.979 | 0.545               | FULL        |
|                          | 4    | 0.439       | 0.998 | 0.935 | 0.949 | 0.964 | 0.983 | 0.991 | 0.989 | 0.838 | 0.999 | 0.929 | 0.967 | 0.915 | 0.979 | 0.487               | FULL        |
|                          | 5    | 0.441       | 0.997 | 0.929 | 0.947 | 0.922 | 0.982 | 0.991 | 0.989 | 0.834 | 0.997 | 0.925 | 0.963 | 0.905 | 0.977 | 0.570               | FULL        |
| 4                        | 1    | 0.504       | 0.997 | 0.923 | 0.946 | 0.912 | 0.983 | 0.991 | 0.988 | 0.852 | 0.997 | 0.917 | 0.957 | 0.910 | 0.975 | 0.506               | FULL        |
|                          | 2    | 0.491       | 0.998 | 0.924 | 0.949 | 0.910 | 0.983 | 0.991 | 0.989 | 0.845 | 0.998 | 0.908 | 0.958 | 0.907 | 0.974 | 0.496               | FULL        |
|                          | 3    | 0.493       | 0.997 | 0.920 | 0.947 | 0.918 | 0.984 | 0.991 | 0.989 | 0.854 | 0.997 | 0.918 | 0.961 | 0.912 | 0.977 | 0.519               | FULL        |
|                          | 4    | 0.492       | 0.997 | 0.926 | 0.951 | 0.916 | 0.984 | 0.991 | 0.989 | 0.849 | 0.998 | 0.915 | 0.956 | 0.914 | 0.975 | 0.479               | FULL        |
|                          | 5    | 0.501       | 0.998 | 0.925 | 0.948 | 0.909 | 0.983 | 0.990 | 0.988 | 0.842 | 0.998 | 0.916 | 0.958 | 0.905 | 0.977 | 0.571               | FULL        |
| 5                        | 1    | 0.453       | 0.999 | 0.923 | 0.938 | 0.940 | 0.983 | 0.991 | 0.989 | 0.868 | 0.999 | 0.926 | 0.989 | 0.917 | 0.978 | 0.524               | FULL        |
|                          | 2    | 0.435       | 0.998 | 0.924 | 0.934 | 0.965 | 0.980 | 0.990 | 0.988 | 0.862 | 0.999 | 0.916 | 0.960 | 0.914 | 0.977 | 0.521               | FULL        |
|                          | 3    | 0.450       | 0.999 | 0.923 | 0.941 | 0.944 | 0.982 | 0.990 | 0.988 | 0.867 | 0.999 | 0.922 | 0.961 | 0.912 | 0.979 | 0.556               | FULL        |
|                          | 4    | 0.395       | 0.924 | 0.776 | 0.883 | 0.840 | 0.886 | 0.895 | 0.943 | 0.297 | 0.977 | 0.750 | 0.796 | 0.649 | 0.840 | 0.483               | FULL        |
|                          | 5    | 0.444       | 1.000 | 0.931 | 0.939 | 0.931 | 0.982 | 0.991 | 0.989 | 0.878 | 1.000 | 0.925 | 0.970 | 0.922 | 0.979 | 0.580               | FULL        |
| Weighted Mean            |      | 0.462       | 0.995 | 0.921 | 0.943 | 0.933 | 0.979 | 0.987 | 0.987 | 0.825 | 0.997 | 0.915 | 0.956 | 0.902 | 0.972 | 0.506               | 100%        |
| Total Average Concurvity |      | 0.912438179 |       |       |       |       |       |       |       |       |       |       |       |       |       |                     |             |

Table A.13 – Performance metrics of the five cross-validation sets of the Eurasian lynx distribution model (GAM approach). To calculate the Boyce index, the predictions were transformed from probability of presence to favourability. Favourability was calculated using the FUZZYSIM package (Barbosa, 2015).

| Replicate Mean | Set   | Sensitivity | Specificity | CCR         | TSS         | AUC-ROC     | AUC-PR      | Boyce       | DevExp (%)  | R <sup>2</sup> (adj.) |
|----------------|-------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------|
| 1              | train | 0.967091837 | 0.82875     | 0.836718003 | 0.795841837 | 0.953150085 | 0.564582383 | 0.894143202 | 47.77407865 | 0.46960               |
|                | test  | 0.935897436 | 0.82700     | 0.833147312 | 0.762897436 | 0.929294872 | 0.405806857 | 0.678365857 | NA          |                       |
| 2              | train | 0.963180272 | 0.86025     | 0.866163022 | 0.823430272 | 0.960598533 | 0.585911085 | 0.875745287 | 51.41743371 | 0.50640               |
|                | test  | 0.917948718 | 0.85000     | 0.853902029 | 0.767948718 | 0.942076923 | 0.495756450 | 0.585890139 | NA          |                       |
| 3              | train | 0.950765306 | 0.86675     | 0.871591439 | 0.817515306 | 0.960840880 | 0.582984749 | 0.877330105 | 51.37620809 | 0.50620               |
|                | test  | 0.885897436 | 0.86600     | 0.867109576 | 0.751897436 | 0.936282051 | 0.477192409 | 0.524419286 | NA          |                       |
| 4              | train | 0.950850340 | 0.88200     | 0.885958508 | 0.832850340 | 0.963407313 | 0.578060162 | 0.844225000 | 52.15627839 | 0.51420               |
|                | test  | 0.919230769 | 0.87800     | 0.880299407 | 0.797230769 | 0.937730769 | 0.467627947 | 0.639160591 | NA          |                       |
| 5              | train | 0.967261905 | 0.85300     | 0.859563138 | 0.820261905 | 0.965980867 | 0.626855433 | 0.828224204 | 54.00500197 | 0.53300               |
|                | test  | 0.950000000 | 0.85000     | 0.855802108 | 0.800000000 | 0.943782051 | 0.524508890 | 0.631905531 | NA          |                       |
| Average        | train | 0.959829932 | 0.85815     | 0.863998822 | 0.817979932 | 0.960795536 | 0.587678763 | 0.863933560 | 51.34580016 | 0.50588               |
|                | test  | 0.921794872 | 0.85420     | 0.858052086 | 0.775994872 | 0.937833333 | 0.474178511 | 0.611948281 | NA          |                       |

### 7.9.3. MaxEnt

The number of background points is, by default, 10 000 (Phillips et al., 2006). However, at this study model's scale (i.e. 10x10 km grid), the total number of pixels in the Iberian Peninsula is 6075. Therefore, the maximum amount of available background points is 6075. Since the default settings (i.e. 10 000 background points) are being used, all the possible background data (i.e. 6075 pixels) was used in the model building. Furthermore, the use of a bias layer is recommended by some authors to correct sampling bias in MaxEnt models (Kramer-Schadt et al., 2013; Syfert et al., 2013). However, it was not possible to generate a bias layer for this model, as explained in the explanatory note found in Appendix 7.4..

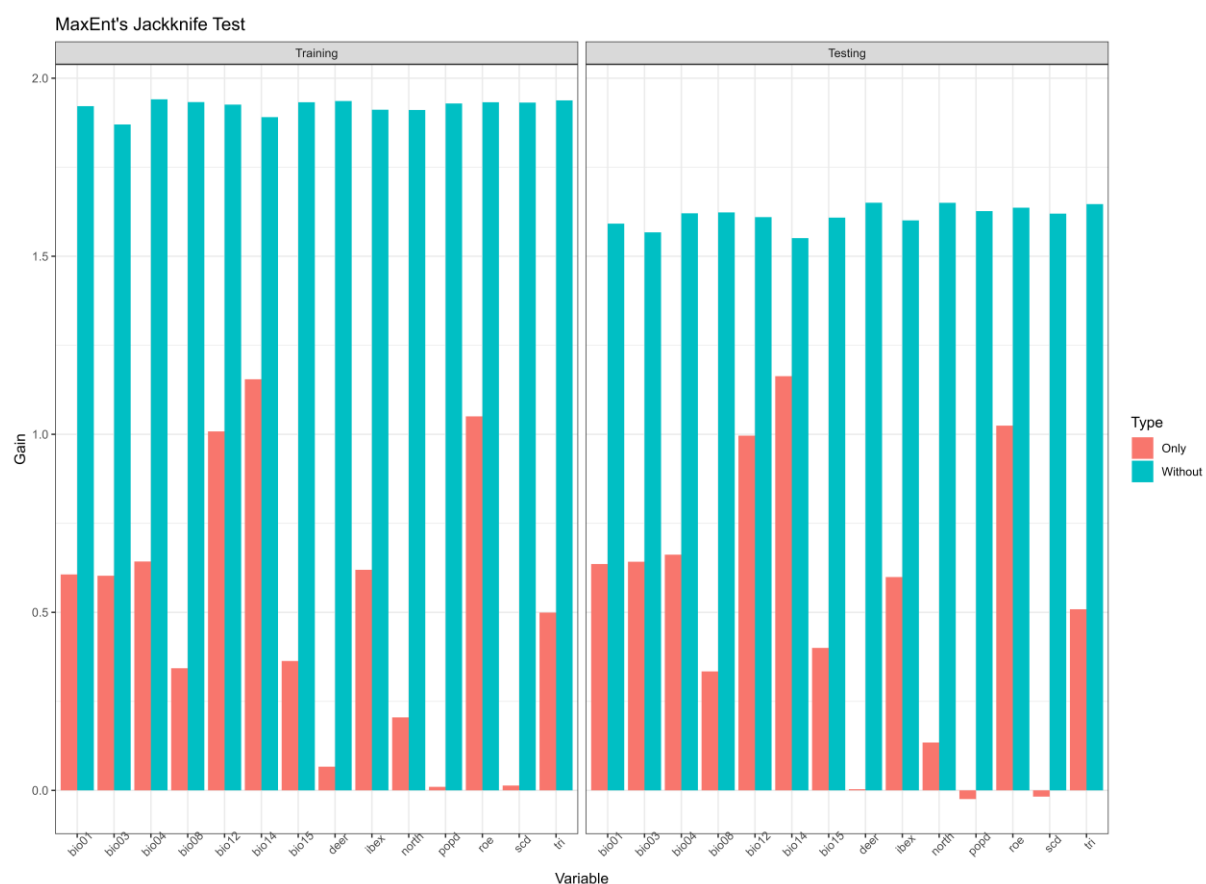


Figure A.21 – Jackknife test of the variables used in the Eurasian lynx distribution model (MaxEnt).

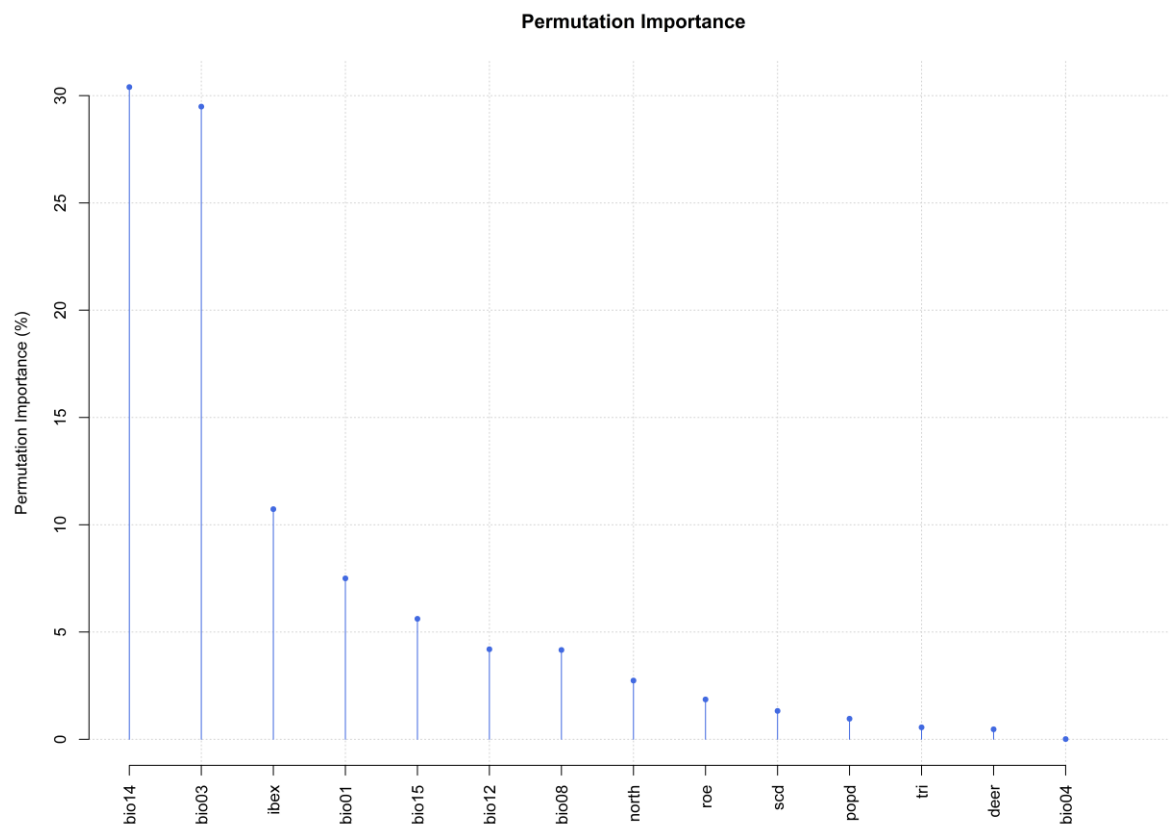


Figure A.22 – Permutation importance of the variables used in the Eurasian lynx distribution model (MaxEnt).

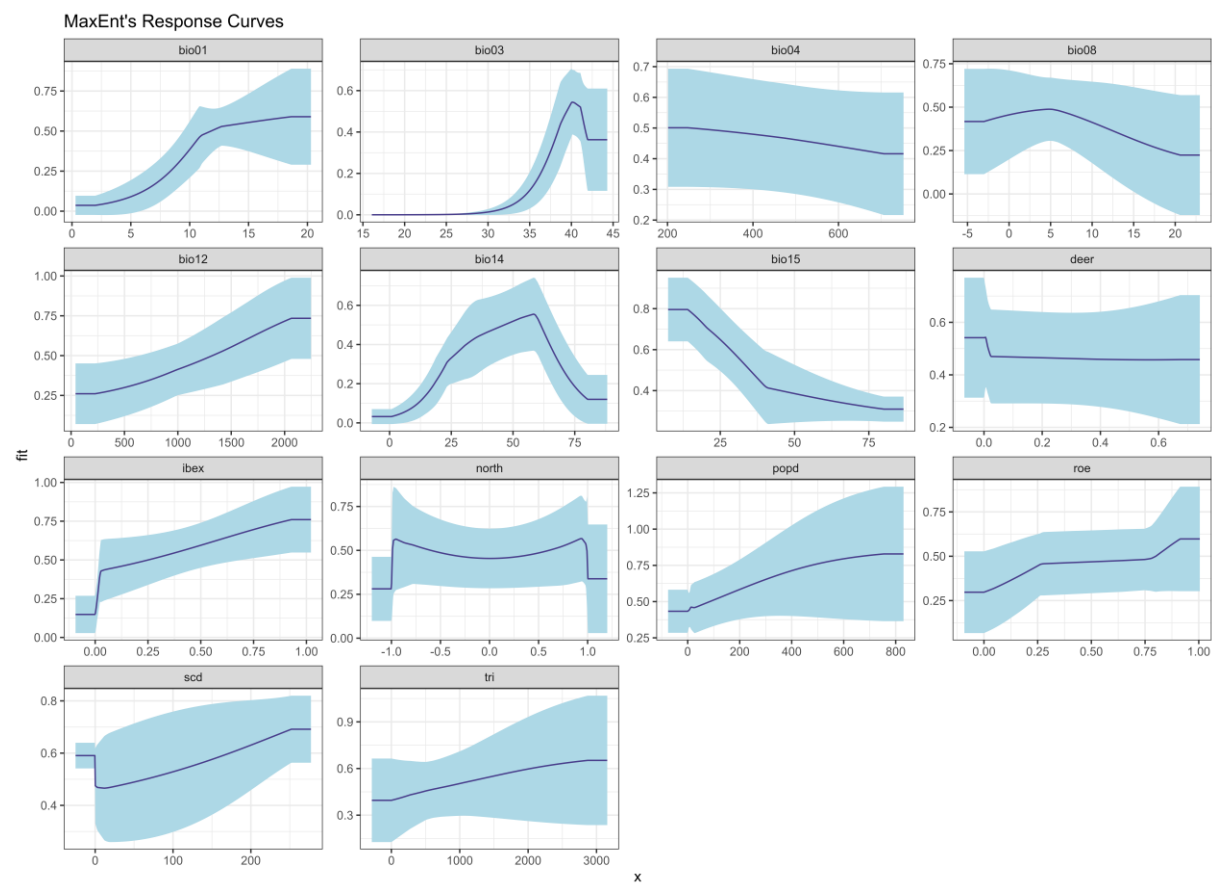


Figure A.23 – Eurasian lynx MaxEnt's variables response curves.

Table A.14 – Performance metrics of the five cross-validation sets in Eurasian lynx distribution model (MaxEnt approach).

| Fold    | Set   | Sensitivity | Specificity | CCR         | TSS         | AUC-ROC     | AUC-PR      | Boyce       |
|---------|-------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 1       | train | 0.959183673 | 0.855144033 | 0.856182522 | 0.814327706 | 0.959599395 | 0.247994145 | 0.945345223 |
|         | test  | 0.833333333 | 0.879012346 | 0.878565607 | 0.712345679 | 0.933196159 | 0.14629625  | 0.564914476 |
| 2       | train | 0.959183673 | 0.836831276 | 0.838052557 | 0.796014949 | 0.95713026  | 0.259563352 | 0.96379151  |
|         | test  | 1.000000000 | 0.818106996 | 0.819885901 | 0.818106996 | 0.945884774 | 0.093138242 | 0.510863983 |
| 3       | train | 0.979166667 | 0.844032922 | 0.845354523 | 0.823199588 | 0.960339506 | 0.261859293 | 0.822782836 |
|         | test  | 0.846153846 | 0.839506173 | 0.839576547 | 0.685660019 | 0.932858500 | 0.117777144 | 0.859392873 |
| 4       | train | 0.938775510 | 0.862139918 | 0.862904869 | 0.800915428 | 0.956573864 | 0.201161031 | 0.966446538 |
|         | test  | 0.916666667 | 0.861728395 | 0.862265689 | 0.778395062 | 0.952434842 | 0.115069056 | 0.522112177 |
| 5       | train | 1.000000000 | 0.800823045 | 0.802811163 | 0.800823045 | 0.964718233 | 0.241334739 | 0.940941729 |
|         | test  | 0.916666667 | 0.786831276 | 0.788101059 | 0.703497942 | 0.904869684 | 0.124572253 | 0.835592533 |
| Average | train | 0.967261905 | 0.839794239 | 0.841061127 | 0.807056143 | 0.959672252 | 0.242382512 | 0.927861567 |
|         | test  | 0.902564103 | 0.837037037 | 0.837678961 | 0.73960114  | 0.933848792 | 0.119370589 | 0.658575208 |

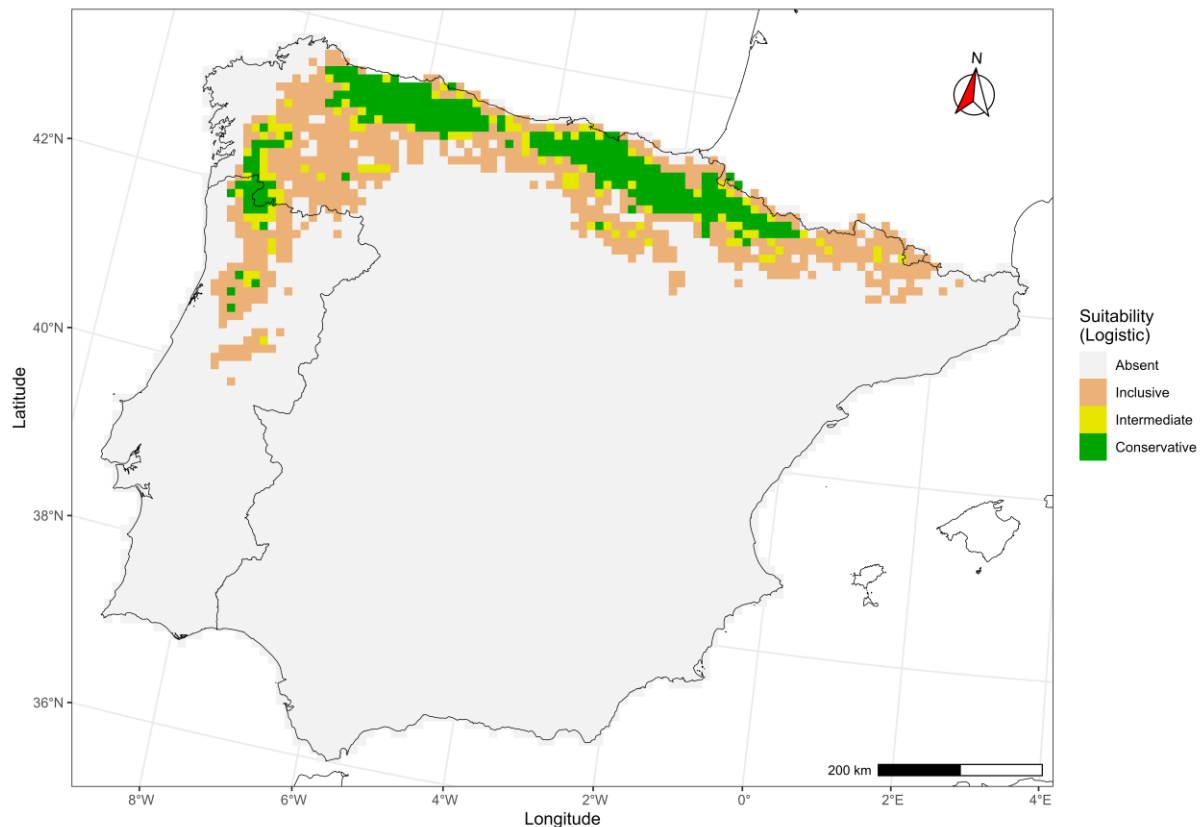


Figure A.24 – Thresholded output of the MaxEnt approach for predicting the Eurasian lynx's distribution within the Iberian Peninsula. Conservative estimates suggest that an area of 26 200 km<sup>2</sup> would have been suitable for the lynx in the Iberian Peninsula; intermediate estimates suggest that an area of 37 400 km<sup>2</sup> would have been suitable for the lynx in the Iberian Peninsula; and inclusive estimates suggest an area of 94 400 km<sup>2</sup> would have been suitable for the lynx in the Iberian Peninsula.

#### 7.9.4. Model Consensus

Table A.15 – Pearson's Correlation between the Eurasian lynx distribution models' outputs.

|        | GLM       | GAM       | MaxEnt    |
|--------|-----------|-----------|-----------|
| GLM    | 1.0000000 | 0.9385107 | 0.8798953 |
| GAM    | 0.9385107 | 1.0000000 | 0.9085268 |
| MaxEnt | 0.8798953 | 0.9085268 | 1.0000000 |

#### 7.9.5. References

- Barbosa, A. M. (2015). fuzzySim: Applying fuzzy logic to binary similarity indices in ecology. *Methods in Ecology and Evolution*, 6(7), 853–858. <https://doi.org/10.1111/2041-210X.12372>
- Kramer-Schadt, S., Niedballa, J., Pilgrim, J. D., Schröder, B., Lindenborn, J., Reinfelder, V., Stillfried, M., Heckmann, I., Scharf, A. K., Augeri, D. M., Cheyne, S. M., Hearn, A. J., Ross, J., Macdonald, D. W., Mathai, J., Eaton, J., Marshall, A. J., Semiadi, G., Rustam, R., ... Wilting, A. (2013). The importance of correcting for sampling bias in MaxEnt species distribution models. *Diversity and Distributions*, 19(11), 1366–1379. <https://doi.org/10.1111/ddi.12096>
- Phillips, S. J., Anderson, R. P., & Schapire, R. E. (2006). Maximum entropy modeling of species geographic distributions. *Ecological Modelling*, 190(3–4), 231–259. <https://doi.org/10.1016/j.ecolmodel.2005.03.026>

Syfert, M. M., Smith, M. J., & Coomes, D. A. (2013). The Effects of Sampling Bias and Model Complexity on the Predictive Performance of MaxEnt Species Distribution Models. *PLoS ONE*, 8(2), e55158. <https://doi.org/10.1371/journal.pone.0055158>

## 7.10. Biome Selection Model

Formula: predictions ~ Biome

Table A.16 – Biome Selection Model Summary.

| Coefficients:              | Estimate | Std. Error | z value | Pr(> z ) |
|----------------------------|----------|------------|---------|----------|
| (Intercept)                | -2.19261 | 0.03650    | -60.07  | <2e-16   |
| BiomeMediterranean         | -1.15439 | 0.05645    | -20.45  | <2e-16   |
| Deviance Explained ≈ 9.32% |          |            |         |          |