

Faunal and human biogeography during the Terminal Pleistocene

Appendices

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Volume II of II

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1 Appendix Chapter 2

1.0 Database

The basis of this thesis is the database that holds all the palaeontological and archaeological data used in the analyses. The database is essentially a spreadsheet with every row being a radiocarbon date.

1.0.1 Structure

The database is designed as a relational database in Access 2010. The relational database upholds several one-to-many relations which give the database the preferred flexibility. Figure 1 shows the relationships between the different tables. The site's main details such as location and type of site (archaeological, palaeontological, single find) are entered in the table Select-Site. Within each site there can be multiple layers, ranging from a single fictional layer when the stratigraphy is unknown, to multiple layers per site. Each layer holds information on the stratigraphy and disturbance. The radiocarbon dates, mammals and archaeology are often described in the literature as belonging to a stratigraphic layer, thus within one layer, multiple radiocarbon dates can occur. Radiocarbon dates finally have their own relationship with the auditing table that keeps track of whether a date is reliable enough to use or not. Key ID's maintain the database integrity, preventing double entries.

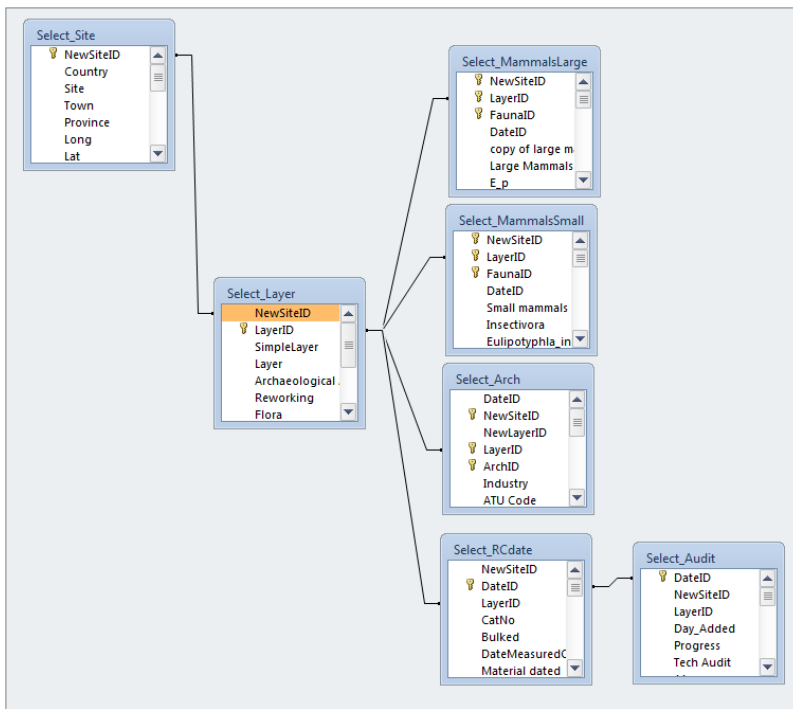


Figure 1 relationships within database

The forms guide the user through the structure. These is a search form, a data review form and a data entry form, print screens are shown below. The search form (Figure 2) enables the user to find the desired sites or radiocarbon dates. The data entry (Figure 3) form allows the user to change, add and remove data. The form maintains the structural integrity of the database and helps the user fill in the data as needed. The data review form (Figure 4) quickly shows the selected date, however, data entry is not possible in this form to maintain a sound structure of the database.

Frm_Search

Search Form

Search a site or other information:

Country	DateID	Date range
Site: Wesse	SiteID	From
Layer	CatNo	To

Number of records 11

Select a record:

NewSiteID	Country	Site	LayerID	Layer	CatNo	DateID	RCDate
10219	Belgium	Trou Al'Wesse	9107	4	Beta-224154	109398	16660
10219	Belgium	Trou Al'Wesse	8947	base couche 4B	LV-1751	112908	6650
10219	Belgium	Trou Al'Wesse	8915	12(base)/14	LV-1752	112907	5950
10219	Belgium	Trou Al'Wesse	8915	12(base)/14	Beta-224155	109185	32040
10219	Belgium	Trou Al'Wesse	5436	L5 / Ch17 / F507 / -758 cm	OxA-7497 (Lyon-)	105435	41100
10219	Belgium	Trou Al'Wesse	5435	L6 / Ch15 / F480 / -543 -647 cm	Ly-212	112906	32325
10219	Belgium	Trou Al'Wesse	5435	L6 / Ch15 / F480 / -543 -647 cm	OxA-7634 (Lyon-)	105434	36500
10219	Belgium	Trou Al'Wesse	5434	? (old (1906) excavation, backdirt)	OxA-19969	109397	33650
10219	Belgium	Trou Al'Wesse	5434	? (old (1906) excavation, backdirt)	OxA-19977	109396	48000
10219	Belgium	Trou Al'Wesse	5434	? (old (1906) excavation, backdirt)	OxA-7496 (Lyon-)	105433	30750
10219	Belgium	Trou Al'Wesse	5433	Associated Aurignacian	Lyon-212 (OxA)	105432	32325

Selected:

SiteID: 10219	Country: Belgium	CatNo: Beta-224154
LayerID: 9107	Site: Trou Al'Wesse	RCDate: 16660
DateID: 109398	Layer: 4	

[Go to site](#)

Record: 1 of 11 [Filtered](#) [Search](#)

Figure 2 Search form in the database. The top section allows for several search parameters to be filled in. The middle section shows the results that are found according to the search parameters. The lower section shows the selected radiocarbon date.

Frm_Main

SiteID: 10219 Site: Trou Al'Wesse Country: Belgium Longitude: 5.294 Latitude: 50.421 Site Type: cave

Region Stewart: Northern region Region Davies: Meters above sea level

Max SiteID: 30308

NewSiteID: 10219 LayerID: 5434 SimpleLayer: Layer: ? (old (1906) excavation, backdirt)

Archaeological Association: Reworking: Remarks: Day Added: Max Layer ID: 12291

Radiocarbon Date Large Mammals Small Mammals Archaeology Literature

DateID: 109397 Max DateID: 118877 LayerID: 5434 SiteID: 10219

CatNo: OxA-19969 Remarks: Sample code: Lab: OxA Pretreatment: Ultrafiltration

Year Dated: 2009 Technique: AMS C14 Duplicate?: Technique Details: Problems:

14C Date: 33650 Min_Max: mgUsed: %Carbon: CN: SD +: 550 SD Remarks: mgYield: d13C: F14C: SD -: %Yield: 15N: F14C+:

Bulked: Material dated: bone point HumMod: Artefact Code_Species Dated: MatCat: Bone Species dated: MatMod: bone artefact OldWoodEffect: Association: Layer:

DateID: 109397 SiteID: 10219 LayerID: Verdict: Species: Humans: Layer: Explanation: Identified problems:

Record: 1 of 3 [No Filter](#) [Search](#)

Record: 1 of 7 [No Filter](#) [Search](#)

Record: 1 of 1 [Filtered](#) [Search](#)

Figure 3 Data entry form.

Figure 4 Data view form.

1.0.2 Data collection

1.0.2.1 Stages of collection

Data collection consists of 4 phases. The first phase was merging the two flat databases from the Stage 3 project into one database (van Andel and Davies 2003). After that the S2AGES database was incorporated into the database (Gamble et al. 2005). This required a lot of cross-checking, for many radiocarbon dates already existed in the Stage 3 database, but often with different spelling.

The second phase required gaining access to the INQUA database and incorporating it into the current database (Vermeersch 2015). The spelling of site names, double entries of radiocarbon dates and typographic errors as well as a different relational structure meant it was a largely manual chore to incorporate this database. The information registered in the INQUA database is highly variable in quality with sometimes only the bare basics mentioned. This has been corrected with a literature search.

Since the INQUA database version 18 is slightly older, it only holds information up to 2011. It was therefore necessary to update my database to 2015. During this third phase a list of 85 journals was compiled of which the last three years were checked by hand, issue by issue. From these journals, 381 articles were extracted that are of use

for the database. The information of the articles has been typed into the database. With the conclusion of the third phase, all available sites and radiocarbon dates are present in the database, with a total of 3396 sites and 15308 associated absolute dates. The fourth phase updated the database with associated faunal information that has been published in journal articles and grey literature since 2005 (the end of the Stage Three database). At present there are 1692 layers with large mammal information and 682 layers with small mammal information in 868 archaeological sites.

1.0.2.2 Collected information

Each table is designed to collect relevant data for the subject. The information is added via forms and stored in table columns, with the columns being a combination of entry fields designed by previous databases and fields created for this project. For information on the actual site, the site name, location, type and excavations is detailed. Redating of a site is also recorded, if so, older dates have to be used with caution. For the layers, a description, archaeological association and information on possible reworking are documented. Most information is recorded for the dates themselves: the actual date, the lab and methods used to produce it, the type of sample and its association Minimum number of individuals (MNI) and Number of Identified Specimens was recorded when presented in the literature.

The collected data has some inconsistencies due to the way the data has been published and collected. First of all is the degree of detail that has been collected for the different databases. The Stage Three Databases were very advanced for their time, but little information on the stratigraphic layers and reworking has been noted down. The INQUA database, a relational database based on layers, has often very patchy data with little radiocarbon pretreatment information. Publications themselves often do not provide all the information requested (such as longitude/latitude which is sometimes estimated with Google maps). The identification of species may be incorrect (difficult to distinguish species such as aurochs and bison) or the association with the archaeology / stratigraphic layer is not elaborated on. These inconsistencies, if detected, have been noted in the database. Gaps in information, when come across during data collection, have been filled in.

However, problems remain with the data and need to be taken into account when analysing.

1.0.2.3 List of unfiltered taxa used in database.

Raw taxa in database, for research often lumped following Stewart 2003.

<i>Alces alces</i>	Muridae
<i>Cervus elaphus</i>	<i>Apodemus</i> sp.
<i>Rangifer tarandus</i>	<i>Apodemus flavicollis</i>
<i>Dama dama</i>	<i>Apodemus sylvaticus</i>
<i>Capreolus capreolus</i>	<i>Clethrionomys glareolus</i>
<i>Megaloceros giganteus</i>	<i>Clethrionomys rutilus</i>
<i>Bos</i> sp.	<i>Clethrionomys rufocanus</i>
<i>Bison</i> sp.	<i>Clethrionomys</i> sp.
<i>Bos/Bison</i>	<i>Pteromys</i> sp.
Bovidae	<i>Marmota primigenia</i>
<i>Rupicapra rupicapra</i>	<i>Marmota bobak</i>
<i>Capra</i> sp.	<i>Marmota marmota</i>
<i>Ovis</i> sp.	<i>Marmota</i> sp.
<i>Capra ibex</i>	<i>Castor fiber</i>
<i>Capra pyrenaica</i>	Arvicolinae
<i>Ovibos moschatus</i>	<i>Arvicola sapidus</i>
<i>Saiga tartarica</i>	<i>Arvicola terrestris</i>
<i>Sus scrofa</i>	<i>Arvicola</i> sp.
<i>Perissodactyla</i>	<i>Pliomys lenki</i>
<i>Equus hydruntinus</i>	<i>Pliomys</i> sp.
<i>Equus hemionus</i>	Genus <i>Microtus</i>
<i>Equus caballus</i>	<i>Microtus lusitanicus</i>
<i>Equus asinus</i>	<i>Microtus fatioi</i>
<i>Equus latipes</i>	<i>Microtus duodecimcostatus</i>
<i>Equus</i> sp.	<i>Microtus subterraneus</i>
<i>Stephanorhinus</i> sp.	<i>Microtus savii</i>
<i>Coelodonta antiquitatis</i>	<i>Ptericola (Pitymys)</i> sp.
Rhinocerotidae	<i>Microstus</i> sp.
Proboscidae	<i>Microtus brecciensis carbrera</i>
Elephantidae	<i>Microtus afghanus</i>
<i>Mammuthus primigenius</i>	<i>Microtus hyperboreus</i>
<i>Elephas</i> sp.	<i>Microtus arvalis</i>
Carnivora	<i>Microtus agrestis-arvalis</i>
<i>Panthera leo</i>	<i>Microtus agrestis</i>
<i>Panthera ls</i>	<i>Microtus gregalis</i>
<i>Felis sylvestris</i>	<i>Microtus nivalis</i>
<i>Lynx lynx</i>	<i>Microtus oeconomus-raticeps</i>
<i>Lynx pardinus</i>	<i>Dinaromys bogdanovi</i>
<i>Lynx</i> sp.	<i>Lemmus lemmus</i>
<i>Crocota crocuta</i>	<i>Lemmus</i> sp.
<i>Canis lupus</i>	<i>Dicrostonyx torquatus</i>
<i>Cuon</i> sp.	<i>Lagurus lagurus</i>
<i>Vulpes vulpes</i>	<i>Eolagurus luteus</i>
<i>Vulpez corzac</i>	<i>Hystrix cristata vinogradovi</i>
<i>Alopex lagopus</i>	<i>Allactaga</i> sp.
<i>Ursus arctos</i>	<i>Ellobius</i> sp.
<i>Ursus spelaea</i>	Sicistinae
<i>Ursus</i> sp.	<i>Sicista</i> sp
<i>Meles meles</i>	<i>Sicista subtilis</i>
<i>Mustela minuta</i>	<i>Sicista betulina</i>
<i>Mustela ermina</i>	<i>Lagomorpha</i>

<i>Mustela nivalis</i>	<i>Oryctolagus cuniculus</i>
<i>Mustela</i> sp.	<i>Lepus europaeus</i>
<i>Putorius putorius</i>	<i>Lepus</i> sp.
<i>Martes</i> sp.	<i>Lepus timidus</i>
<i>Gulo gulo</i>	<i>Lepus tolai</i>
<i>Lutra lutra</i>	<i>Ochotona pusilla</i>
Primates	Sciuridae
<i>Macaca sylvana</i>	<i>Sciurus vulgaris</i>
<i>Homo sapiens</i>	<i>Spermophilus major</i> <i>Citellus superciliosus</i>
<i>Homo neanderthalensis</i>	<i>Spermophilus</i> sp.
<i>Homo</i> sp.	Gliridae
<i>Eulipotyphla</i> indet	<i>Glis glis</i>
Soricidae indet	<i>Muscardinus avellanarius</i>
<i>Crocidura</i> sp. group	<i>Eliomys quercinus</i>
<i>Crocidura russula</i>	<i>Spermophilus pygmaeus</i>
<i>Sorex</i> sp.	<i>Allactaga jaculus</i>
<i>Sorex araneus</i> group	<i>Allactaga elater</i>
<i>Sorex minutus</i>	<i>Alactagulus</i> sp.
<i>Sorex minutissimus</i>	Pygeretmus
<i>Talpa</i> sp.	<i>Allocricetulus eversmanni</i>
<i>Talpa europea</i>	
<i>Erinaceus</i> sp.	
<i>Ericaneus europeanus</i>	
<i>Neomys</i> sp.	
<i>Desmana</i> sp.	
Chiroptera	
<i>Babaxrella barbastrellus</i>	
<i>Myotis myotis</i>	
<i>Plecotus auritus</i>	
<i>Miniopterus schreibersii</i>	
Rodentia	
Cricetinae	
<i>Cricetus</i> sp.	
<i>Cricetus cricetus</i>	
<i>Cricetulus migratorius</i>	
<i>Allocricetus bursae</i>	
<i>Mesocricetus</i> sp.	
<i>Myopus schisticolor</i>	
Spalacinae	
<i>Spalax</i> sp.	

1.1 Grotte des Romains

Level	Industry	Lab. Number	Result	Method/sample	Comments
III	Magdalenian [VI]	Ly-16	14,380±380	AMS: charcoal	problematic
III	Magdalenian [VI]	GrA-9709(Lyon-642)	12,690±60	Reindeer bone	
lib	Magdalenian	Ly-356	12,980±240	Bone[s]	
lib	Magdalenian	MC-1215	12,540±400	Shells	
lib	Magdalenian	GrA-9710(Lyon-643)	13,380±60	Reindeer bone	problematic
lib	Magdalenian	GrA-9710(Lyon-432)	12,830±60	AMS: reindeer bone	problematic
lib	Magdalenian	Ly-1307	10,280±630	AMS: charcoal	problematic
III	Magdalenian	Ly-1308	10770±410	charcoal	missing
		MC-1274			
		MC-1275			
		MC-1276			

Table above shows all radiocarbon dates as depicted in Pettit et al. (2003). There are multiple dates that are not completely right. Ly-16 is not produced by AMS, it has been made in 1970 – before the arrival of AMS, and furthermore the sample consists of charcoal fragments that were sifted from a great volume of sediments (Evin 1969, BANADORA and (Combiér 1977)). Finally, the sample provenance is unclear, the original datelist does not mention any provenance for Ly-16, the 1973 datelist agrees for level III, whilst the 1979 datelist stated Ly16 is from layer IIa.

The GrA-9710(Lyon-643) should have an age of 12,830±60 according to the Groningen database and BANADORA (consulted April 2016). Furthermore, the GrA-labcode indicates that the date was produced by AMS. The GrA-9710(Lyon-432) does not seem to exist. GrA has only dated 9710 once and the 1973 datelist and BANADORA refer to a different site for Lyon-432 (LY-432), namely Le Calvaire produced in 1971. GrA-9710/Ly-648 and GrA-9710/Ly-643 do feature in Maier (2015).

Ly-1307 is a conventional date, published in 1979 (very diluted sample) and thus not an AMS date. Ly-1308 is missing from Pettitt et al.'s overview, which is a conventionally produced charcoal date from layer III (also diluted). These two dates are considered too young by the laboratory and it has been suggested that there was downward migration of charcoal or contamination of the sample (Evin & Marechal, 1979). The

dates on gastropod shells (MC-1274, MC-1275 and MC-1276) are also missing from Pettit et al (2003).

2 Appendix Chapter 3

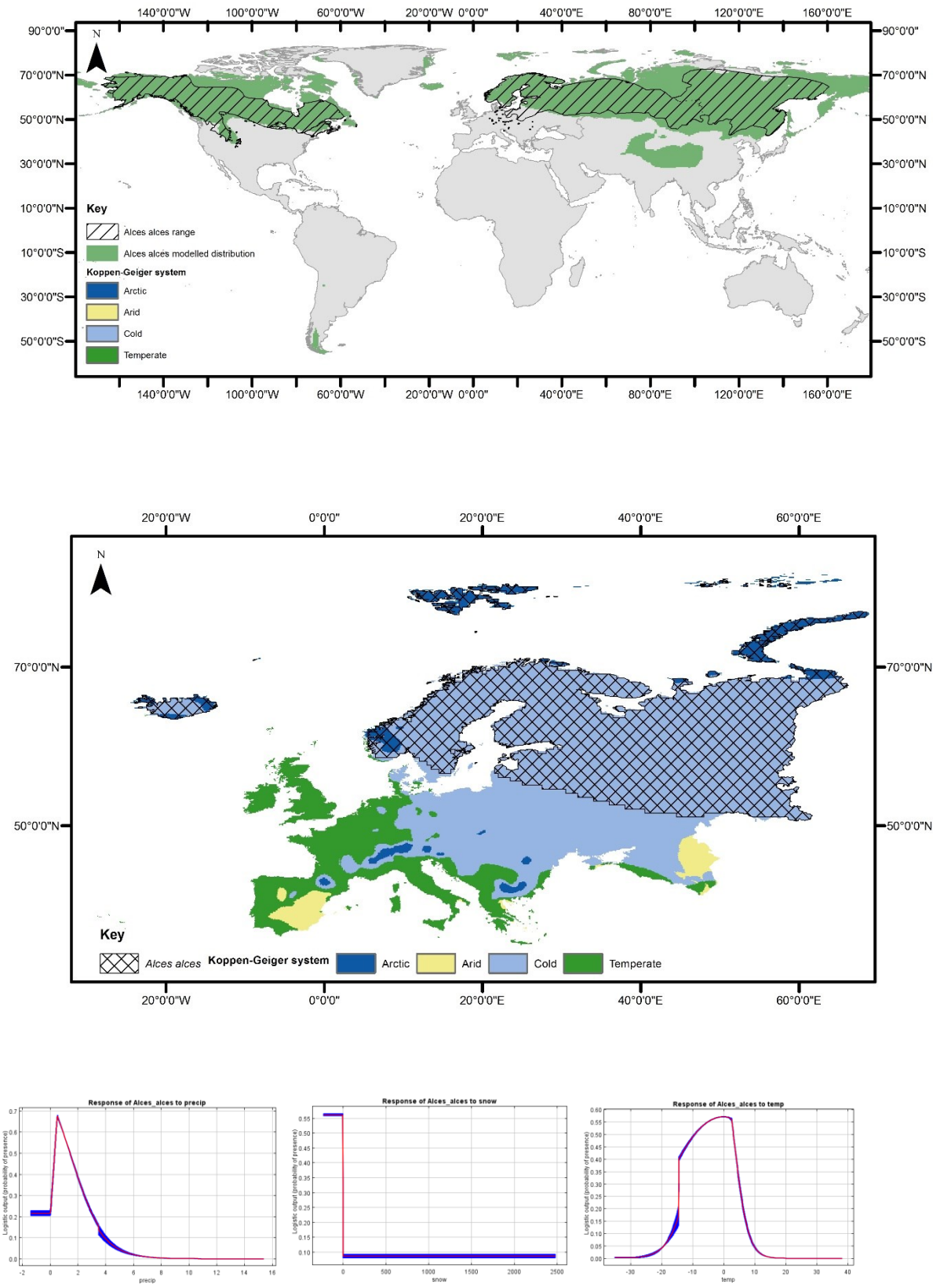
The appendix is ordered alphabetically, which each taxon on a separate page. Per page there are 5 figures.

The first figure is a world map with the taxa's range that was used to create the random points for the MaxEnt modelling (hatched) and modelled distribution (green) on it.

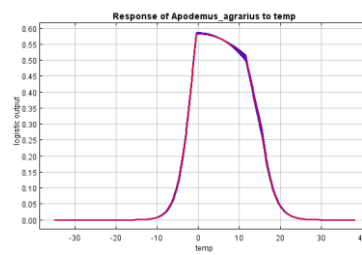
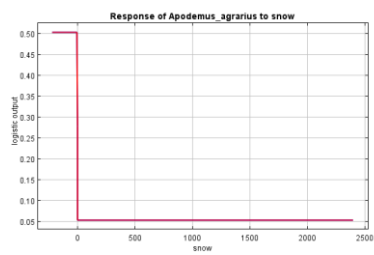
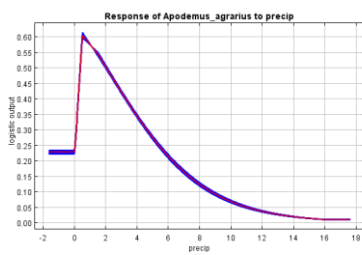
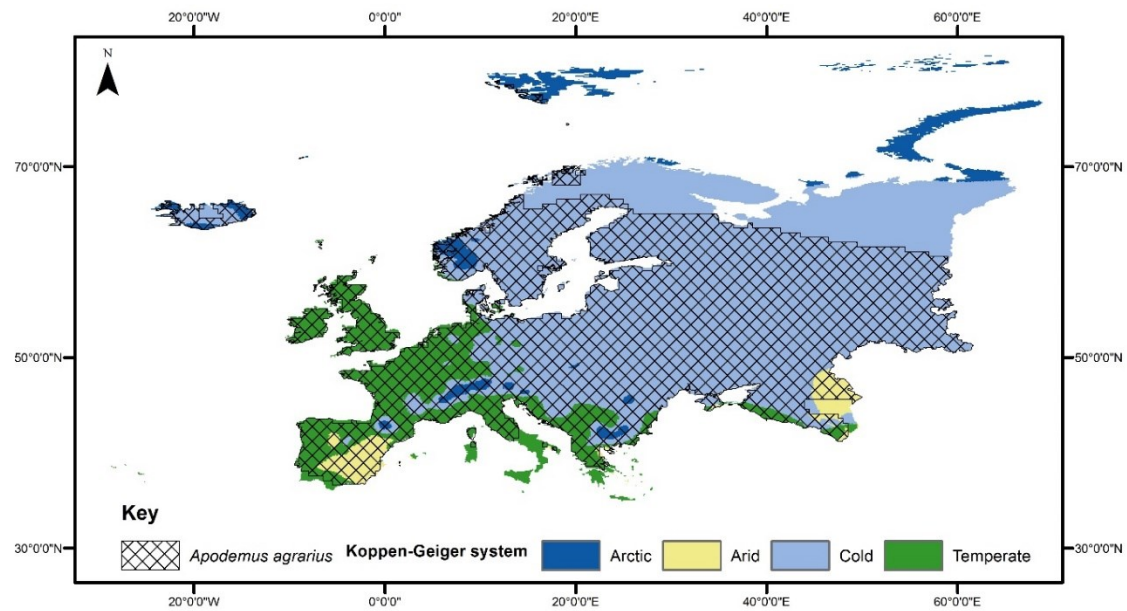
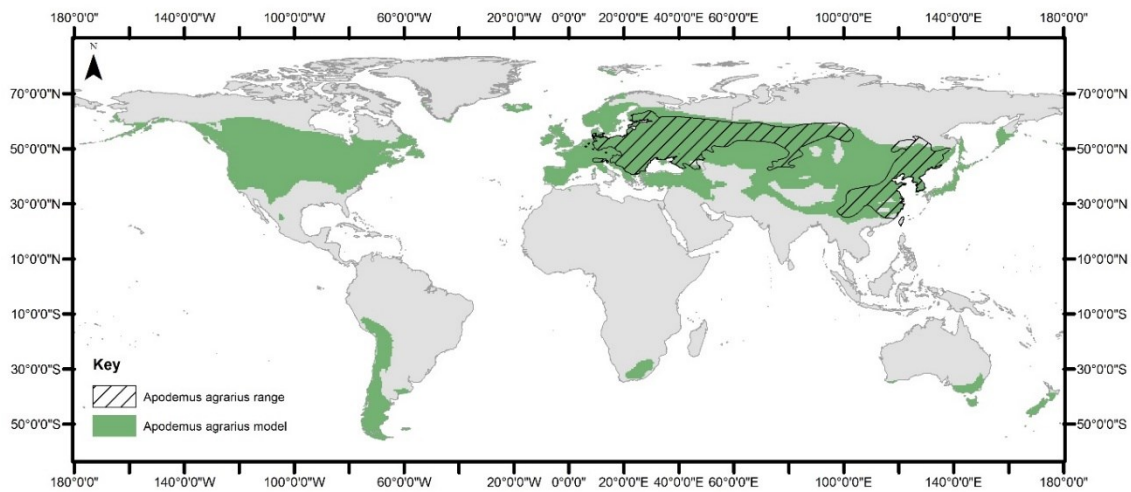
The second figure is the zoomed in map of Europe with the taxa's modelled distribution on it (crosshatched). The background shows the Köppen-Geiger climate categories.

The last three figures are graphs from the modelling output that show how the taxa responded to each variable. Precip= mean annual precipitation, snow = mean annual snow cover in mm, temp= mean annual temperature in °C.

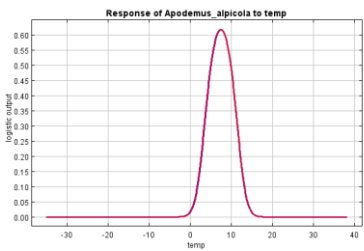
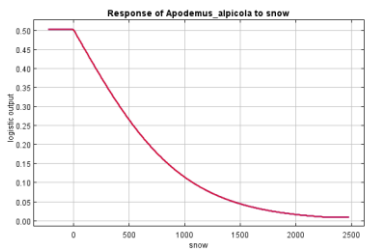
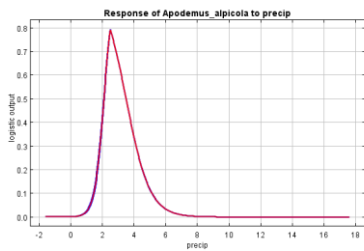
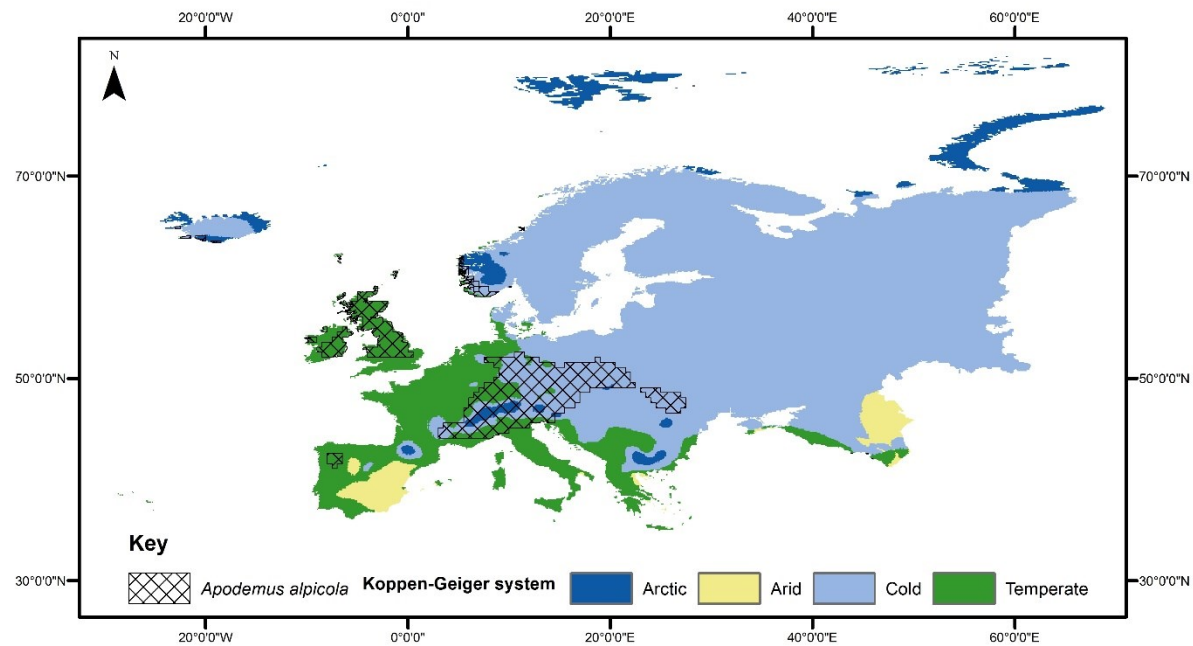
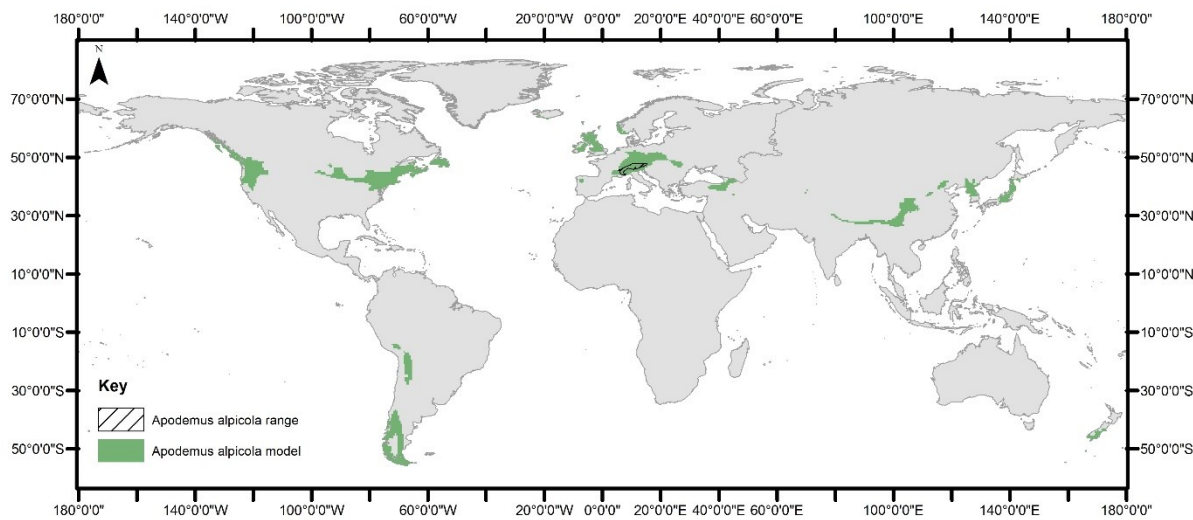
2.0 *Alces alces*



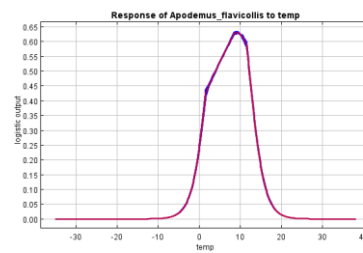
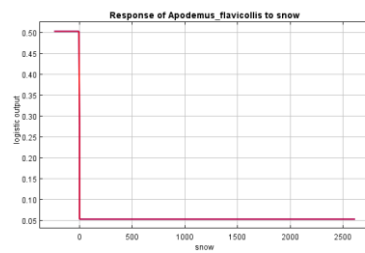
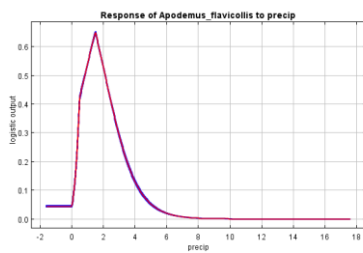
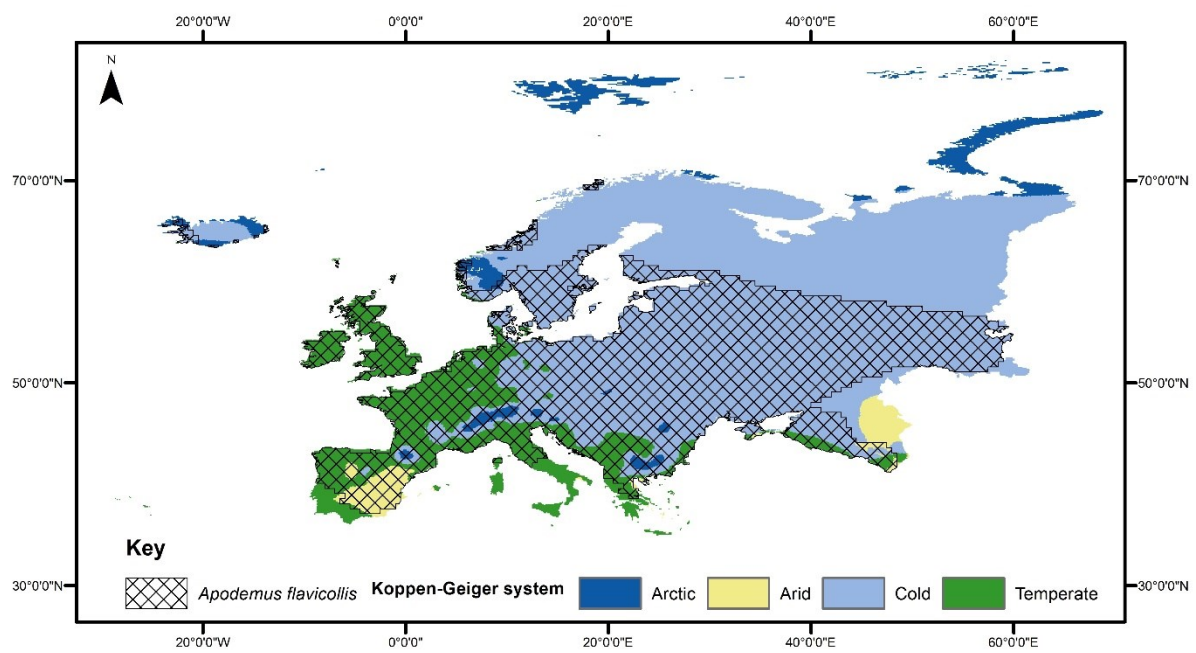
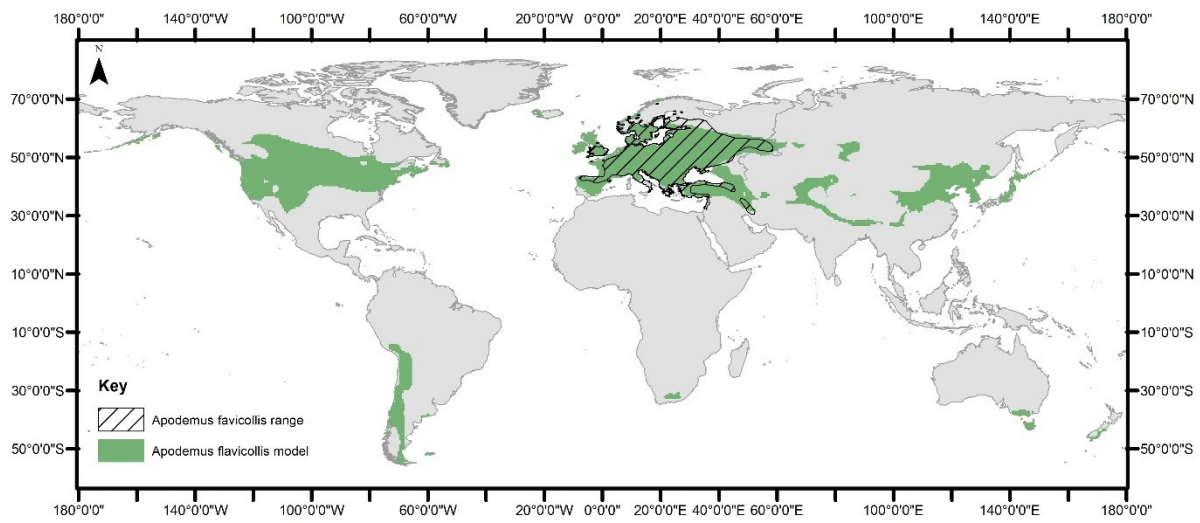
2.1 *Apodemus agrarius*

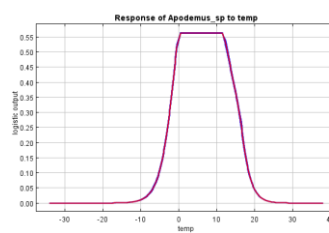
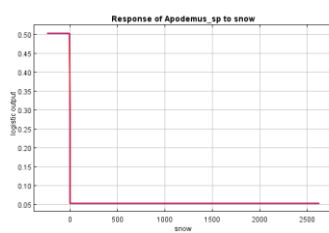
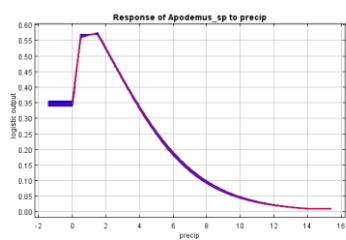
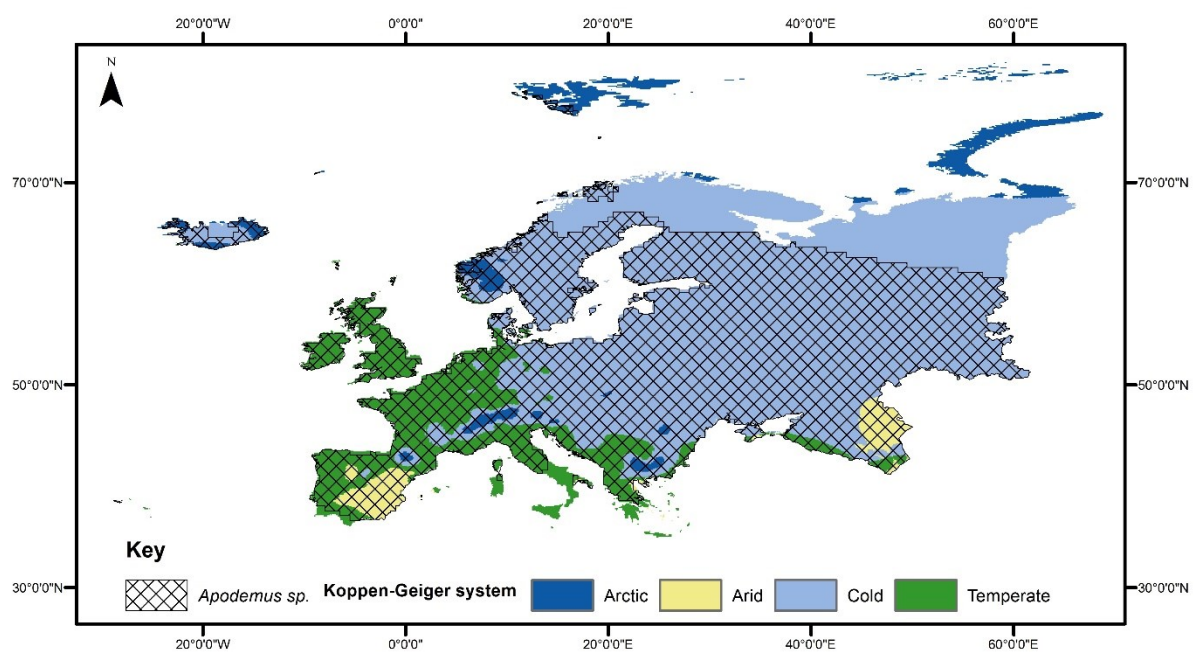
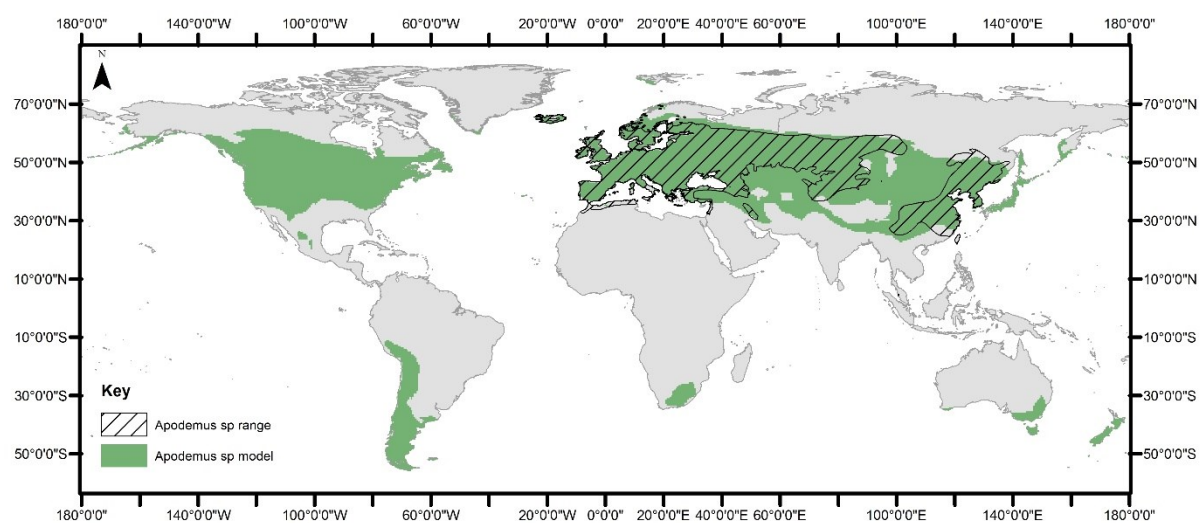


2.2 *Apodemus alpicola*

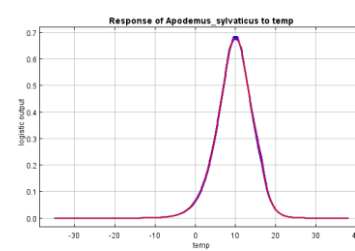
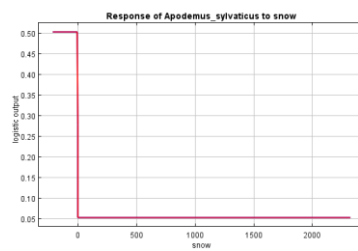
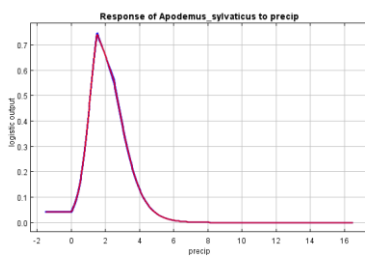
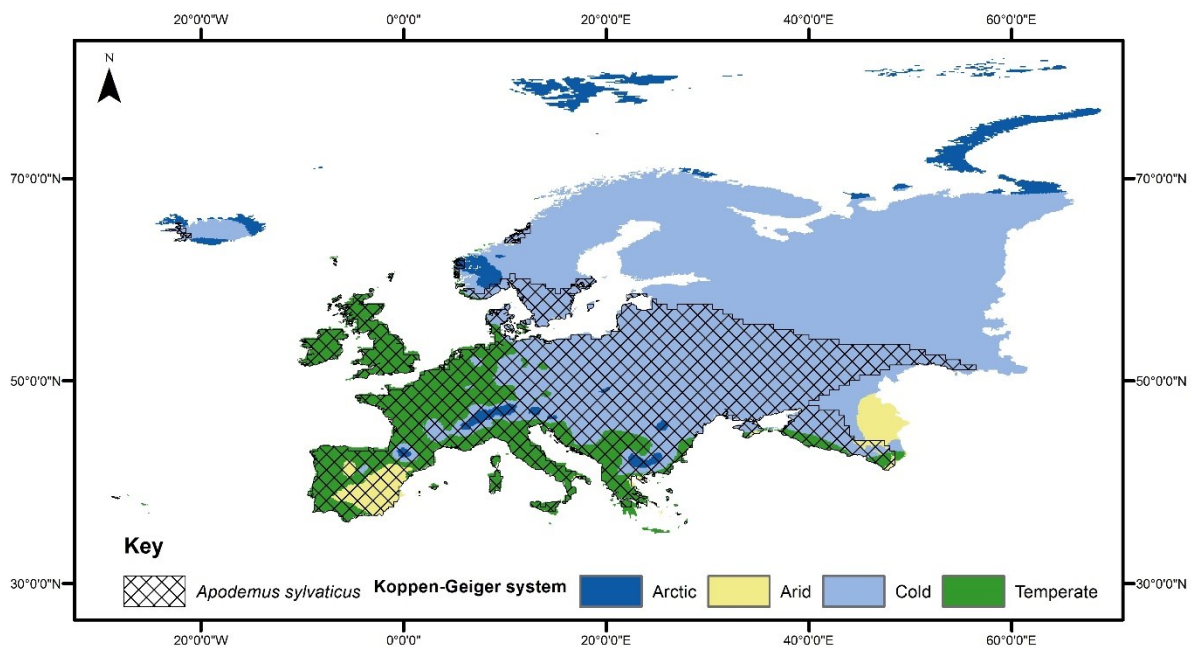
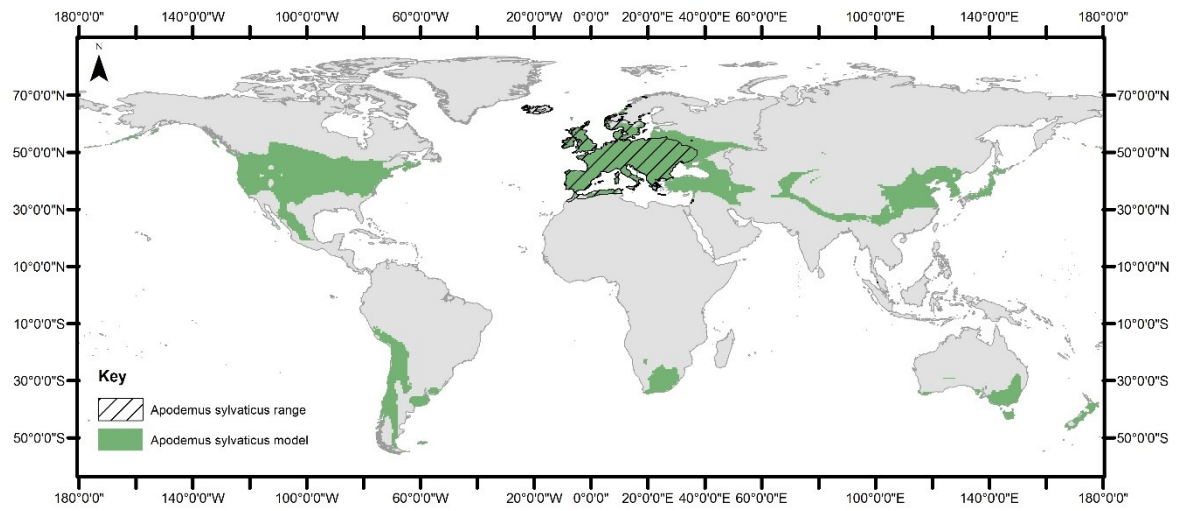


2.3 *Apodemus flavicollis*

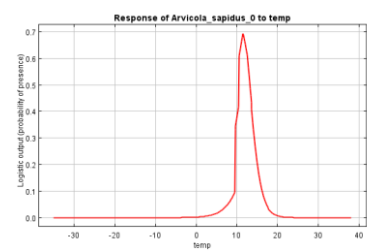
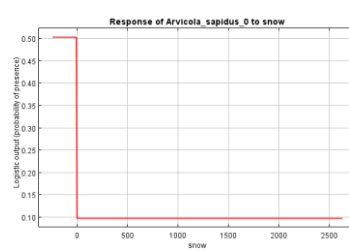
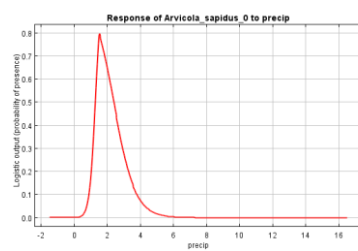
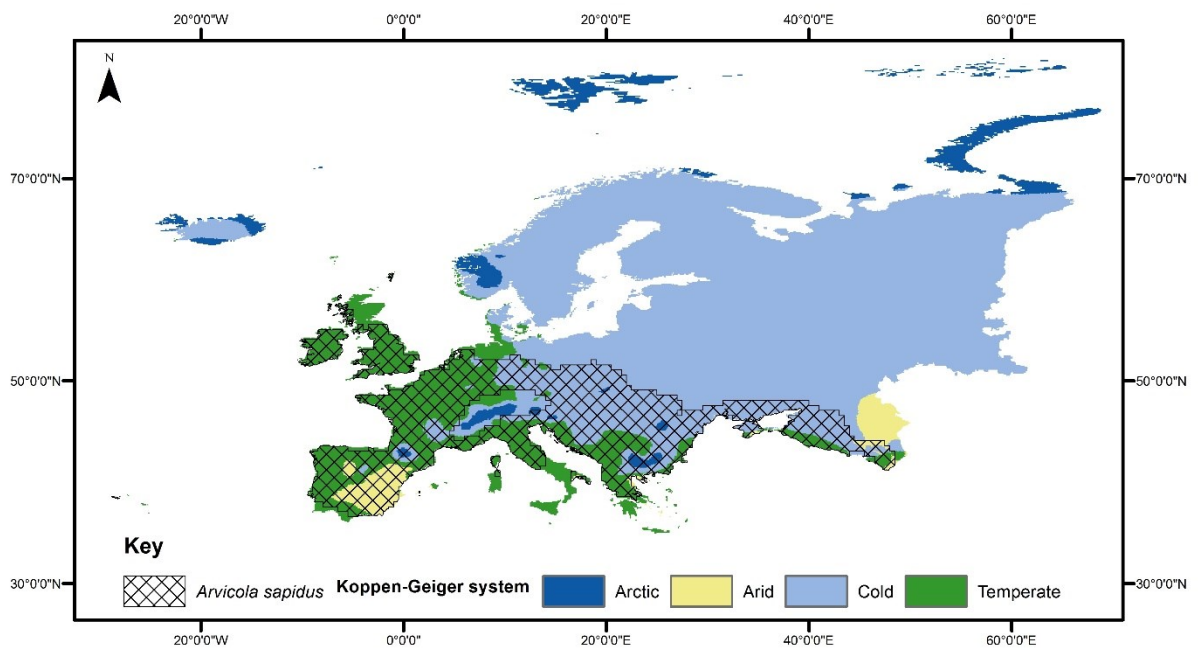
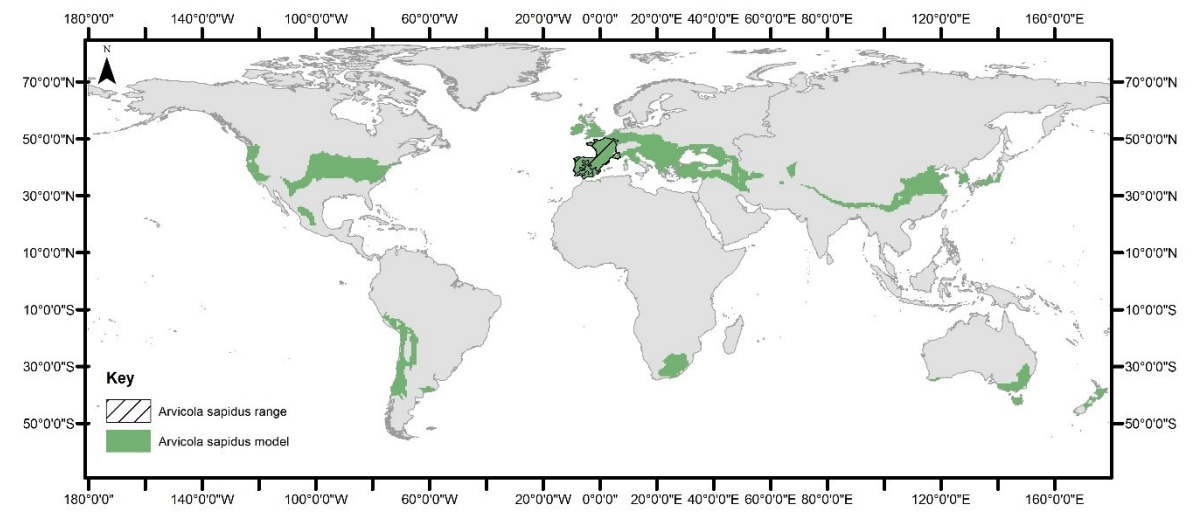


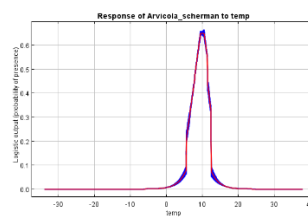
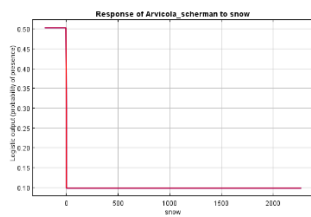
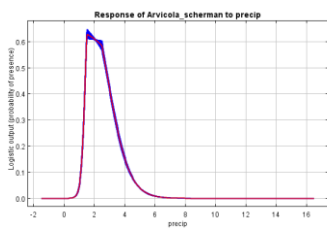
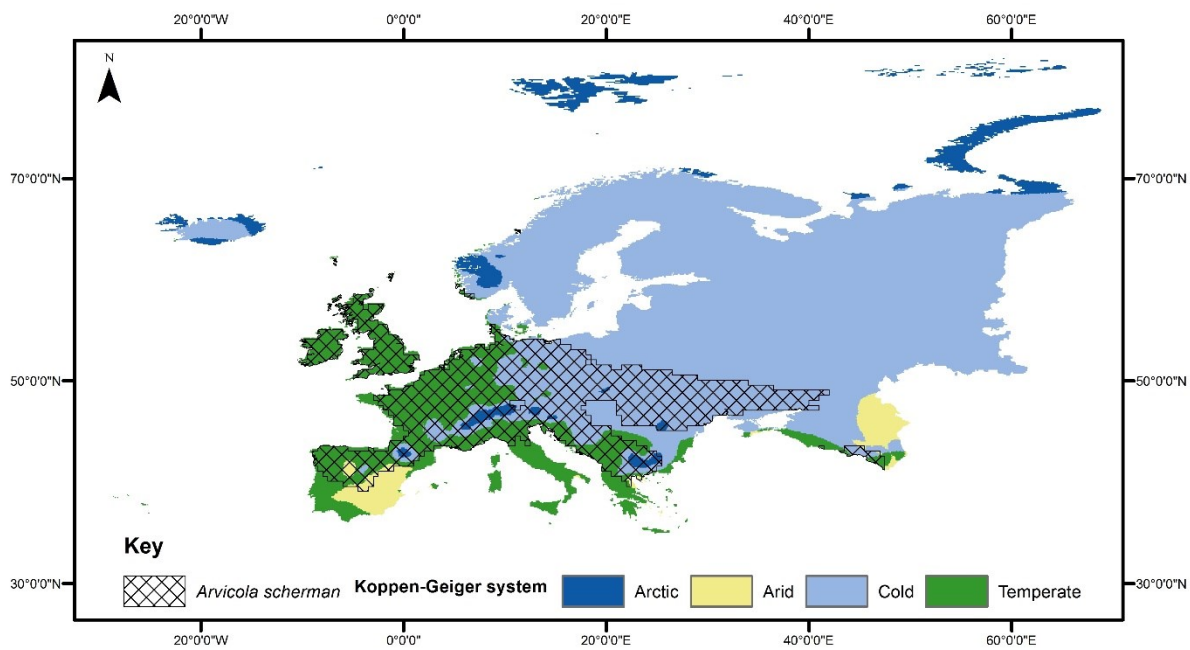
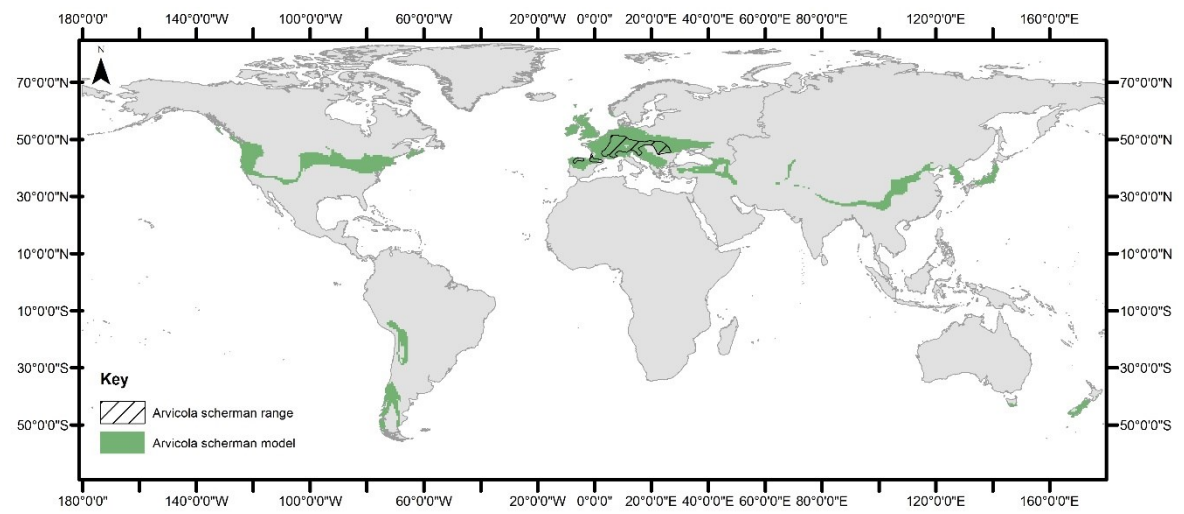
2.4 *Apodemus* sp.

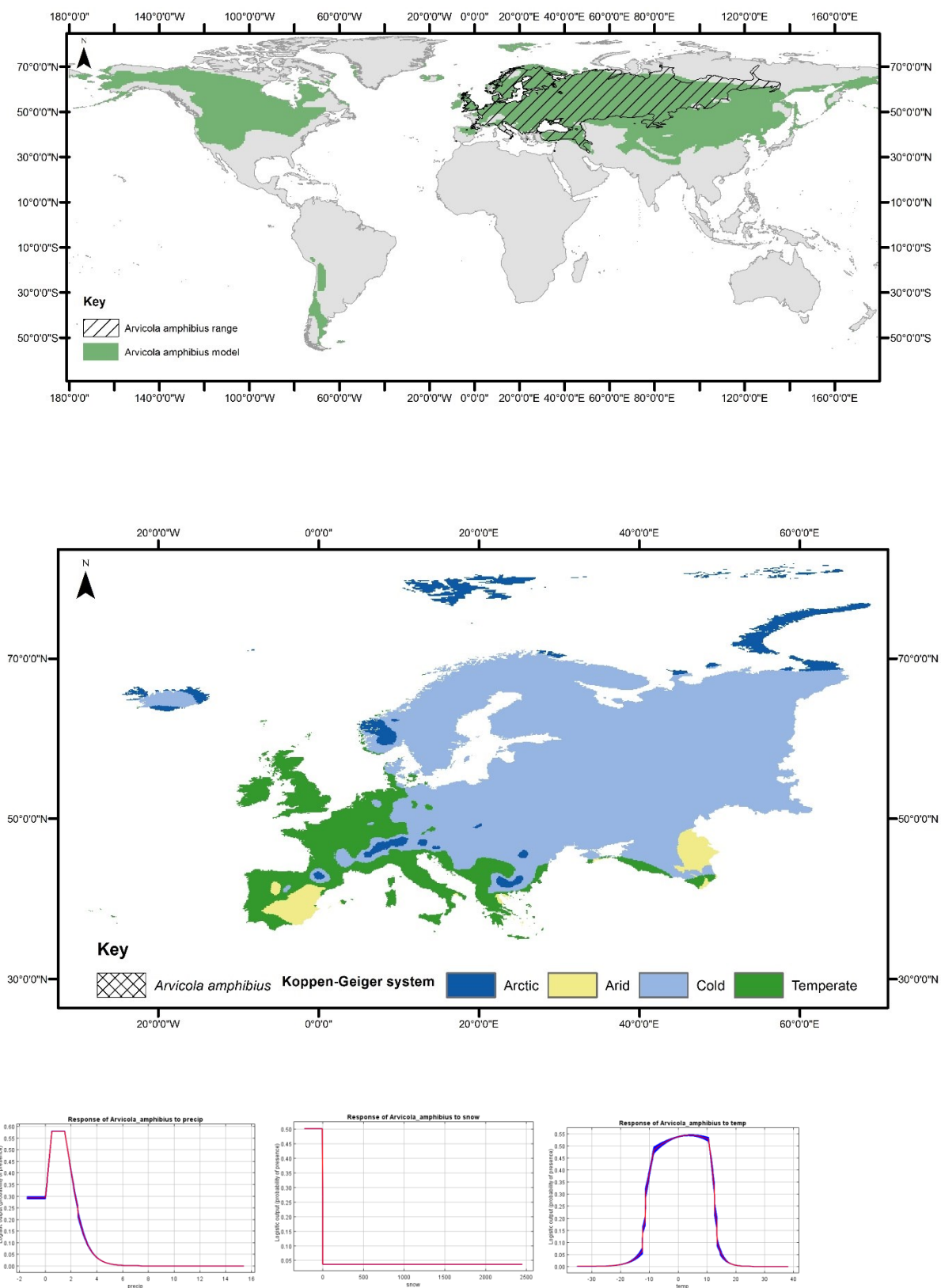
2.5 *Apodemus sylvaticus*



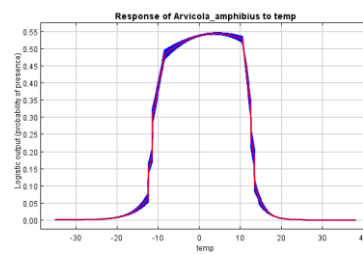
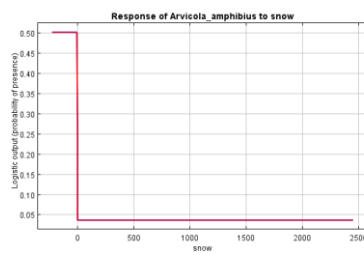
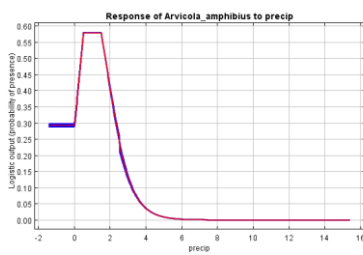
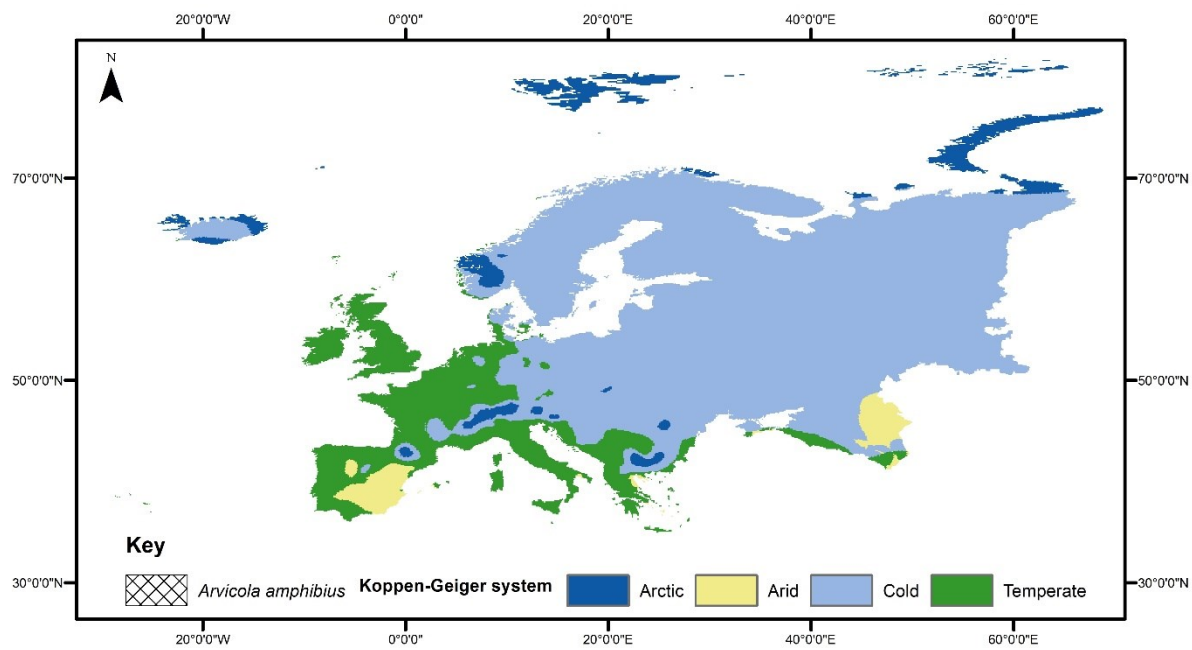
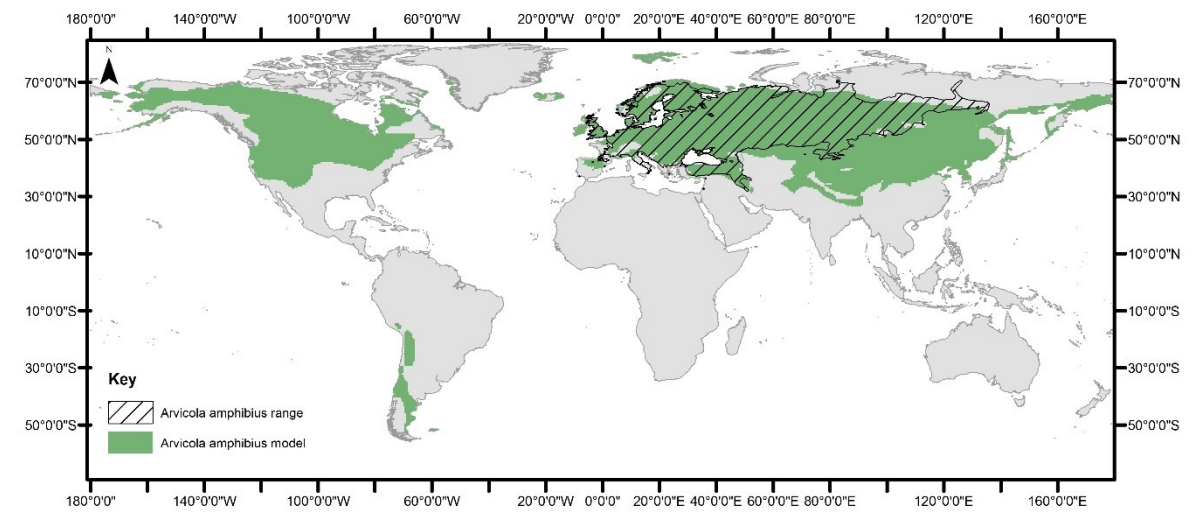
2.6 *Arvicola sapidus*



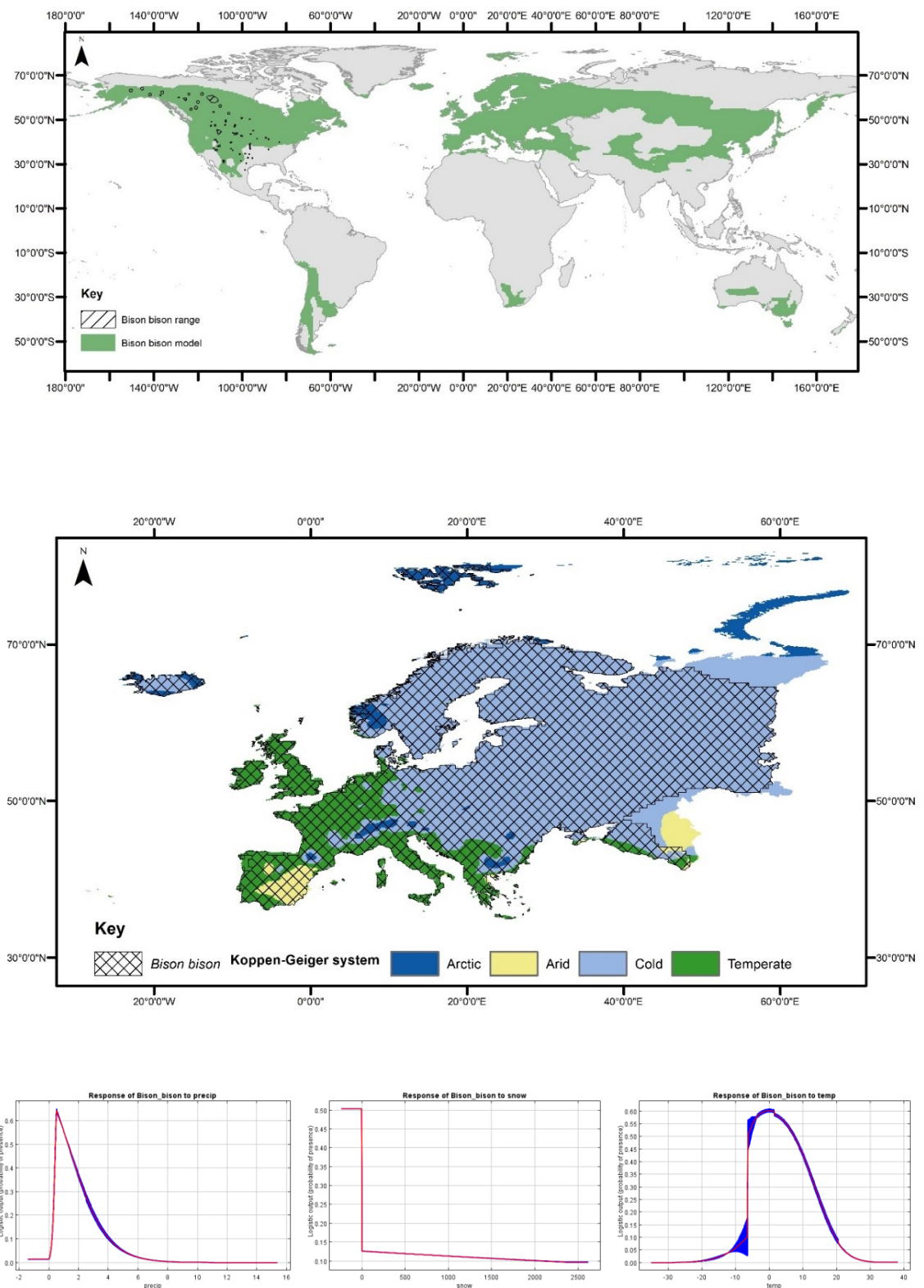
2.7 *Arvicola scherman*

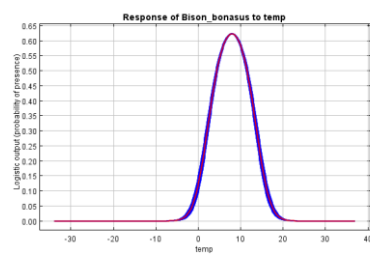
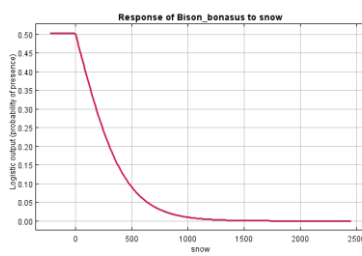
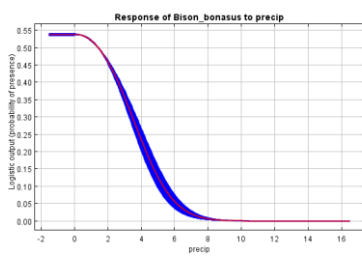
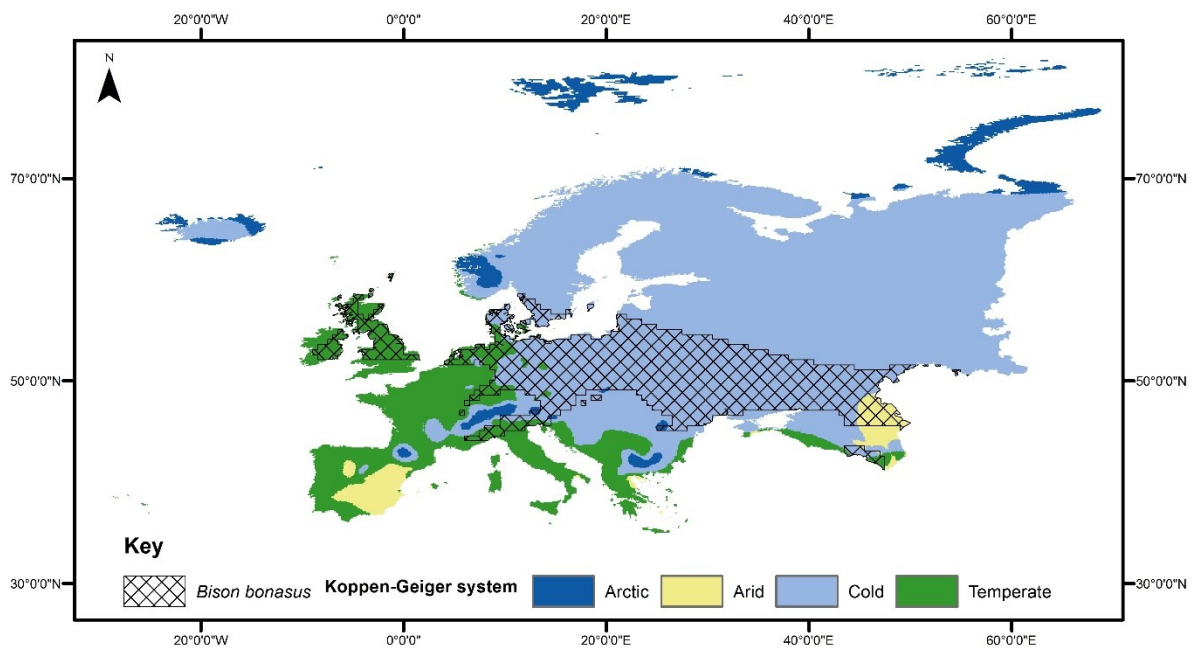
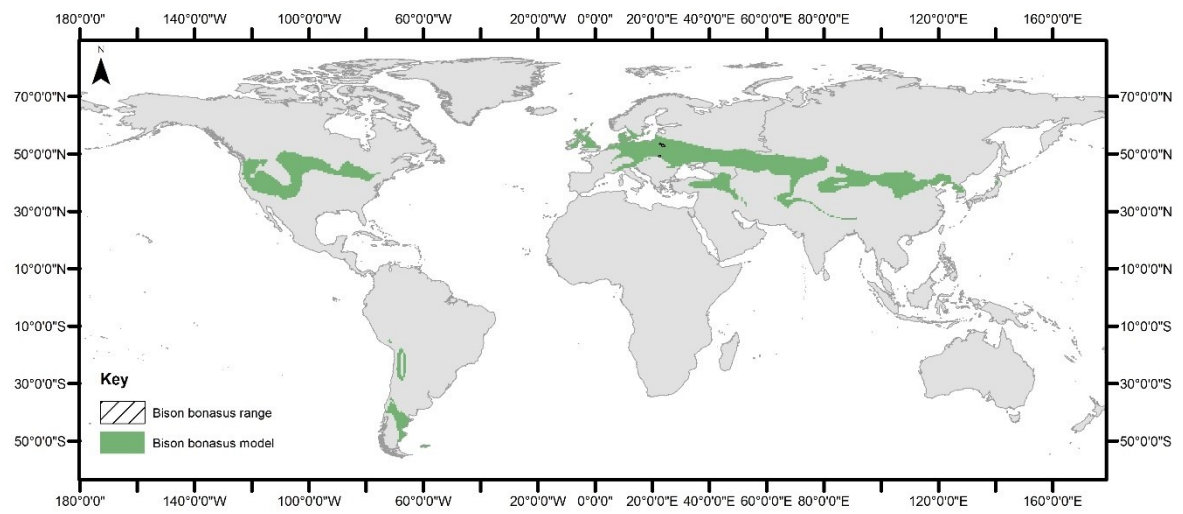
2.8 *Arvicola amphibius*

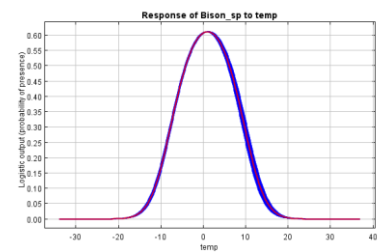
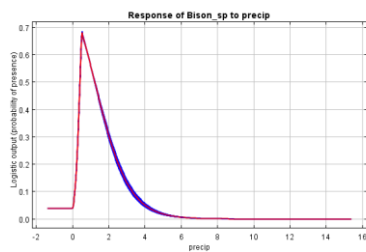
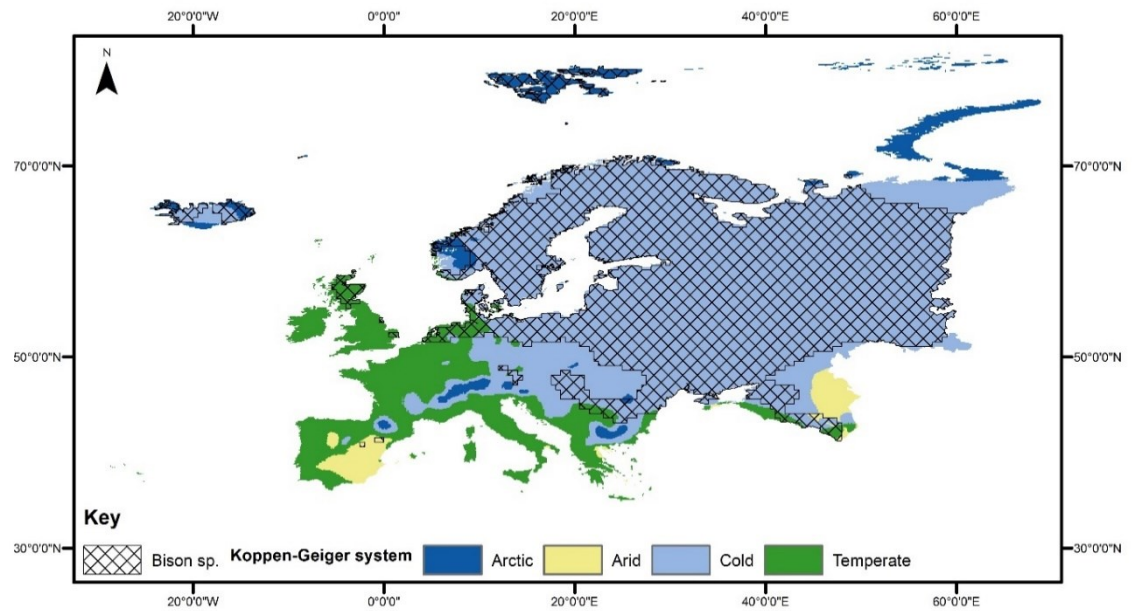
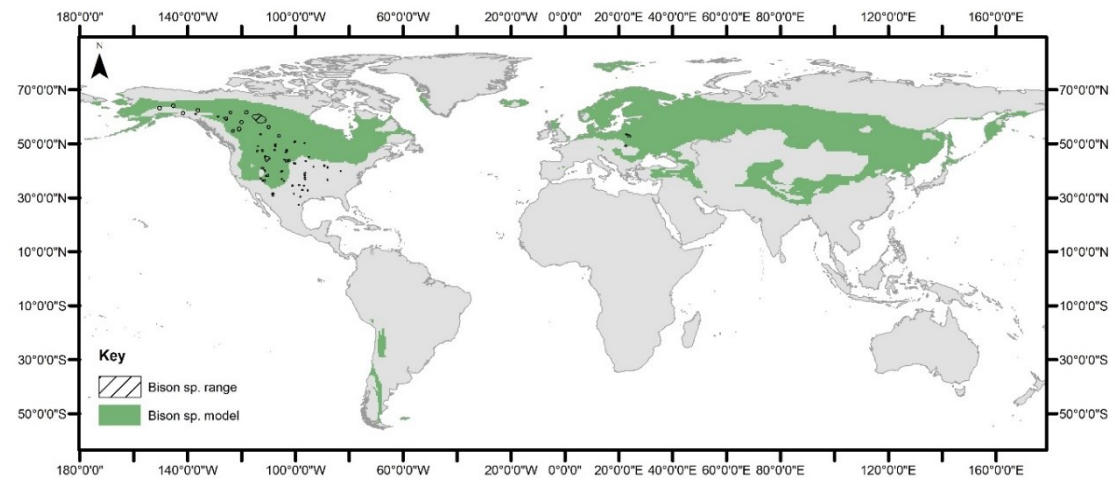
2.9 *Arvicola amphibius*

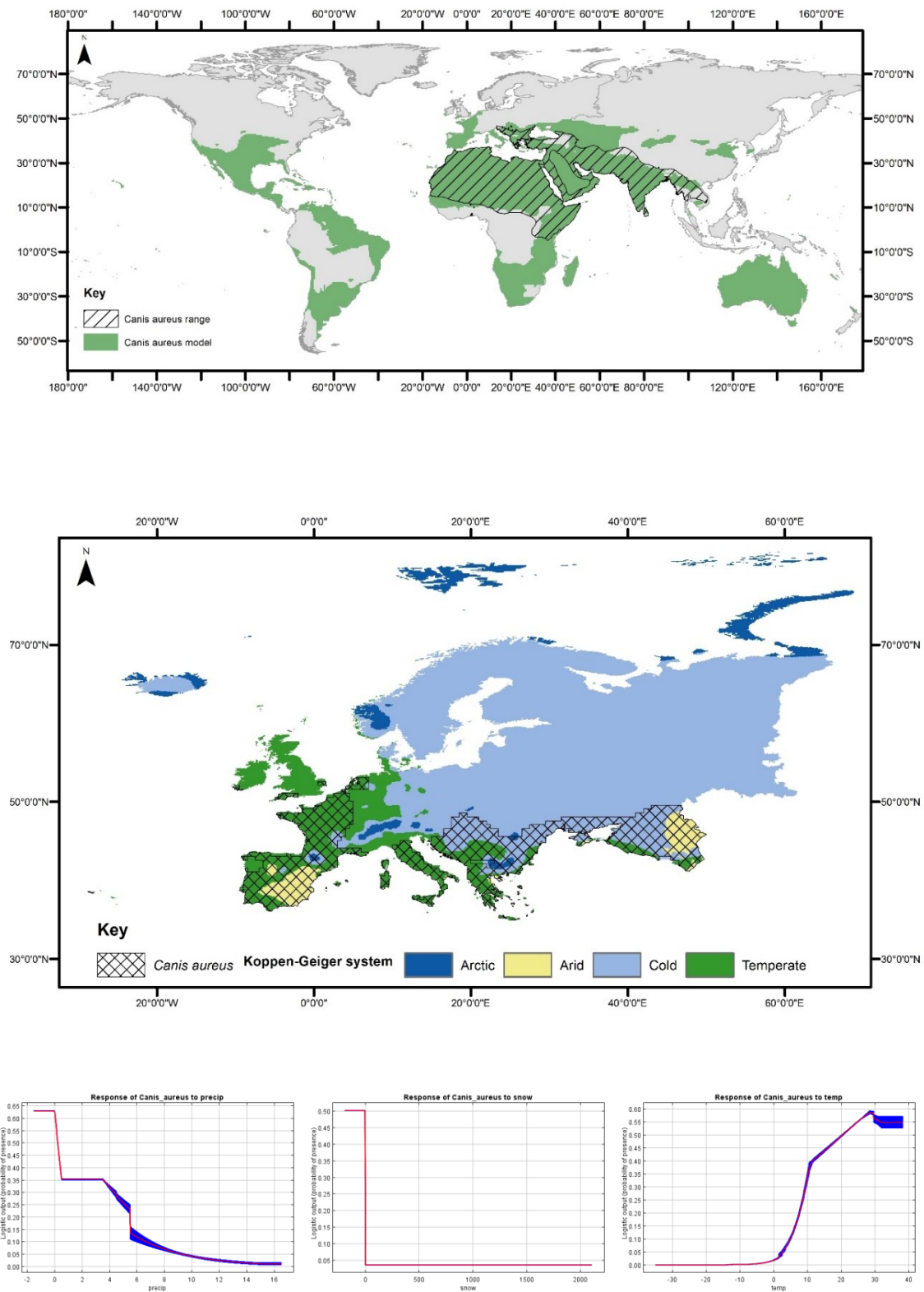


2.10 *Bison bison*

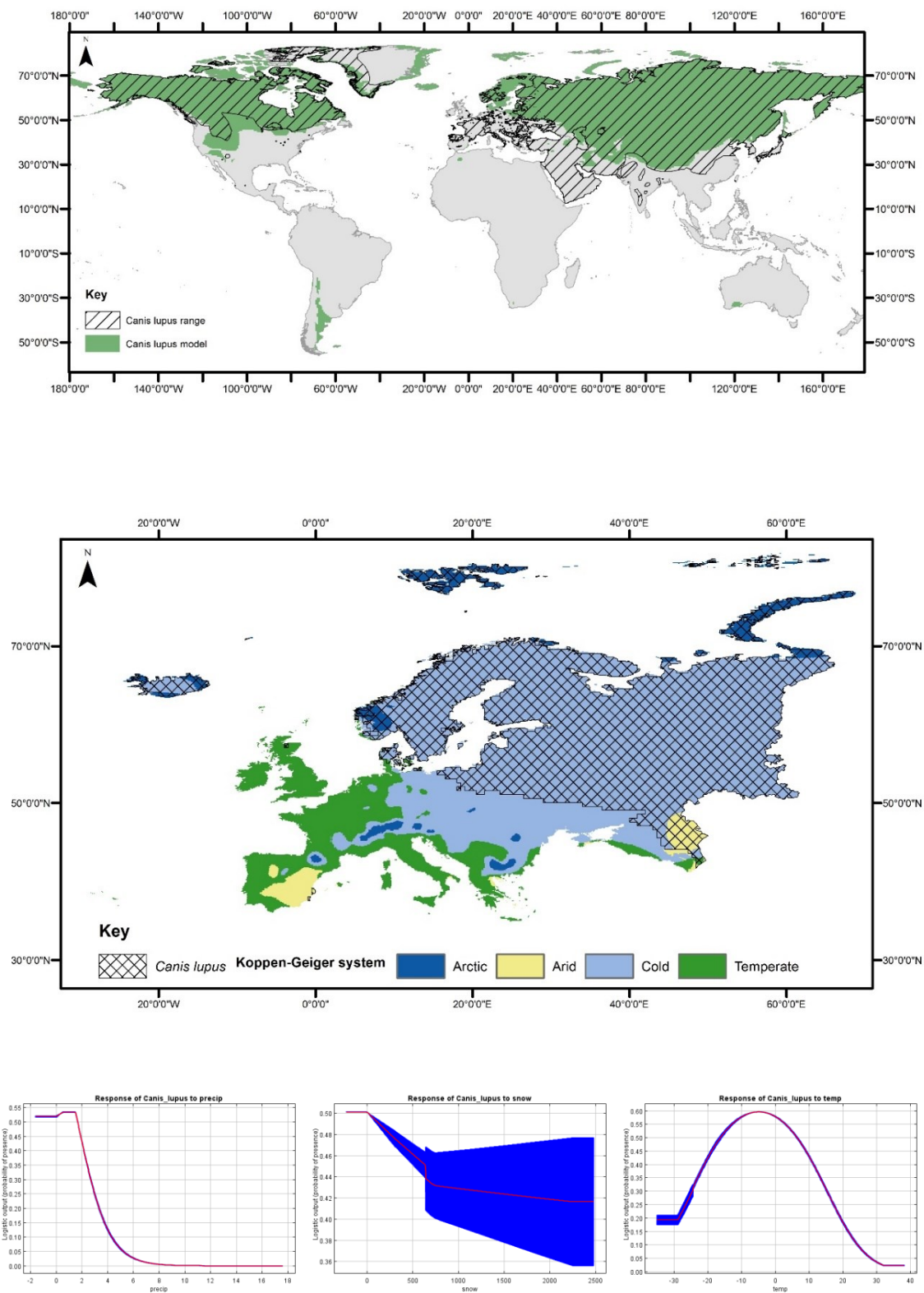


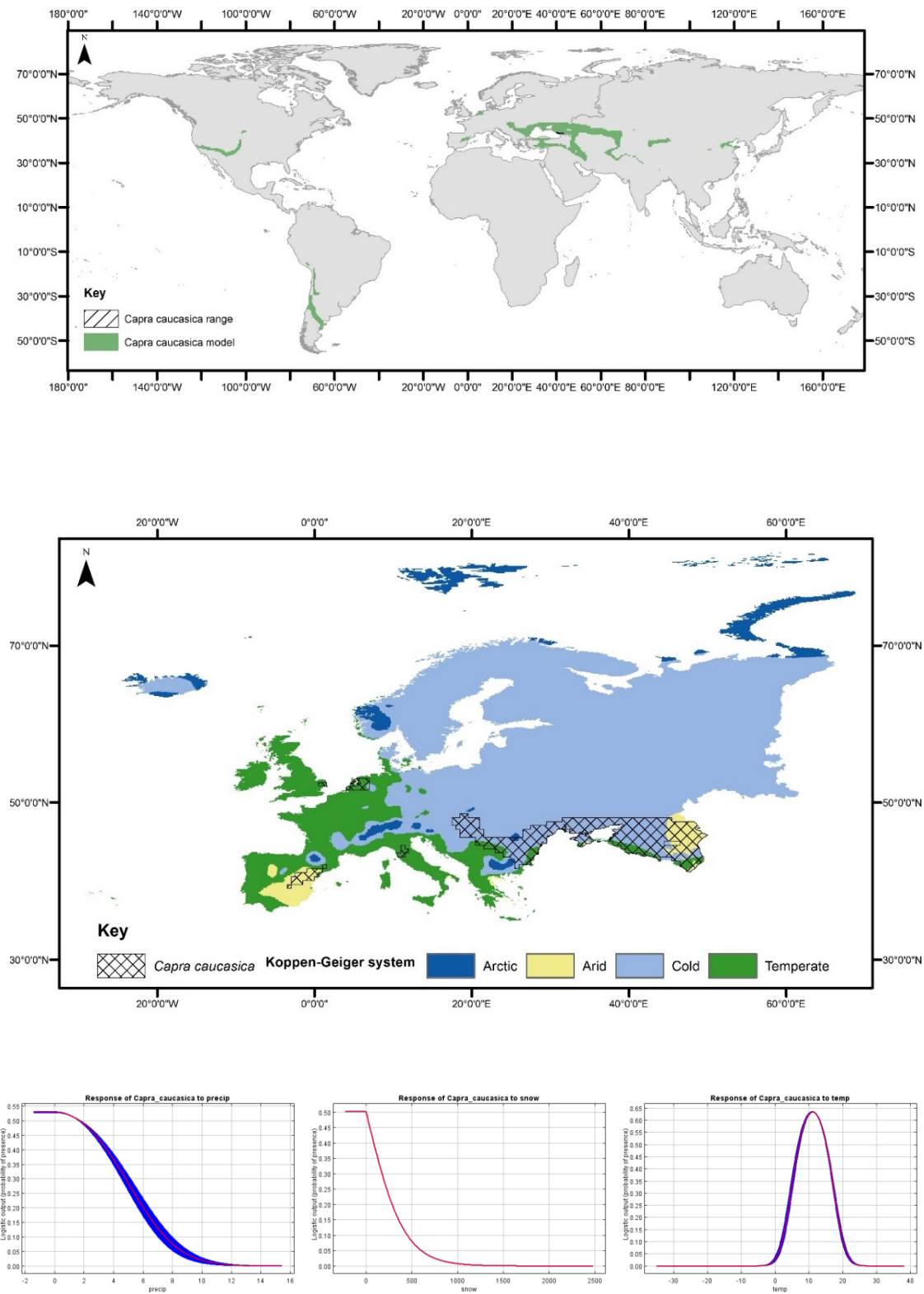
2.11 *Bison bonasus*

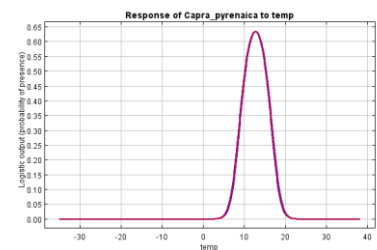
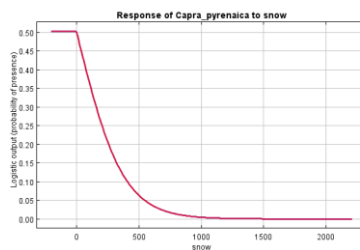
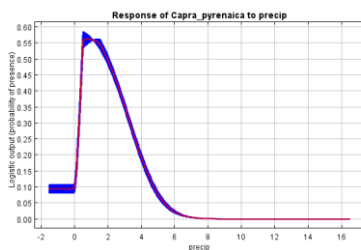
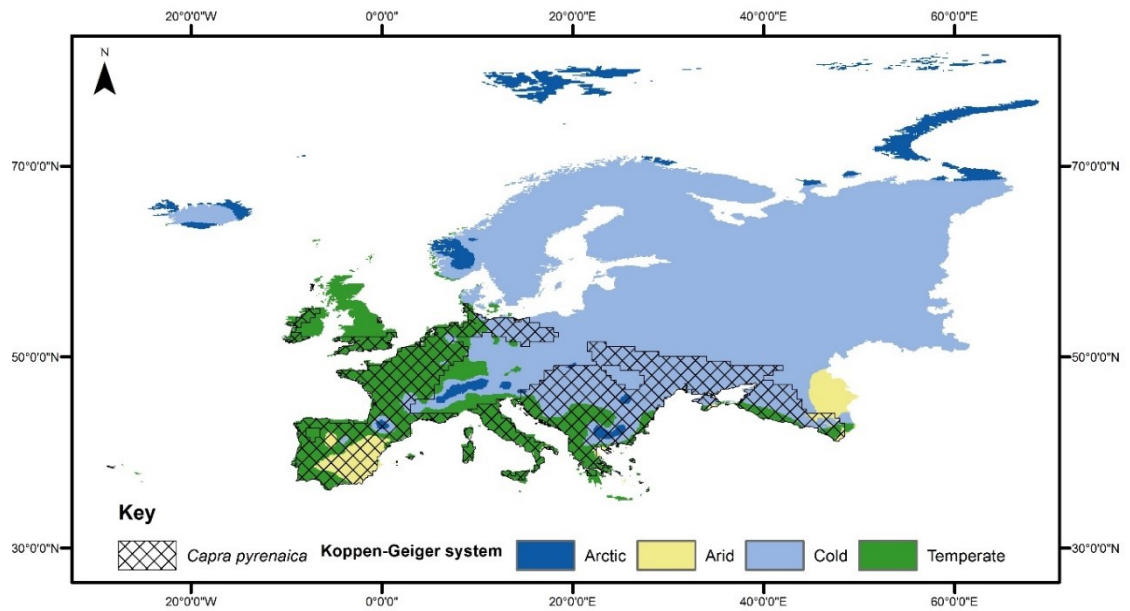
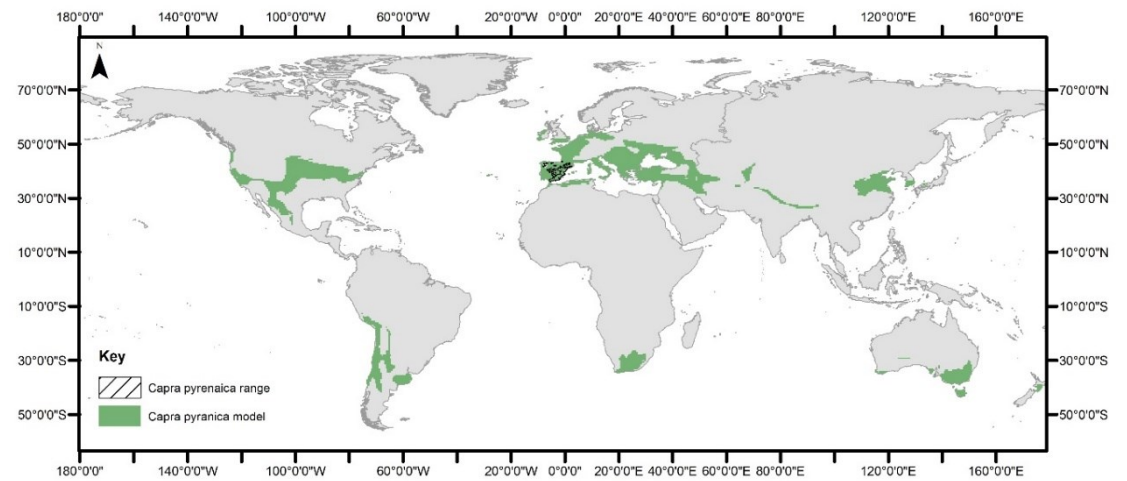
2.12 *Bison sp.*

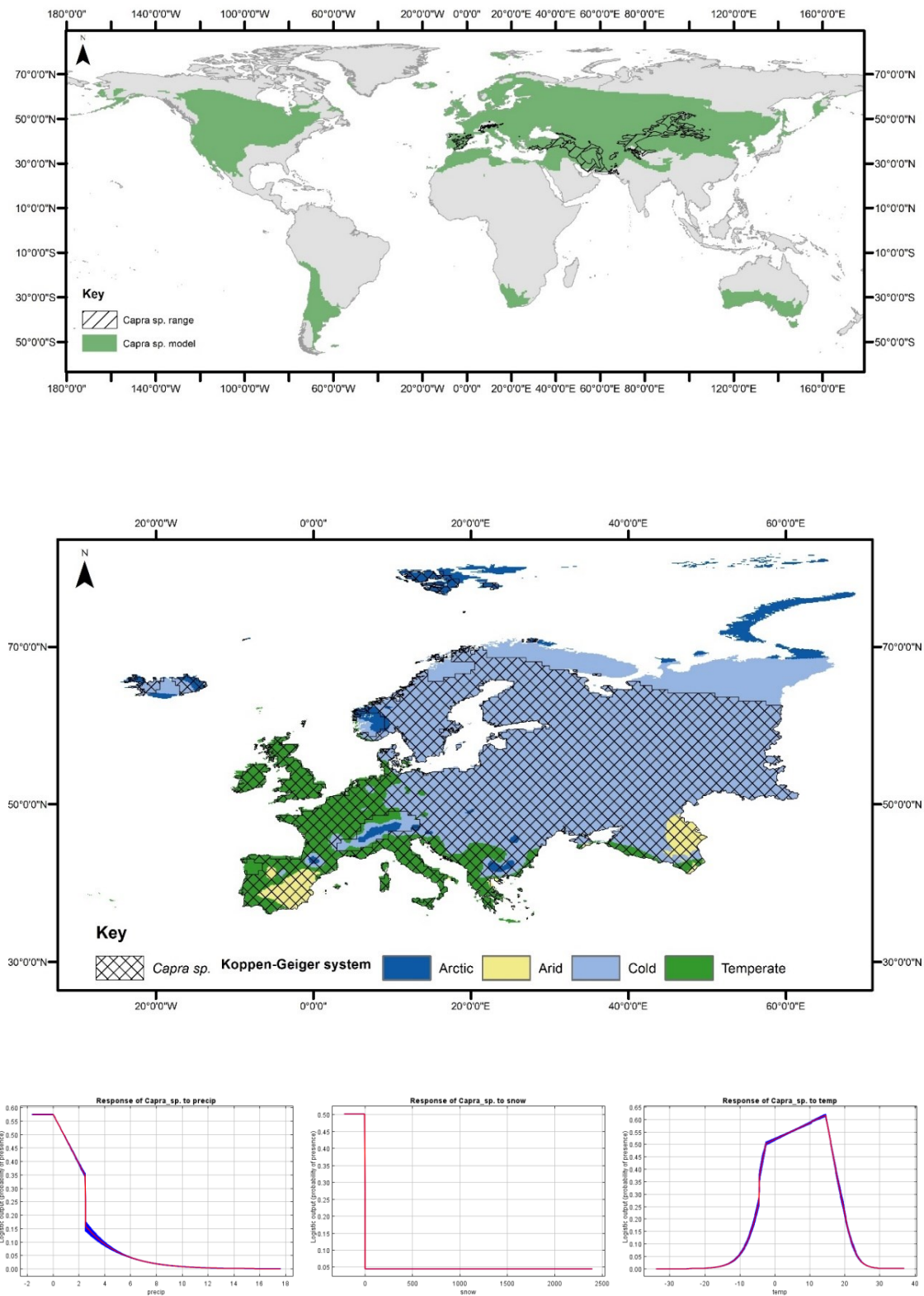
2.13 *Canis aureus*

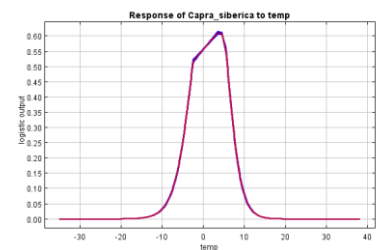
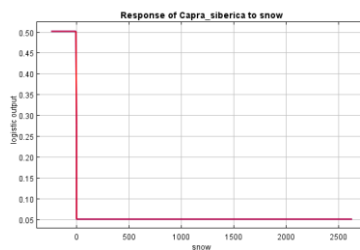
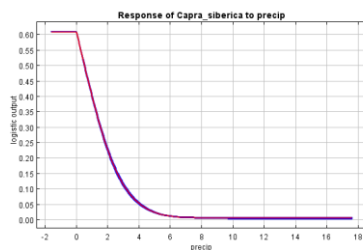
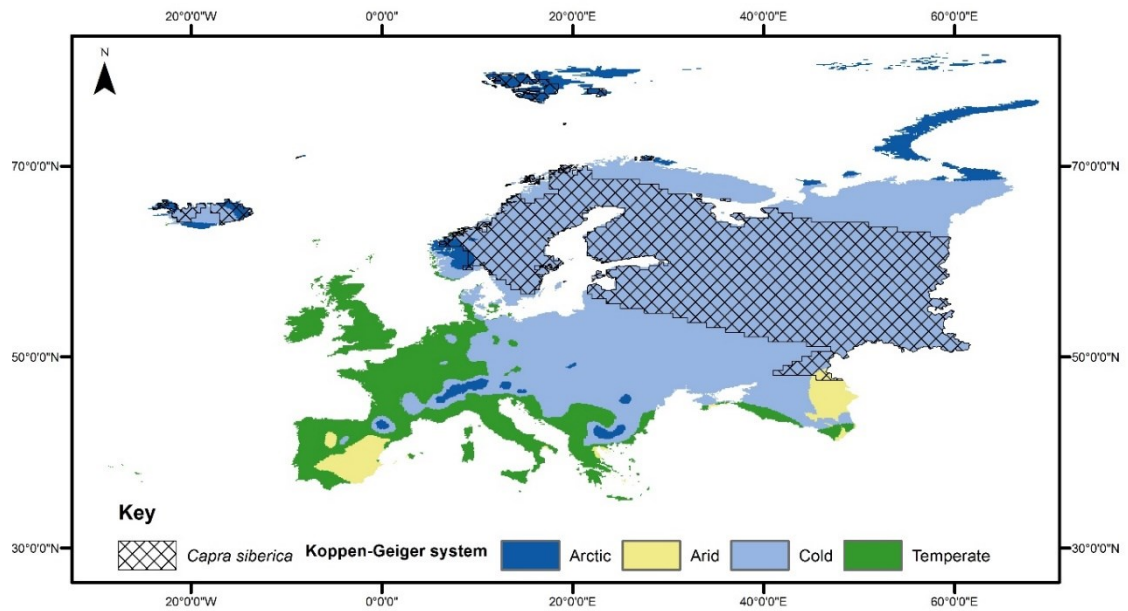
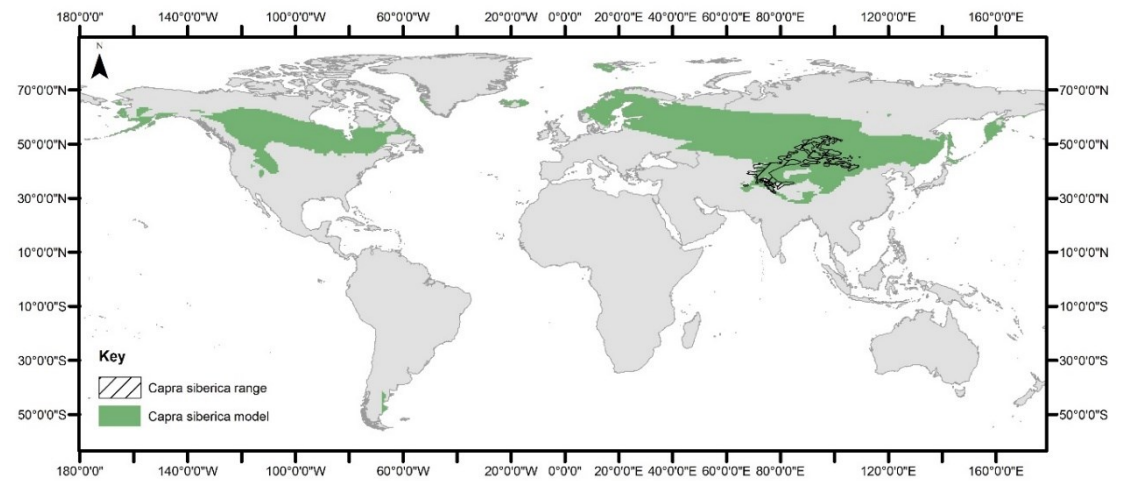
2.14 *Canis lupus*

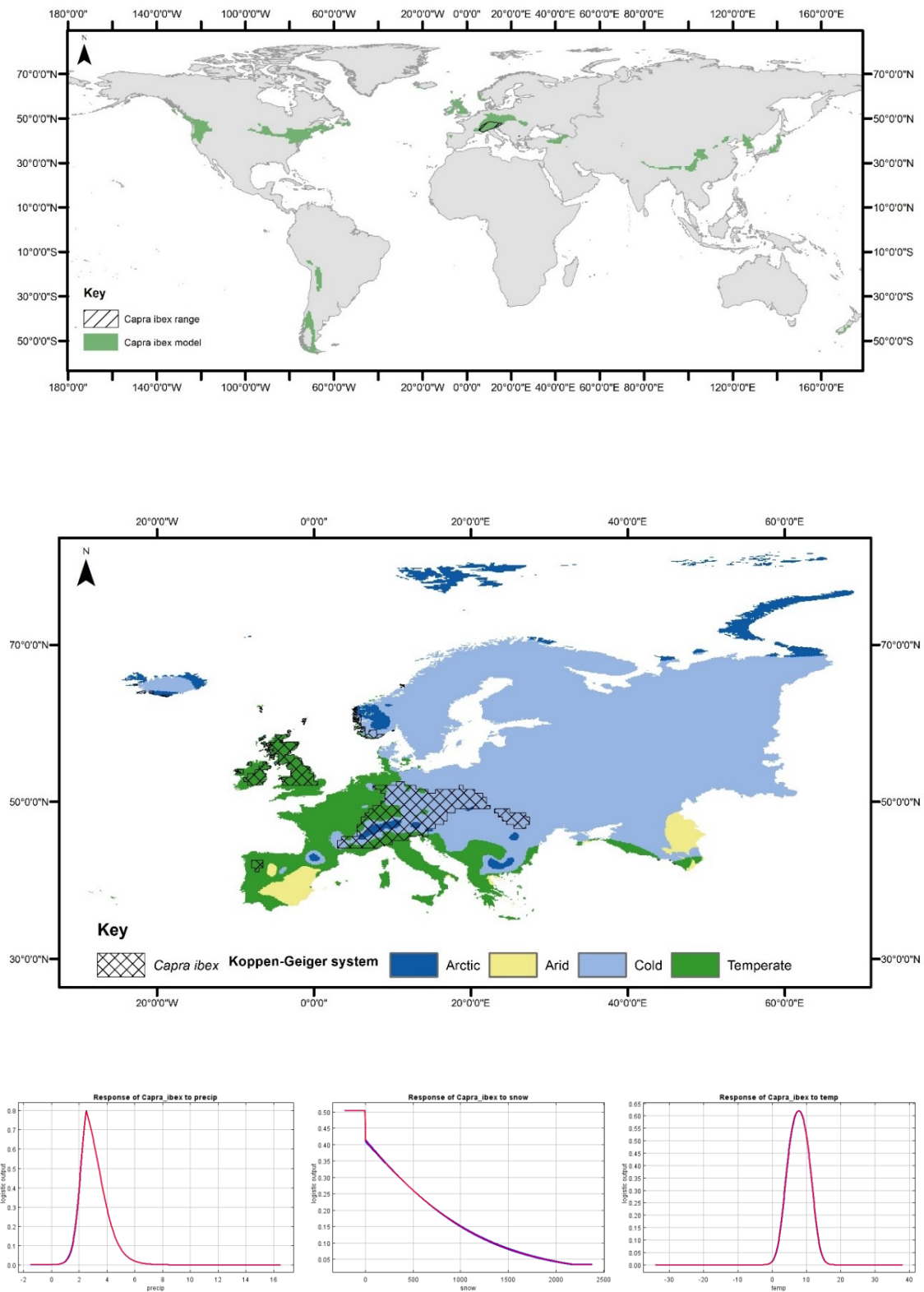


2.15 *Capra caucasica*

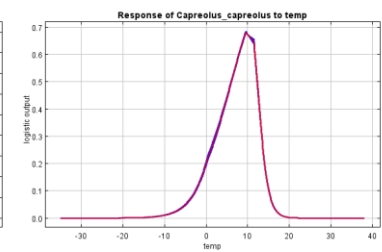
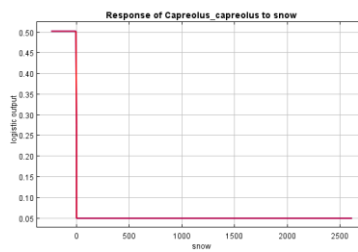
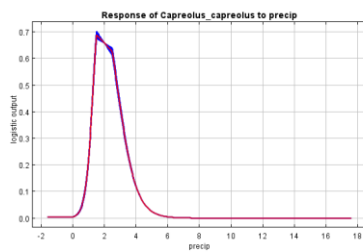
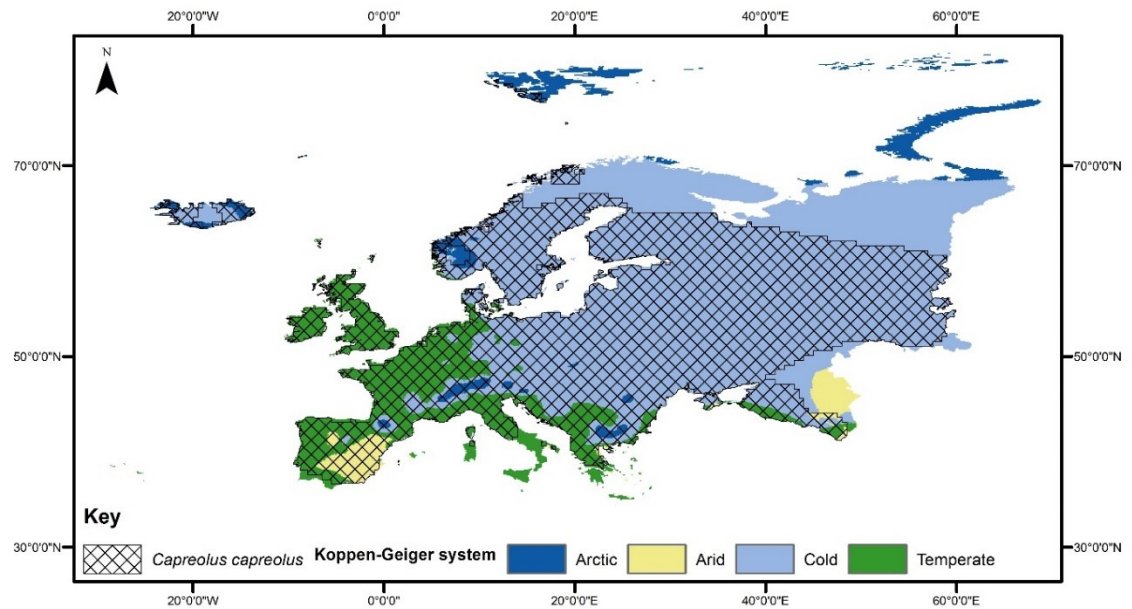
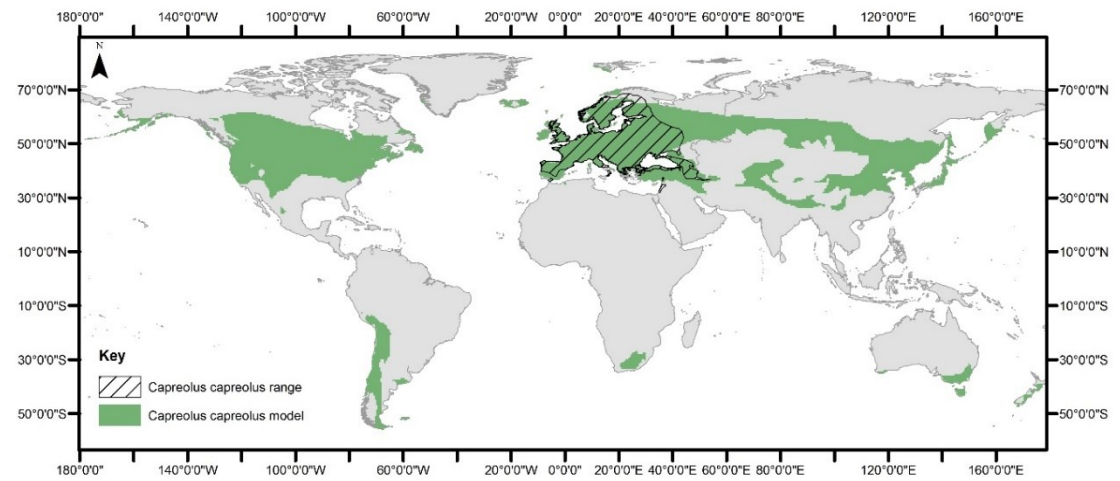
2.16 *Capra pyrenaica*

2.17 *Capra* sp.

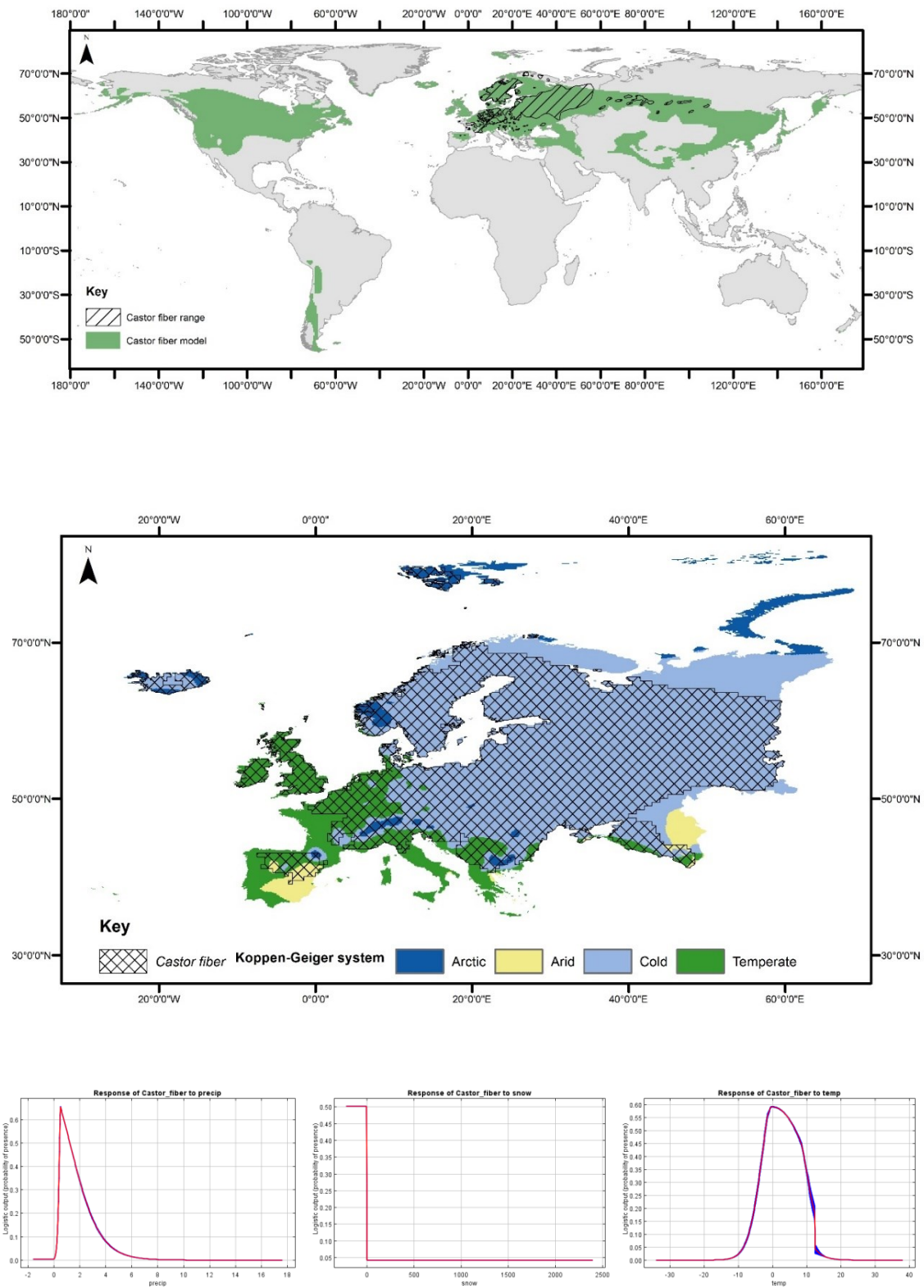
2.18 *Capra siberica*

2.19 *Capra ibex*

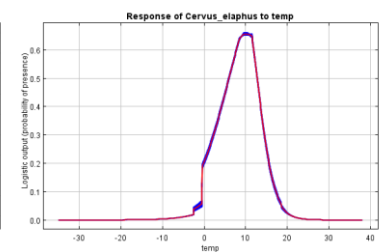
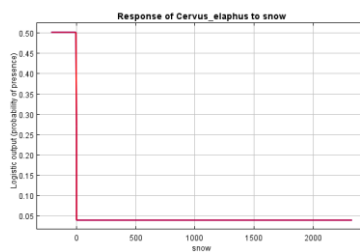
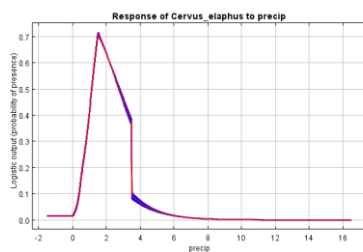
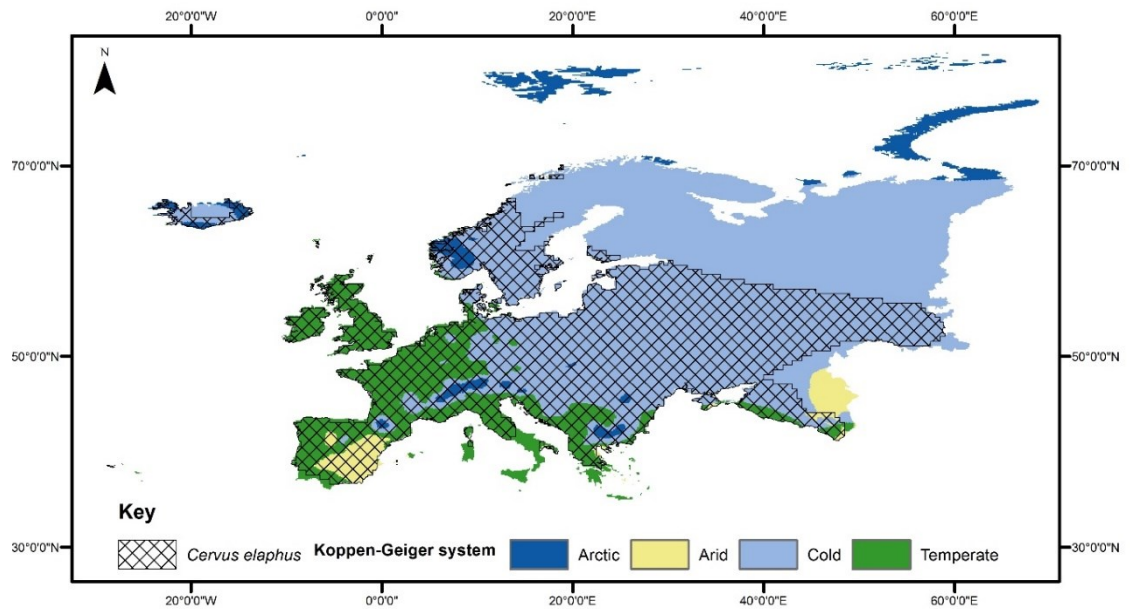
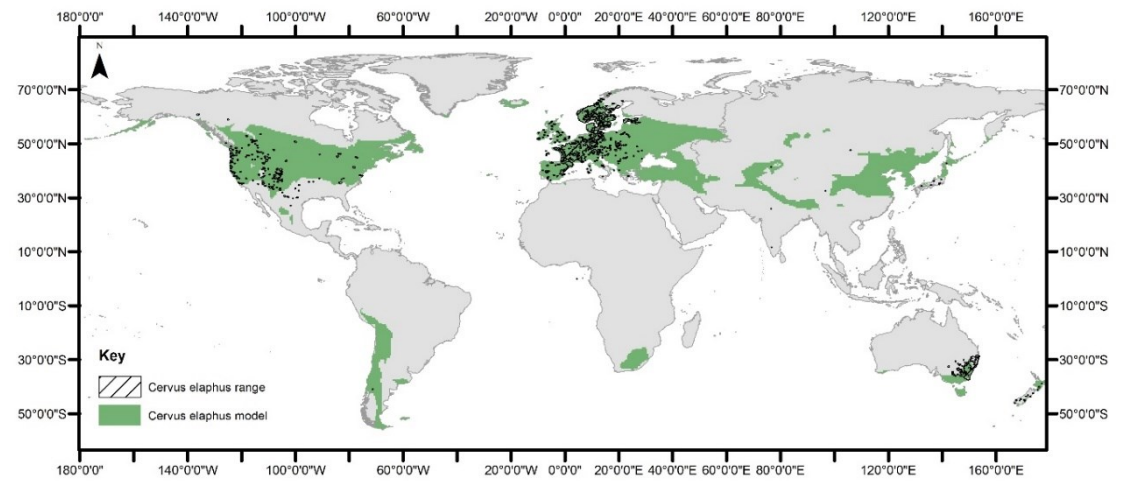
2.20 *Capreolus capreolus*

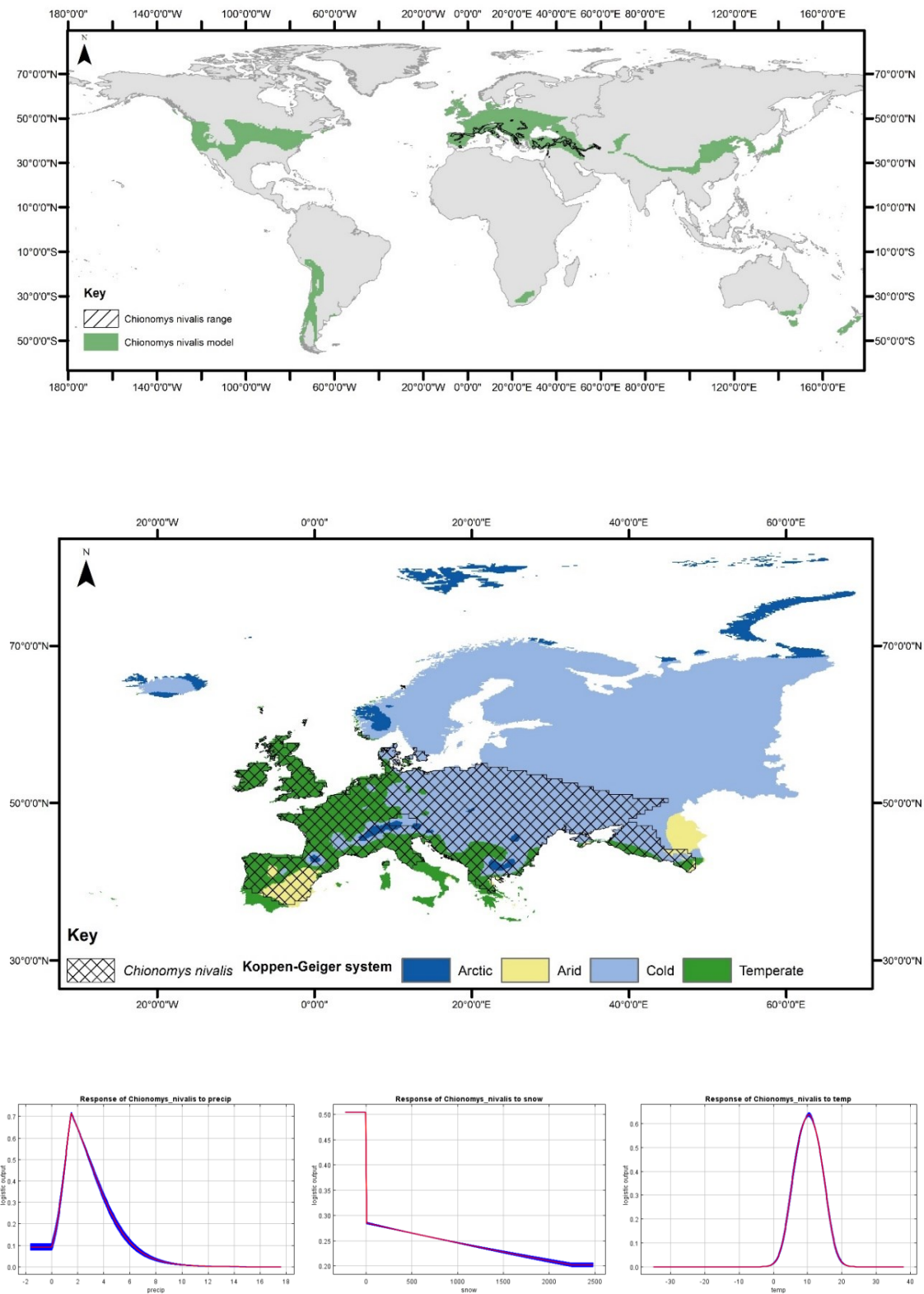


2.21 *Castor fiber*

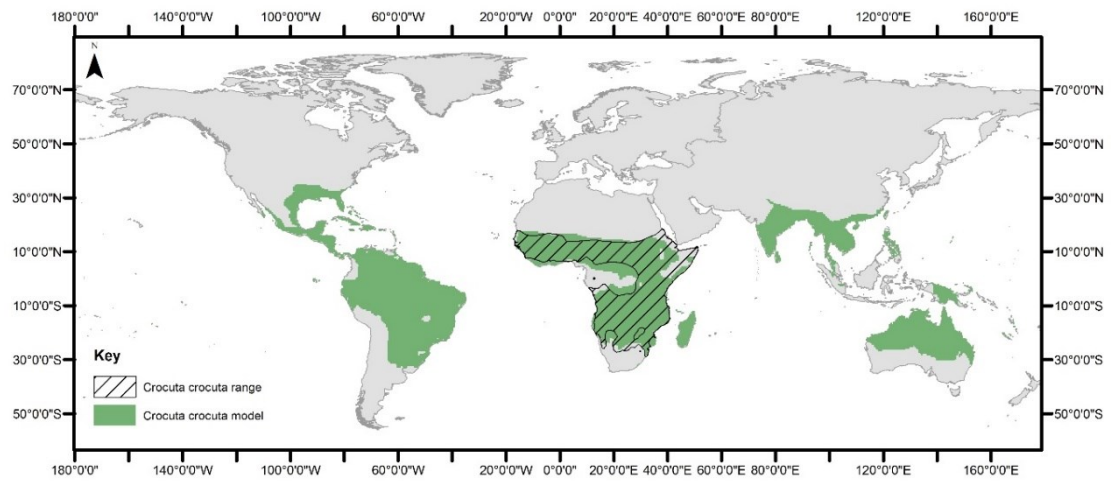


2.22 *Cervus elaphus*

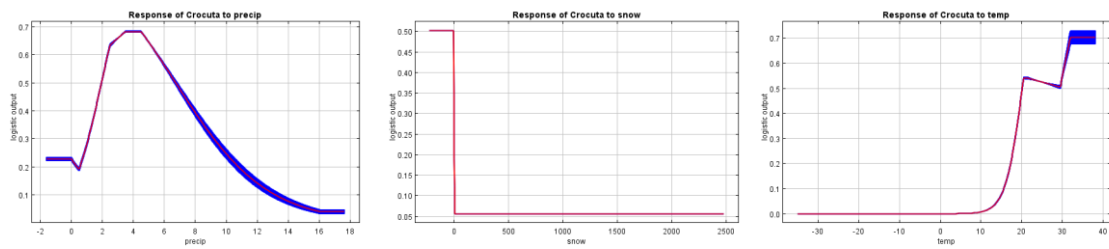


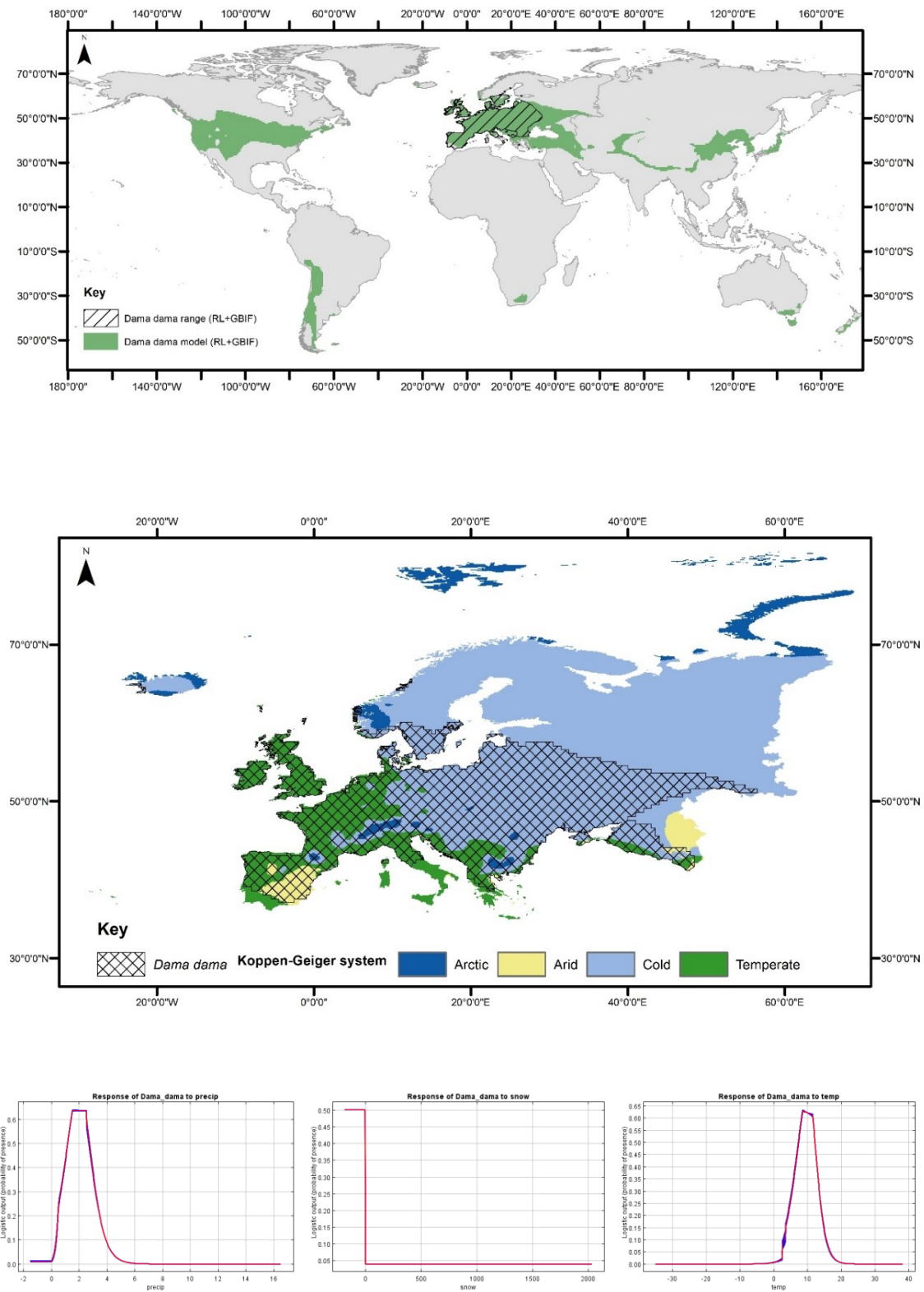
2.23 *Chionomys nivalis*

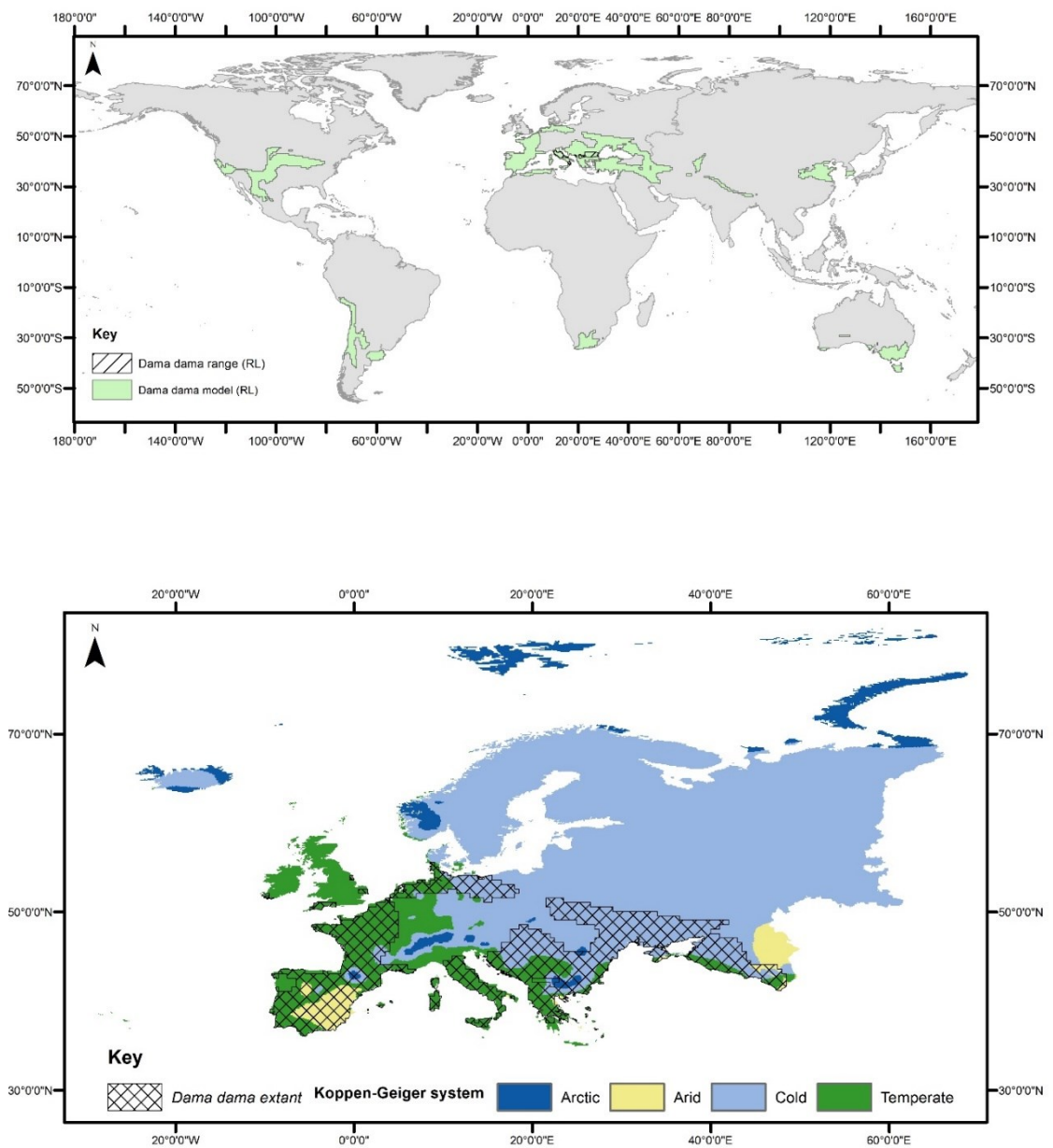
2.24 *Crocota crocuta*

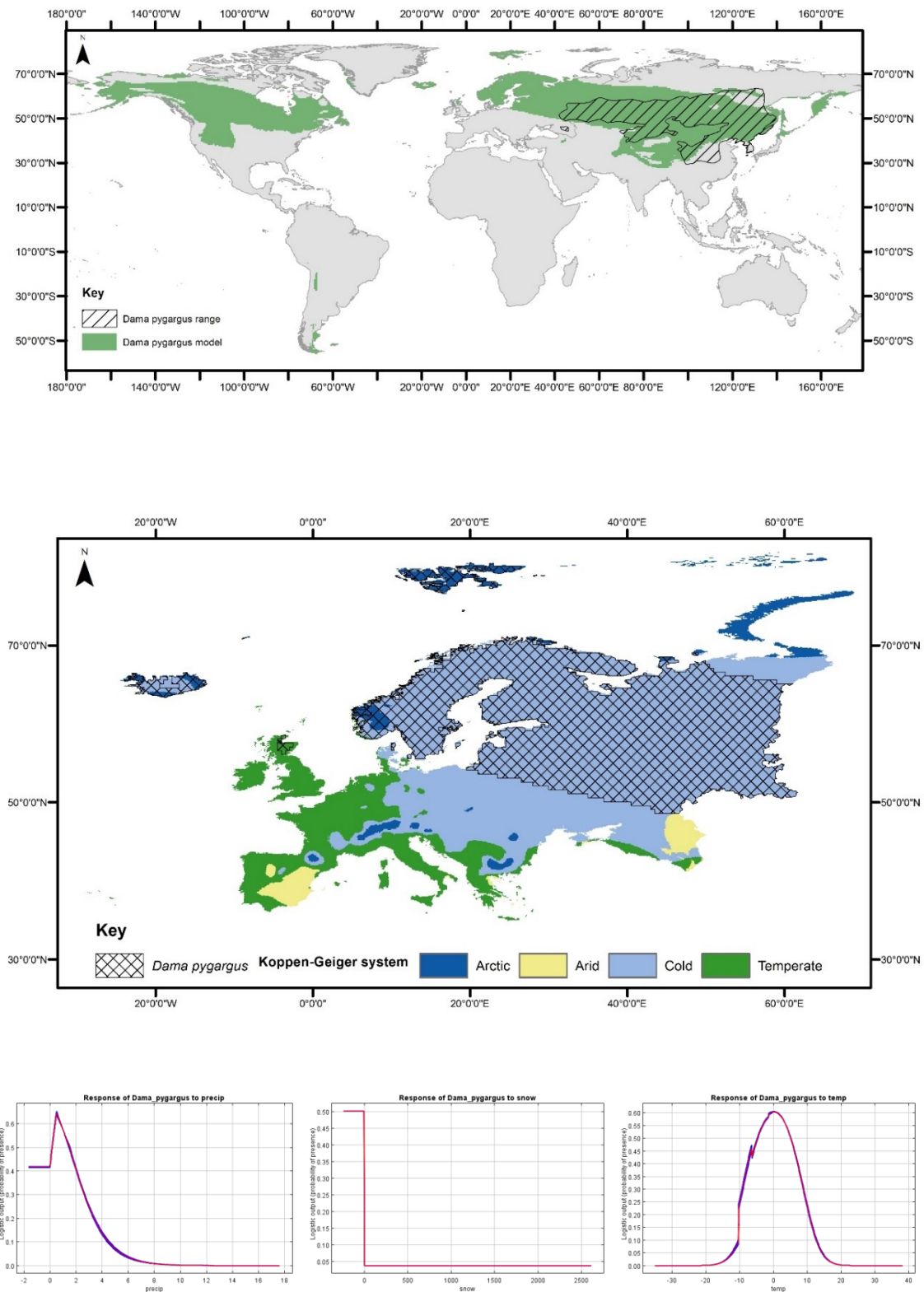


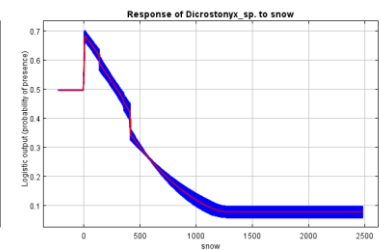
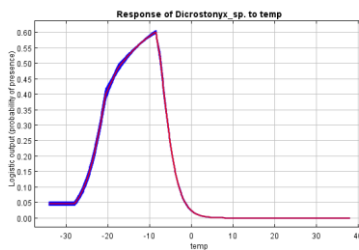
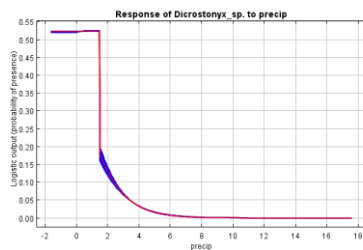
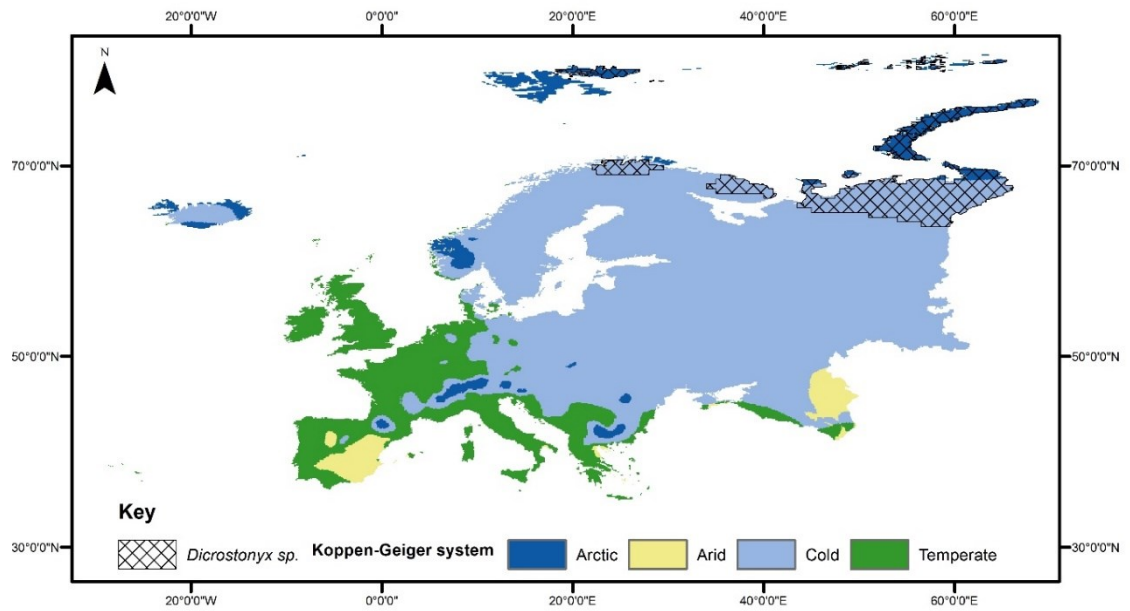
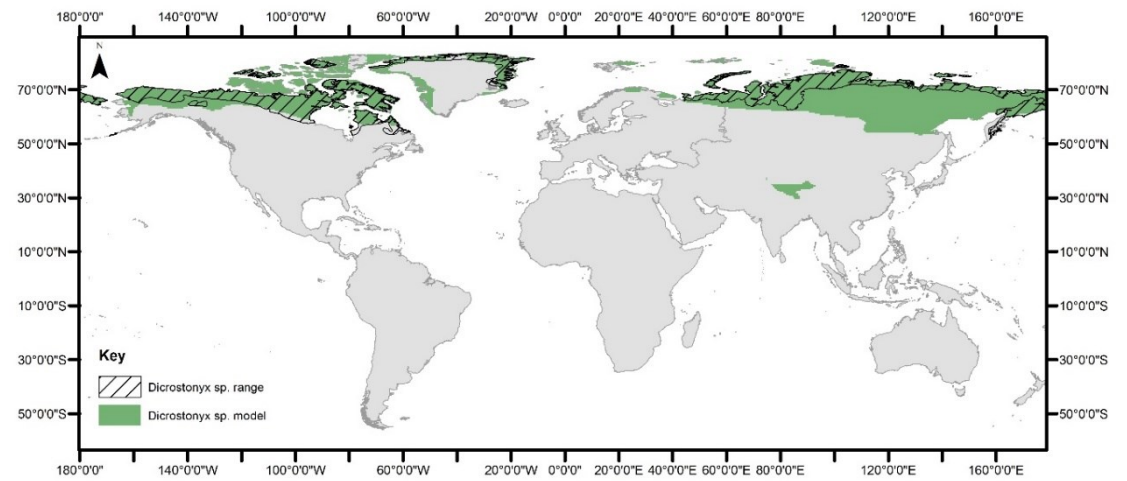
Modelled distribution outside of Europe. No zoomed-in map of Europe provided.

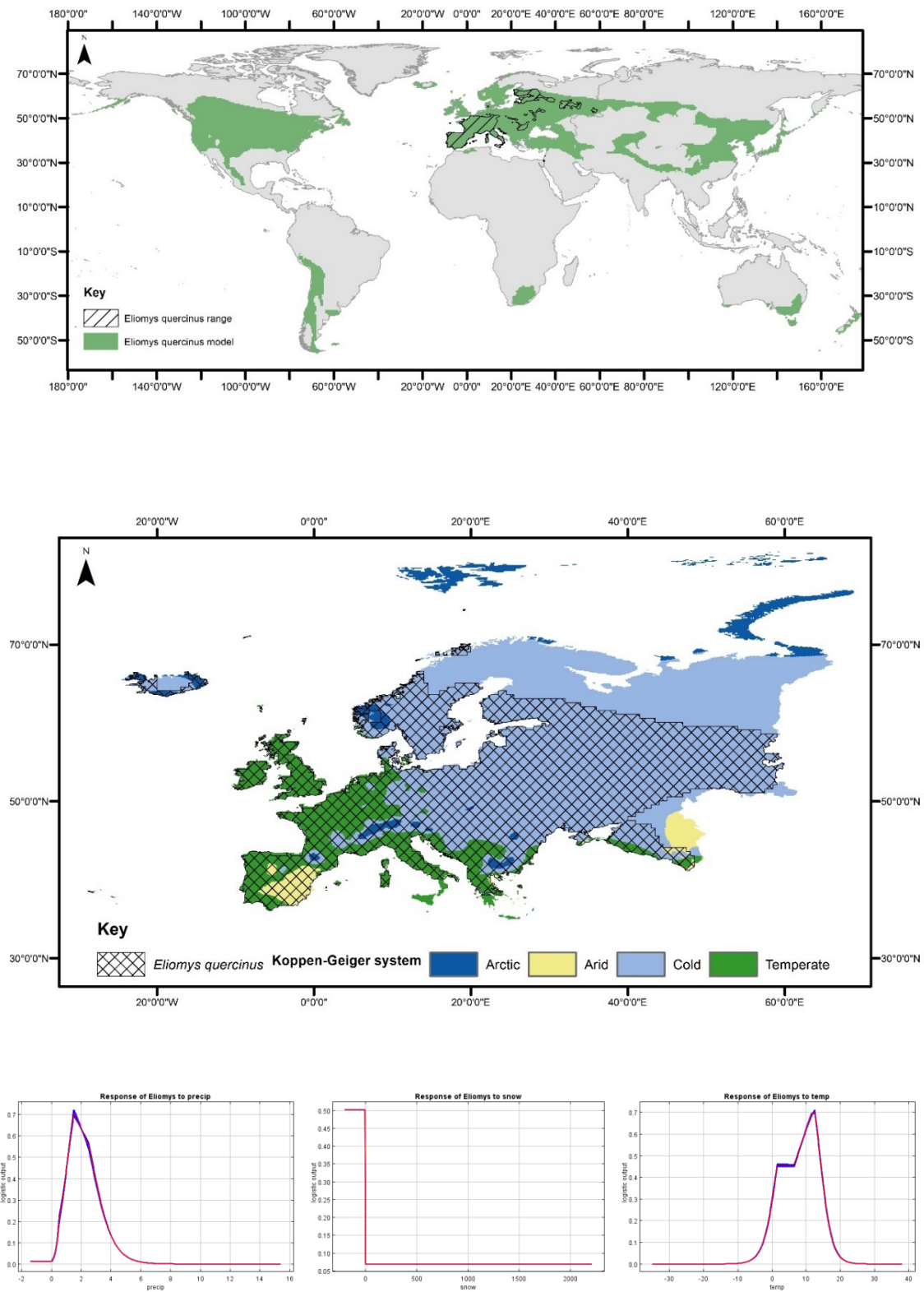


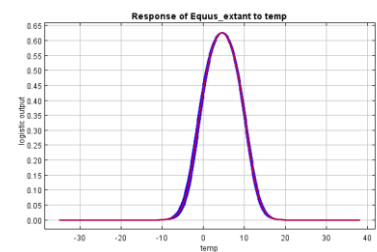
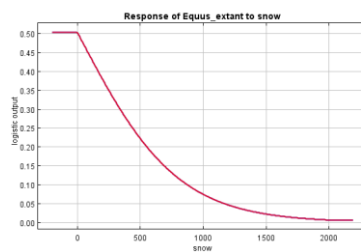
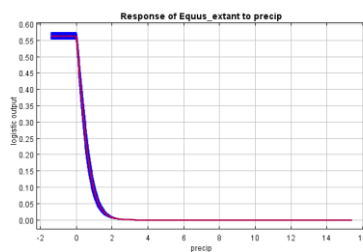
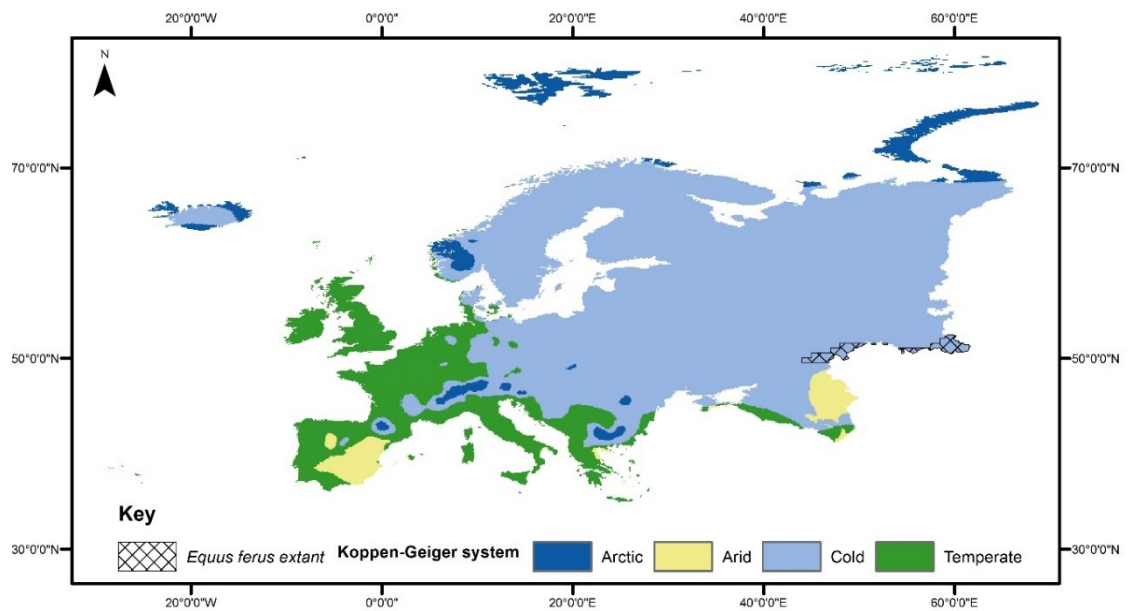
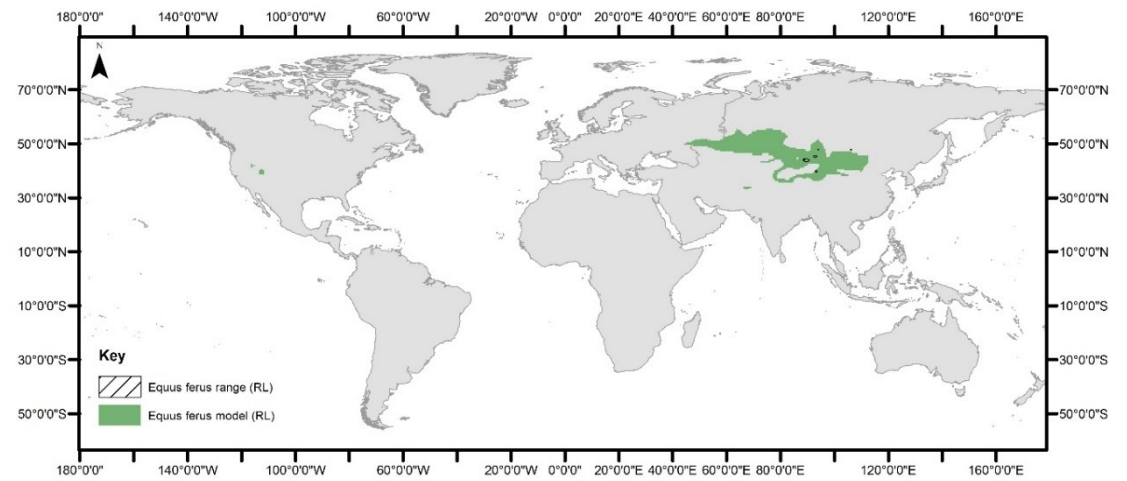
2.25 *Dama dama* (RL&GBIF)

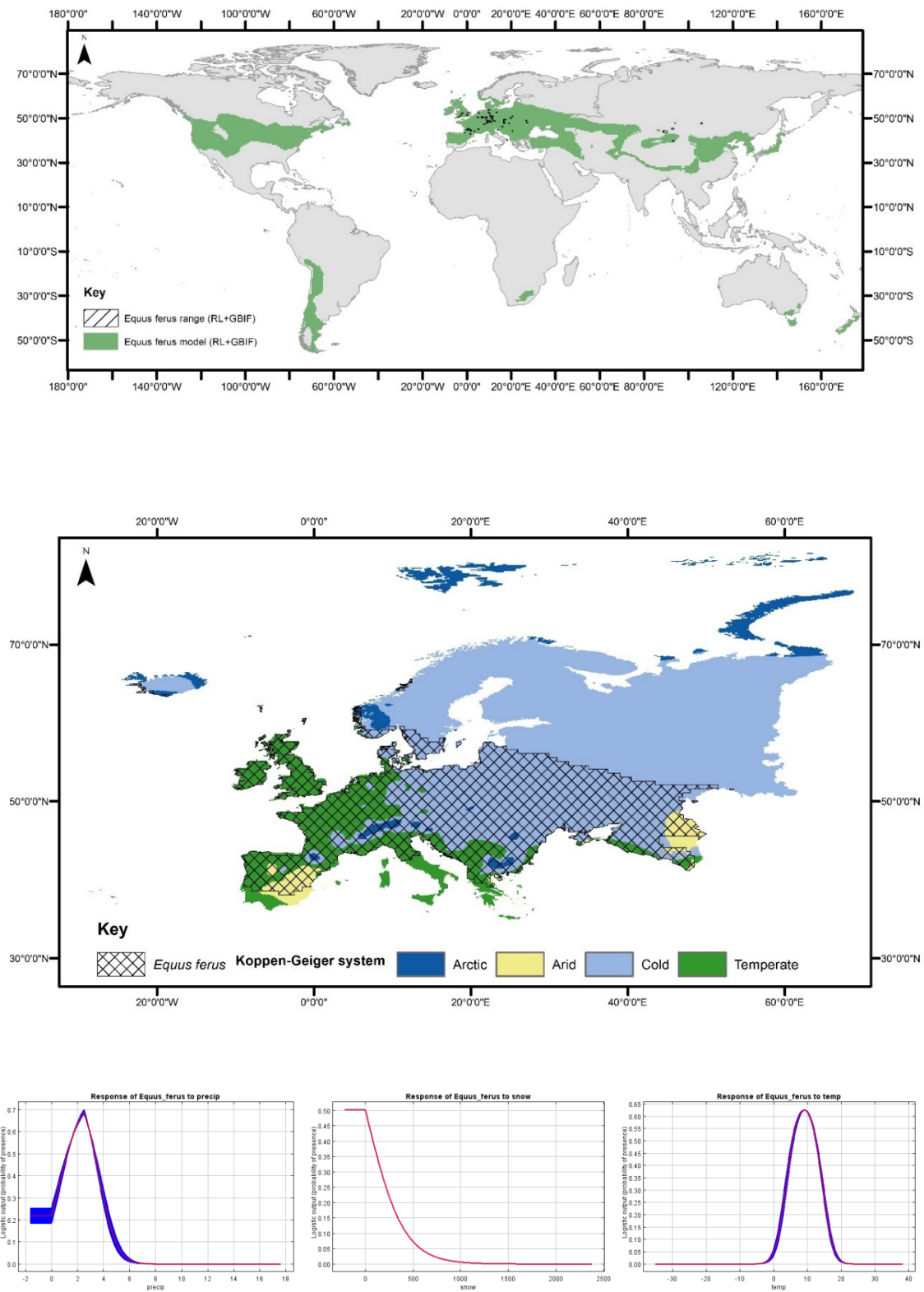
2.26 *Dama dama* (RL)

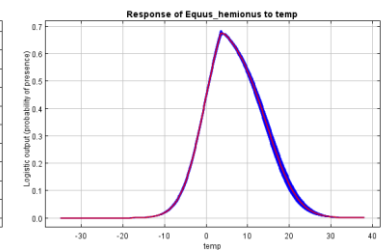
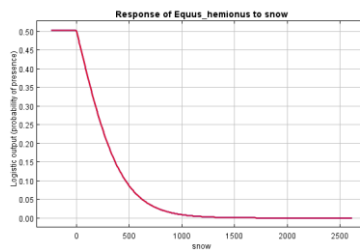
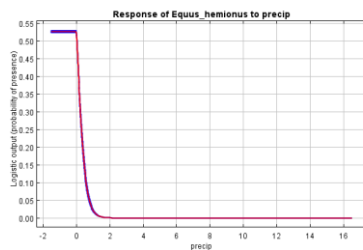
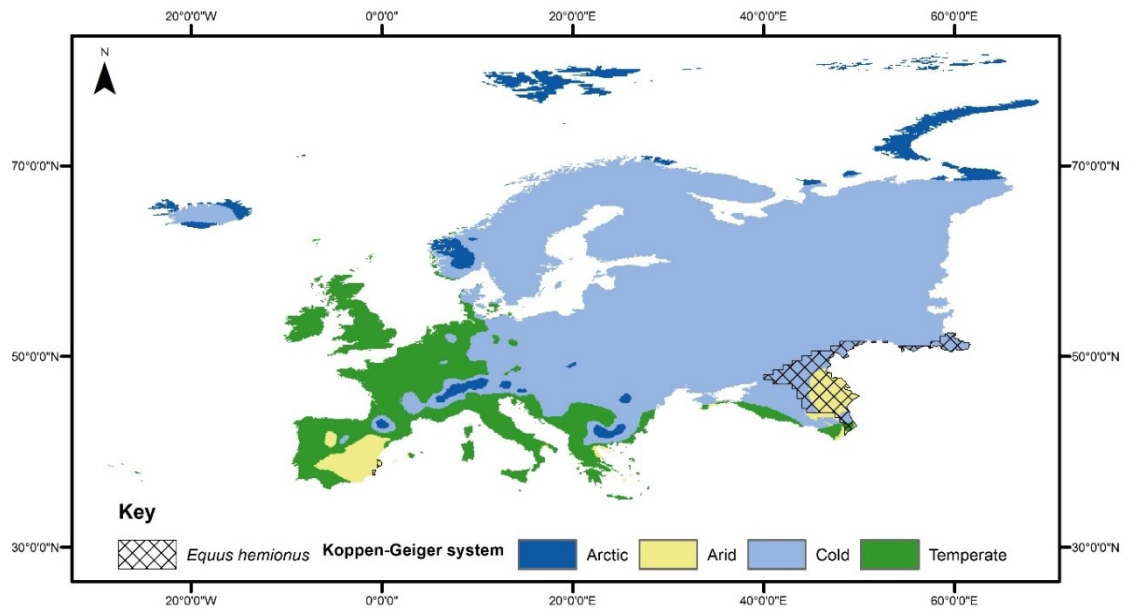
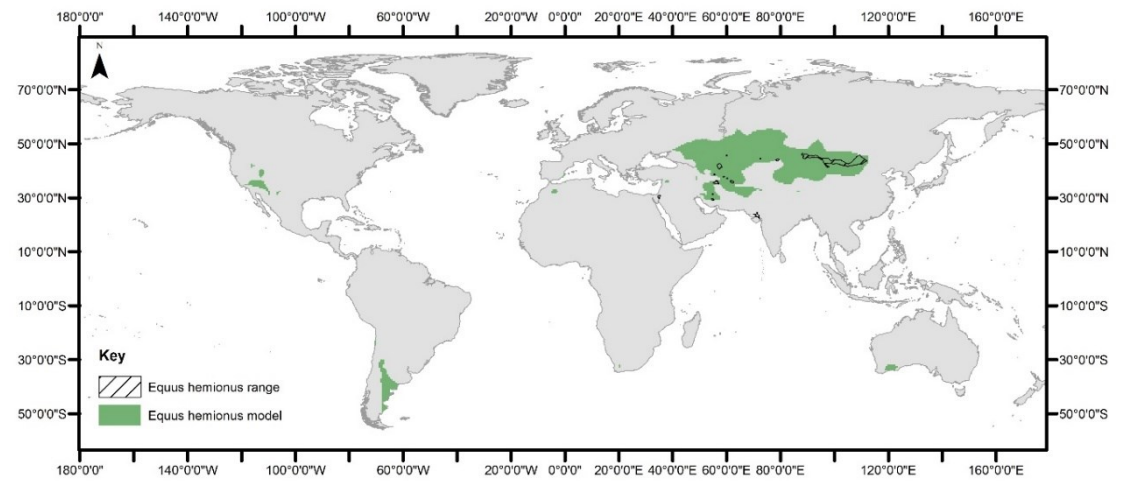
2.27 *Dama pygargus*

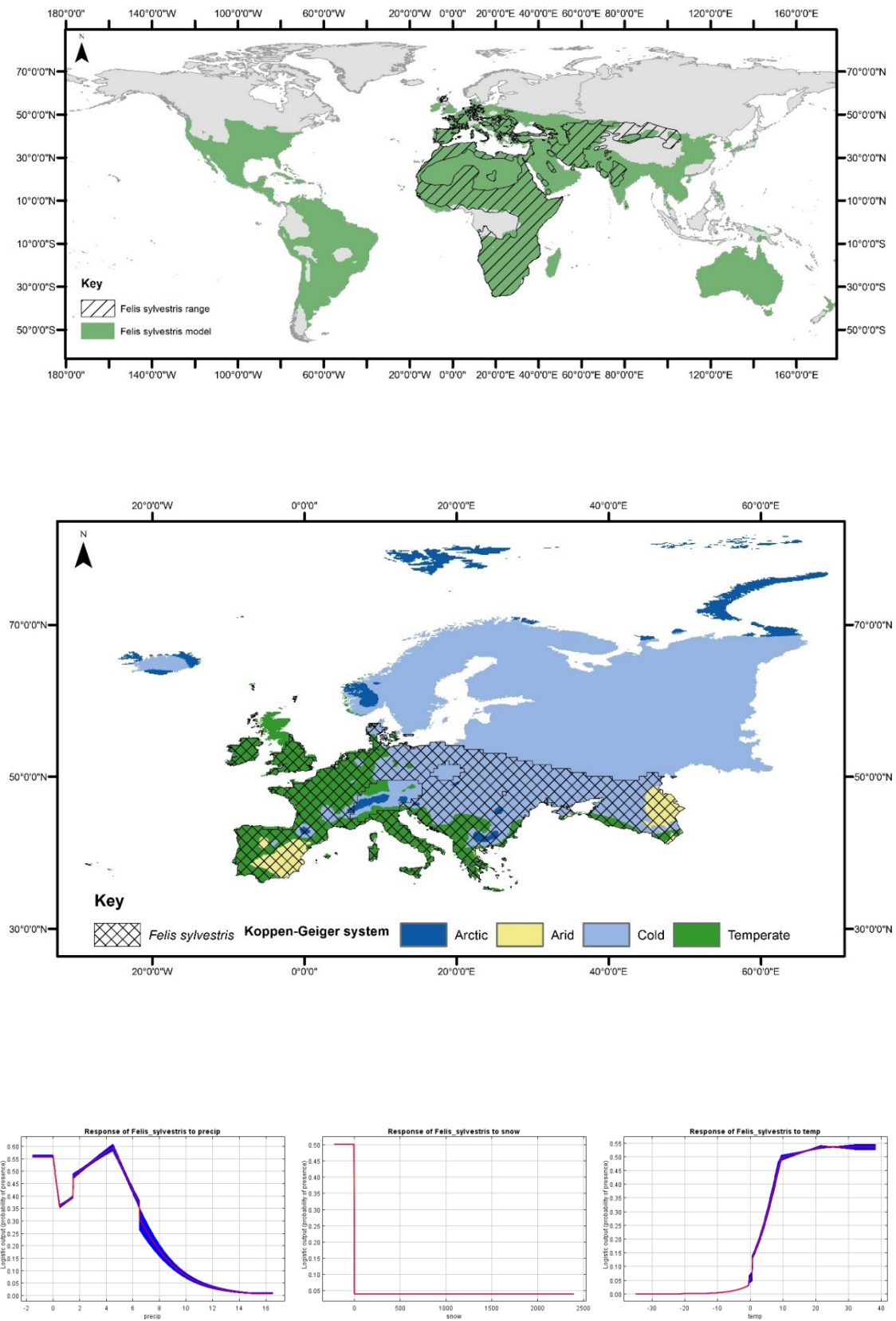
2.28 *Dicrostonyx* sp.

2.29 *Eliomys quercinus*

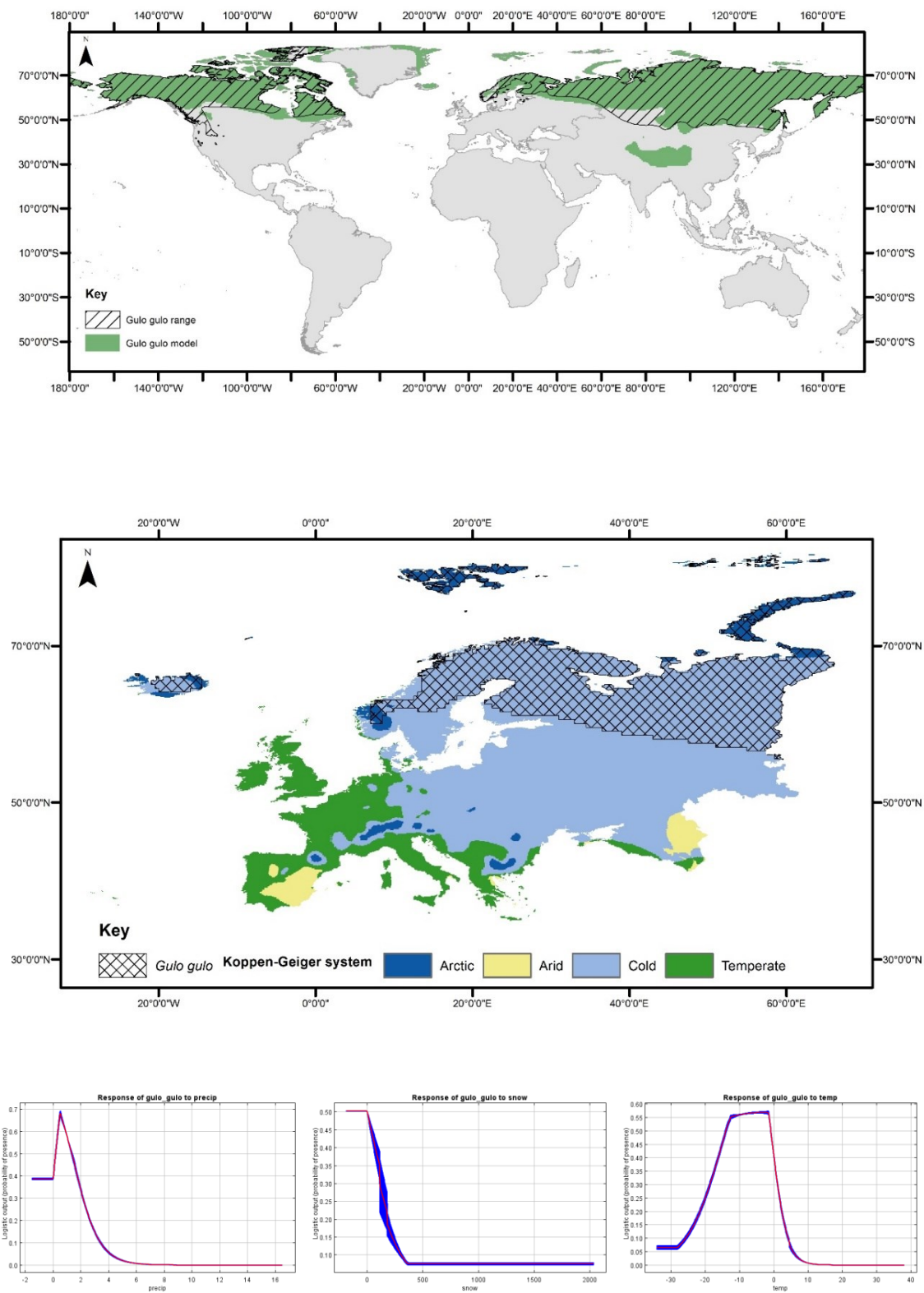
2.30 *Equus ferus* (RL)

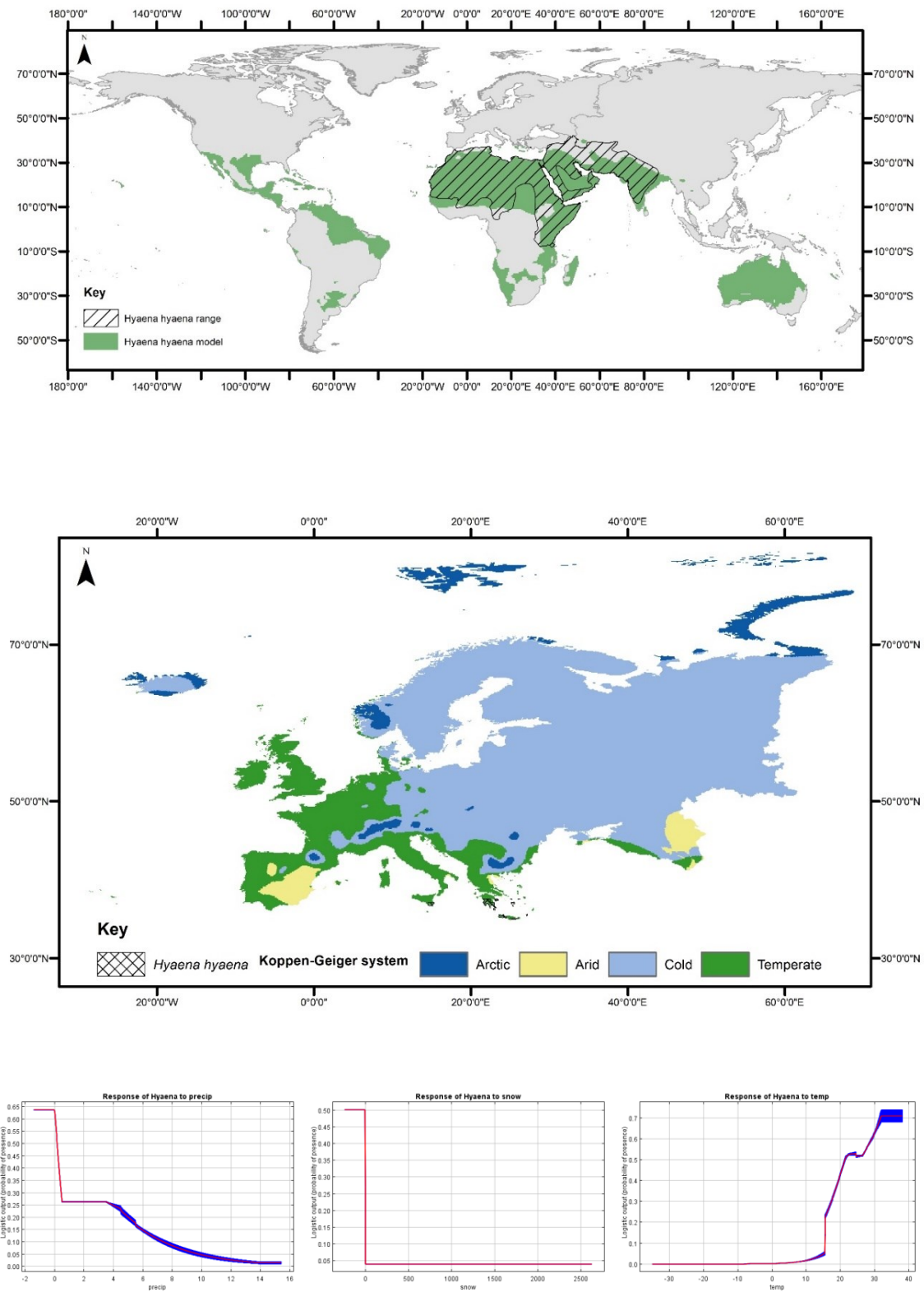
2.31 *Equus ferus* (RL+GBIF)

2.32 *Equus hemionus*

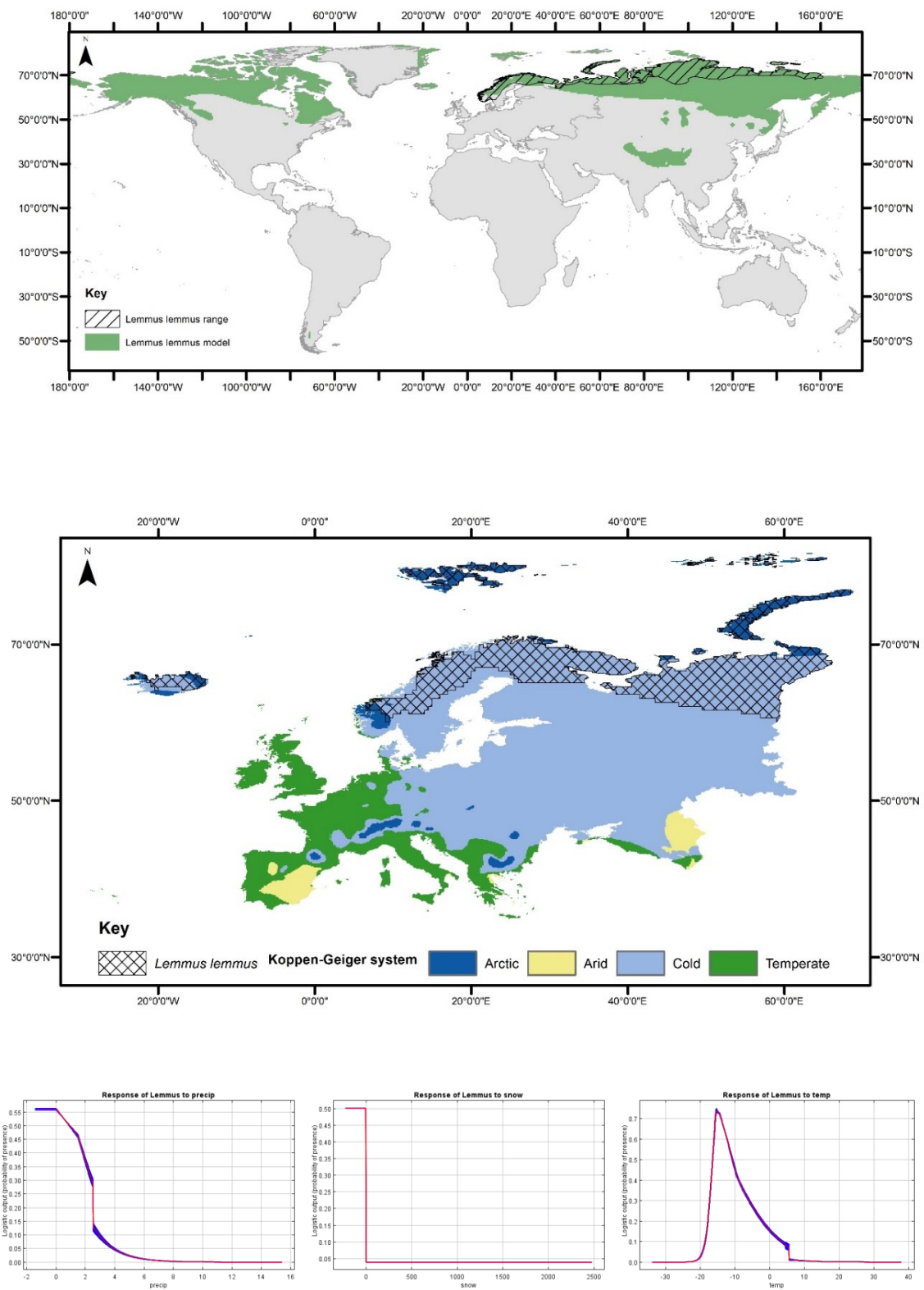
2.33 *Felis sylvestris*

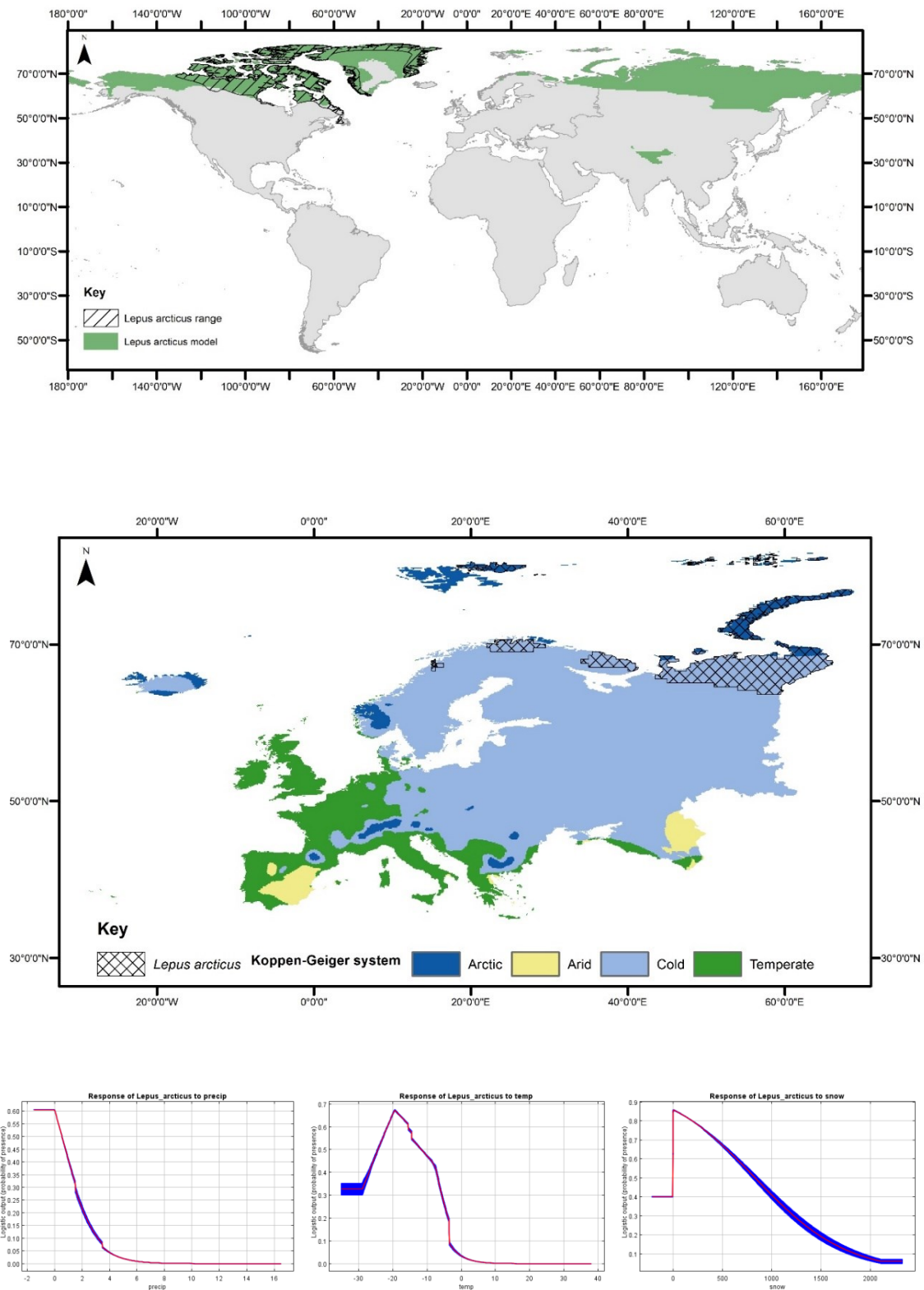
2.34 *Gulo gulo*

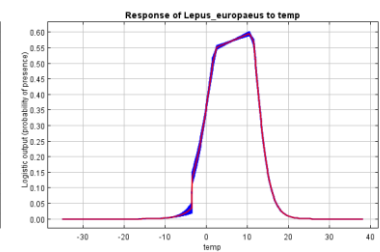
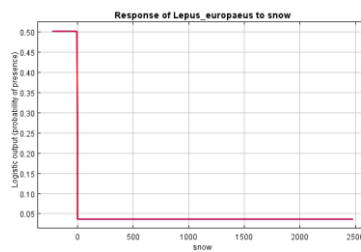
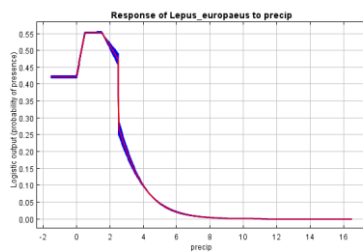
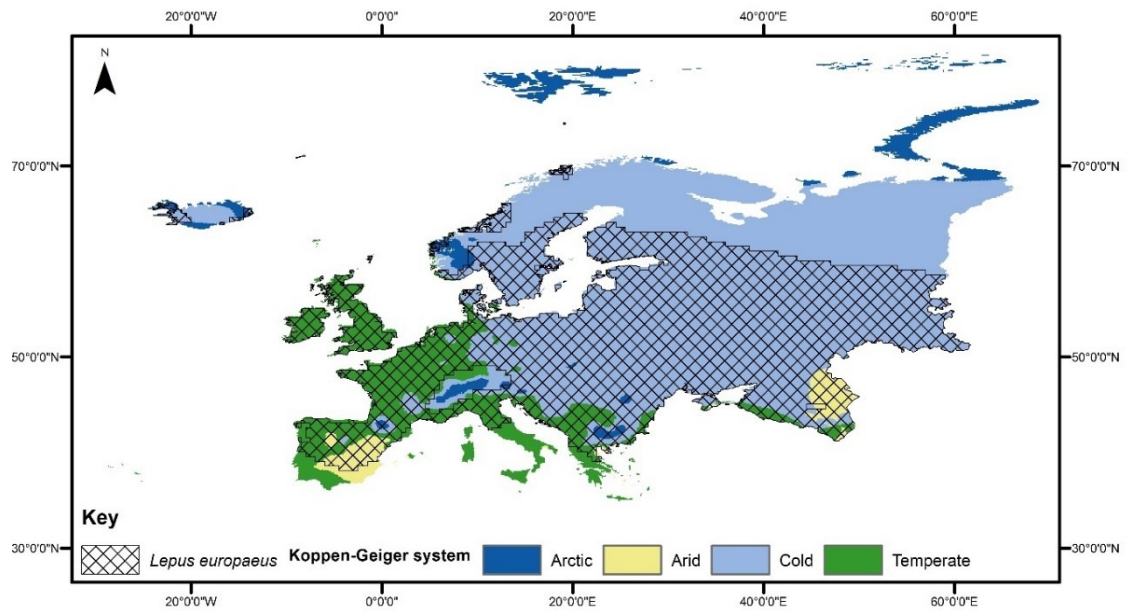
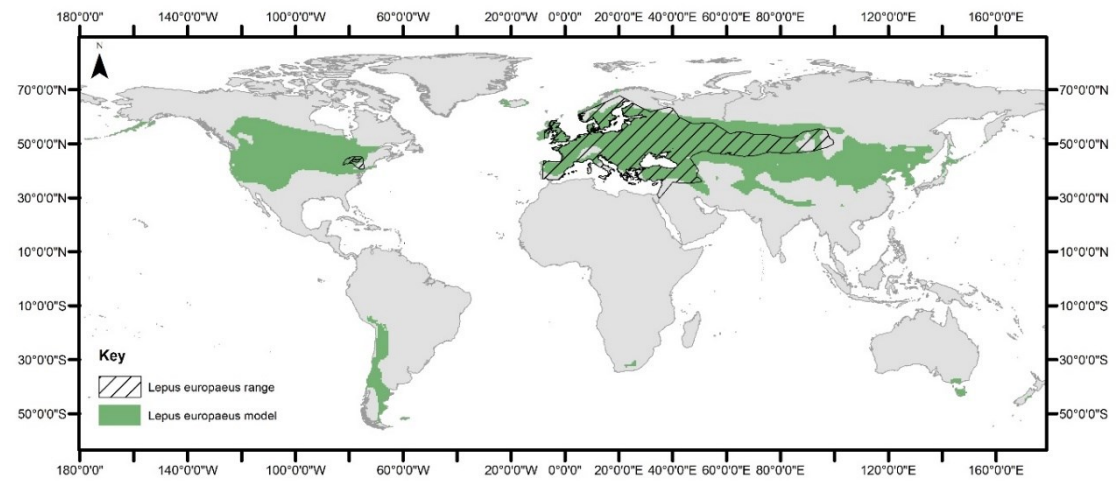


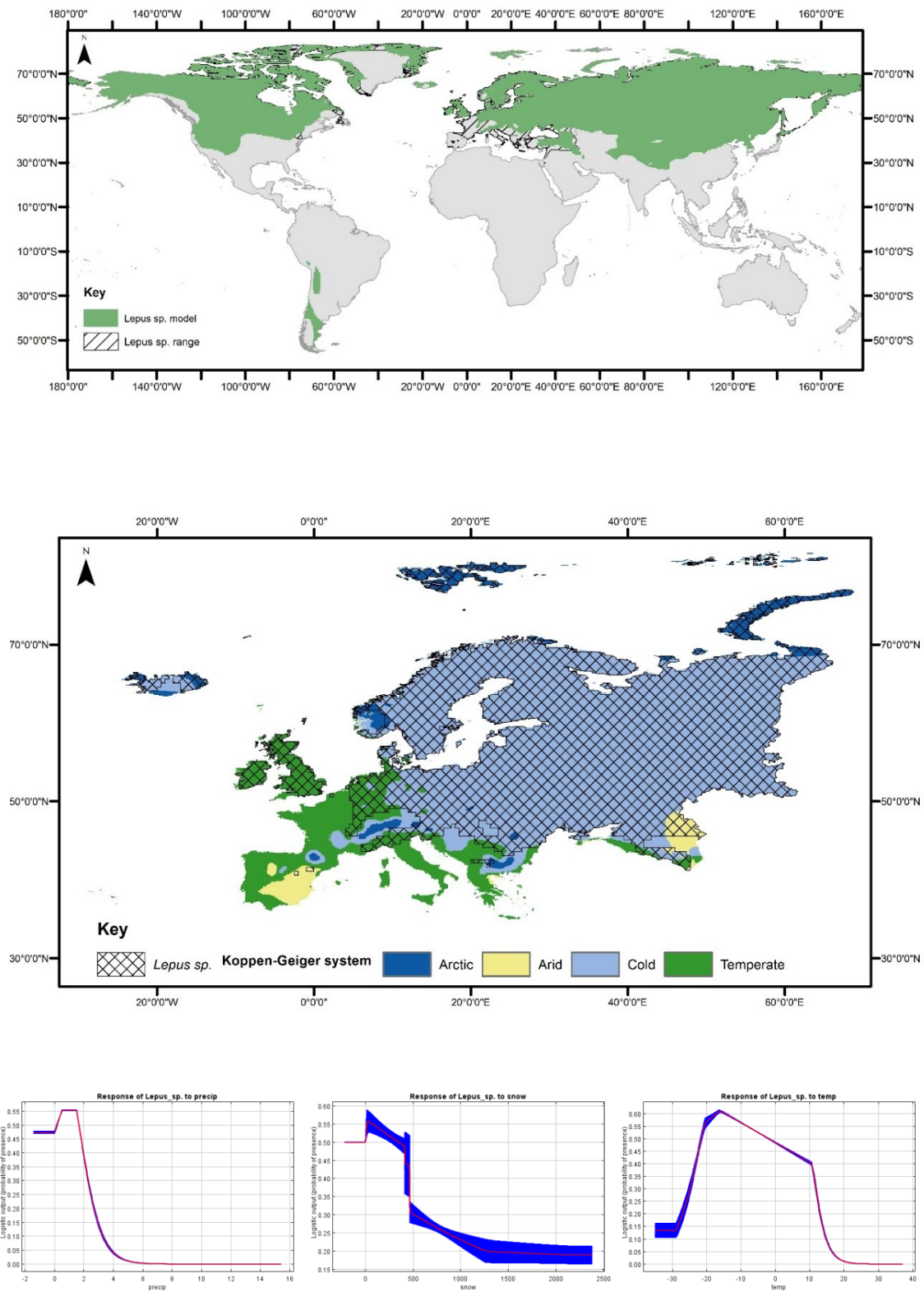
2.35 *Hyaena hyaena*

2.36 *Lemmus lemmus*

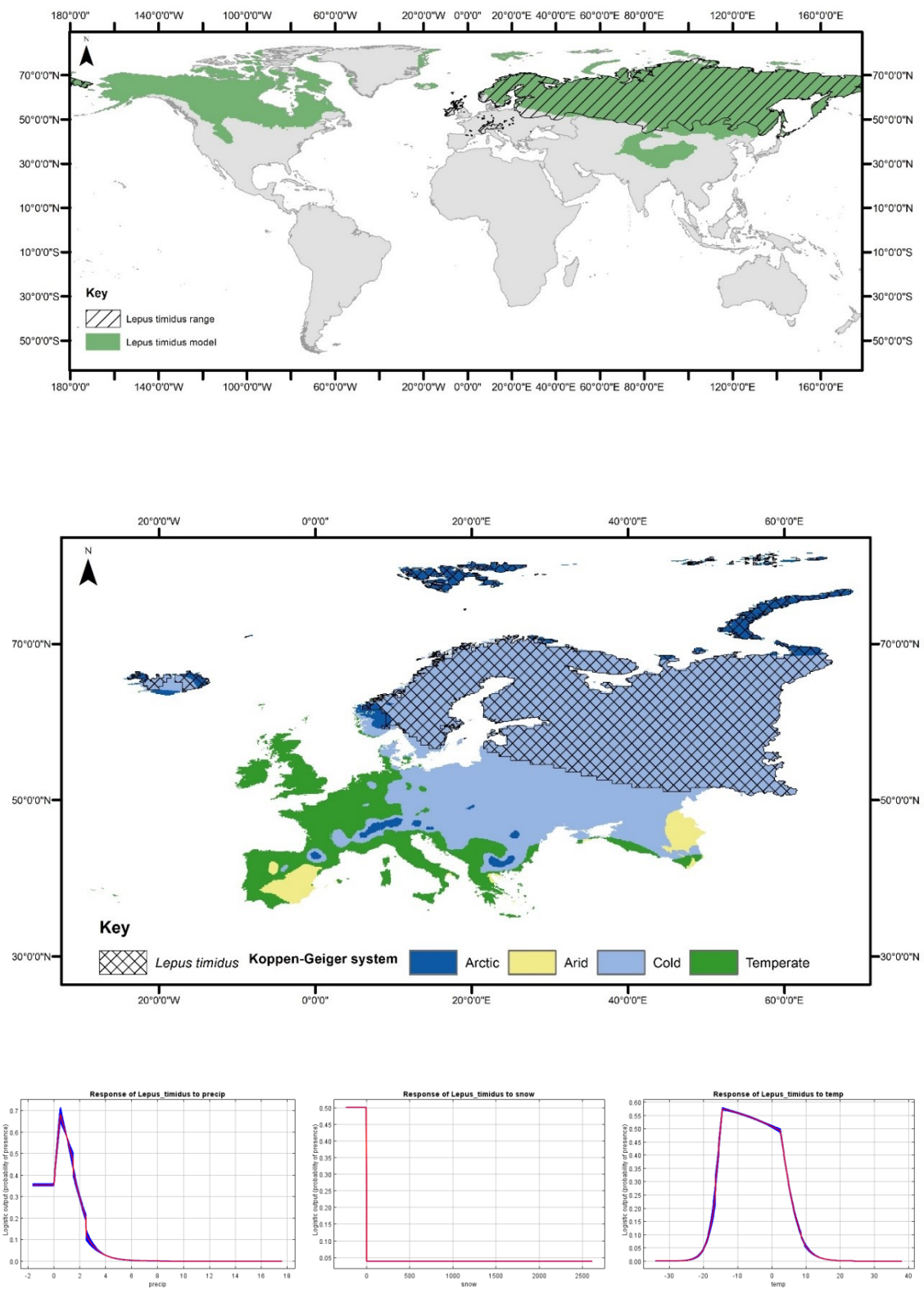


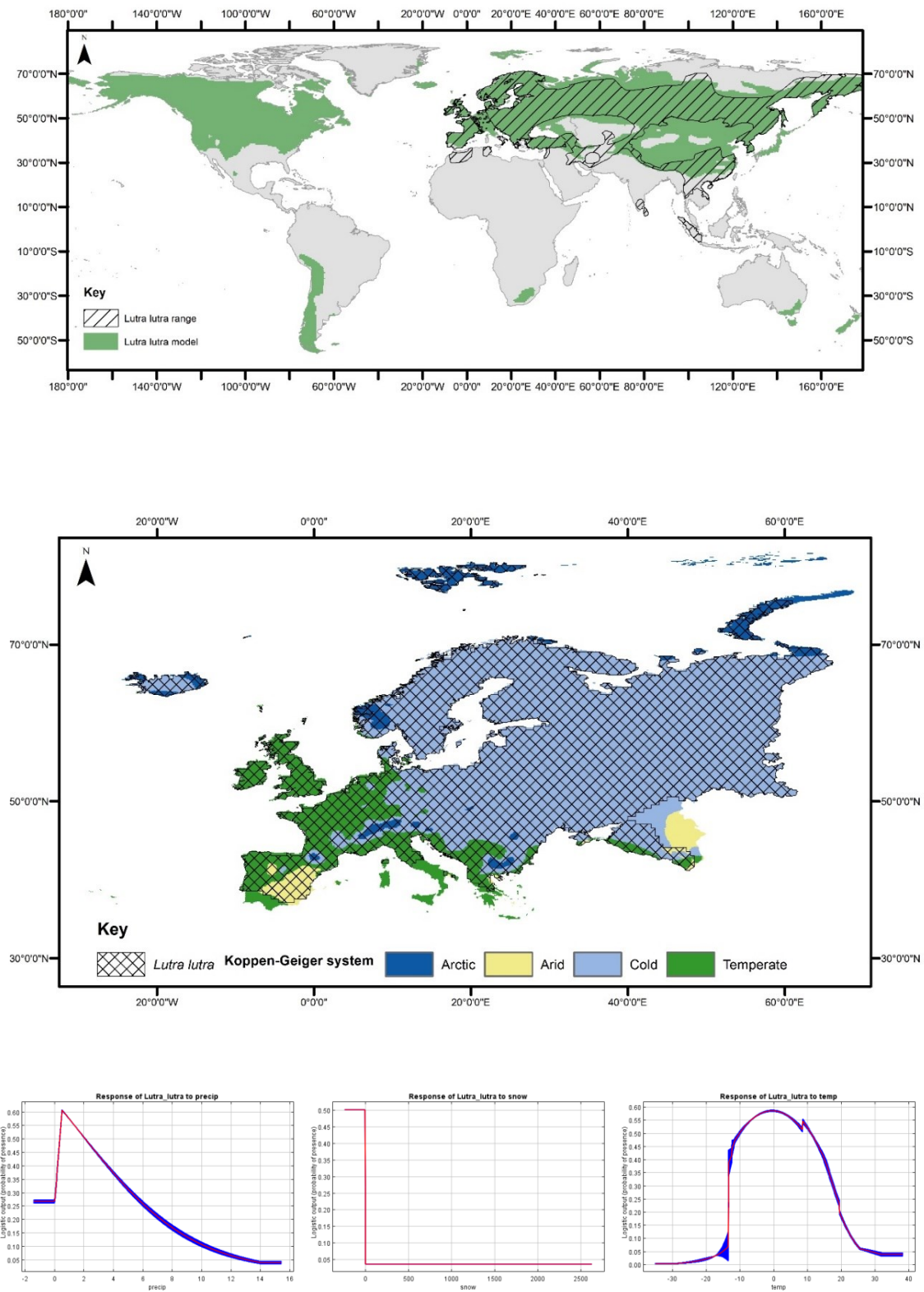
2.37 *Lepus arcticus*

2.38 *Lepus europaeus*

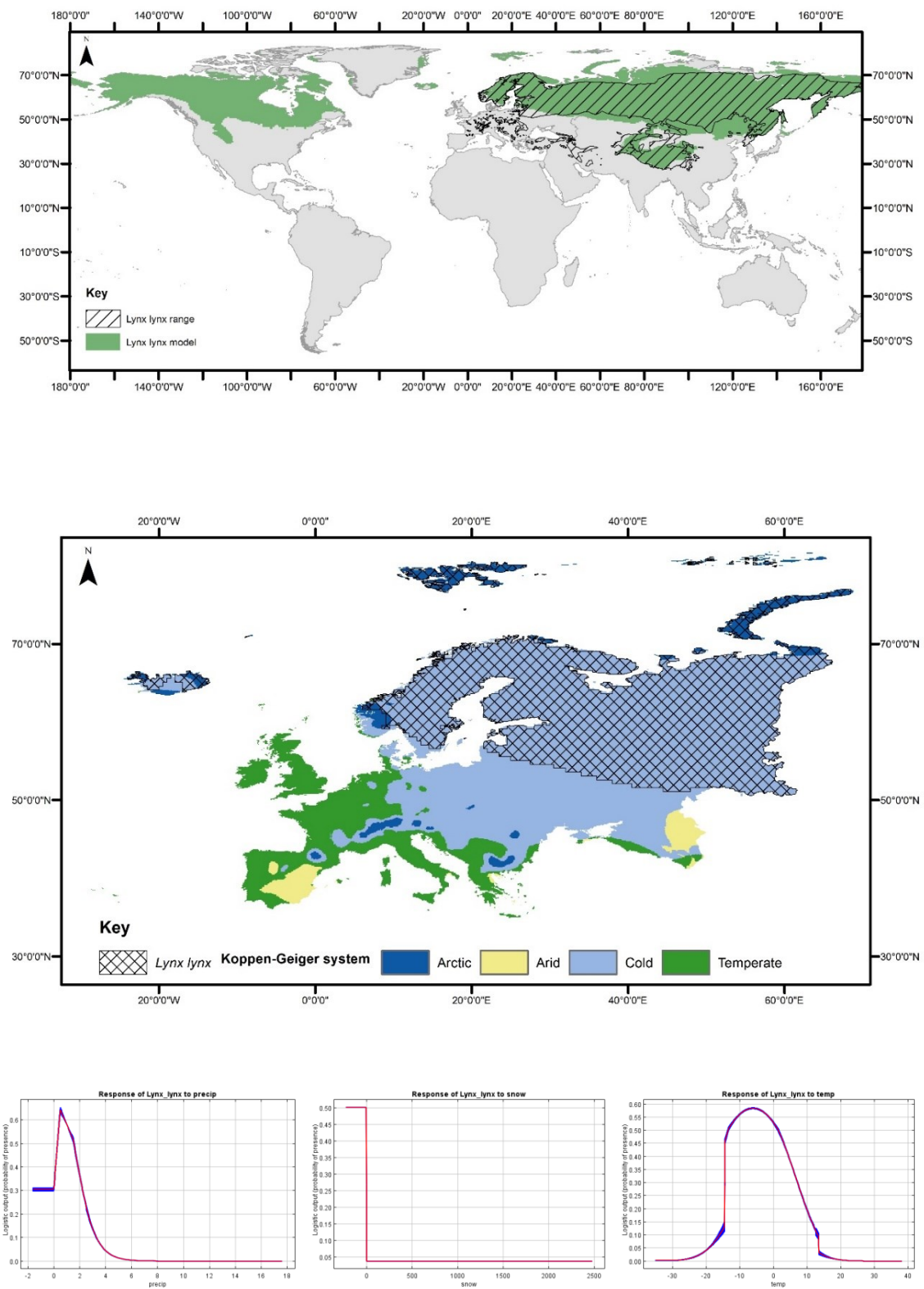
2.39 *Lepus* sp.

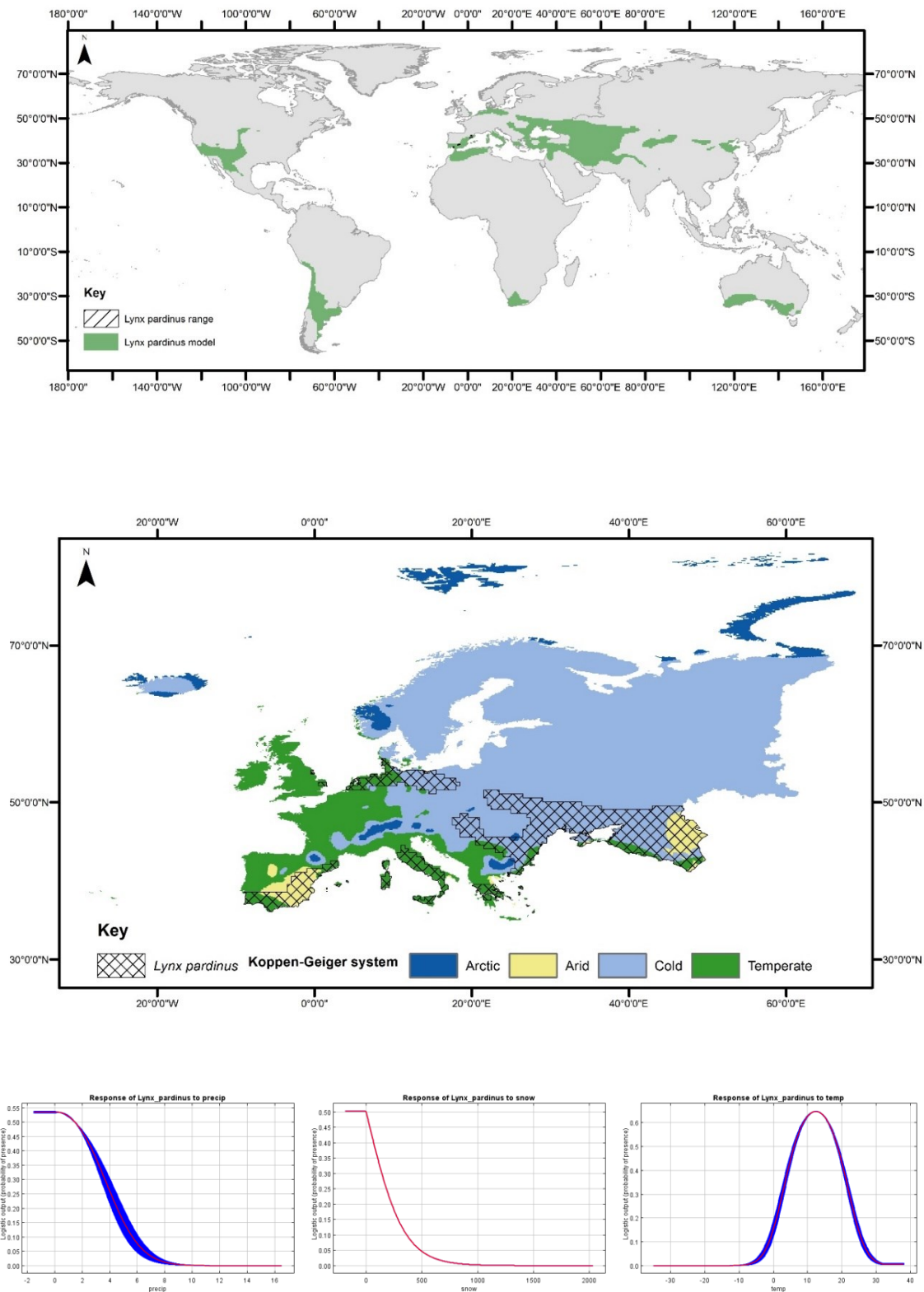
2.40 *Lepus timidus*

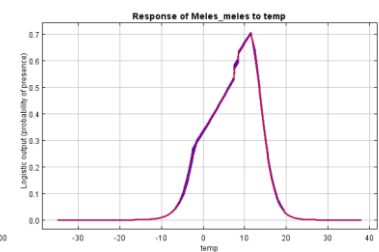
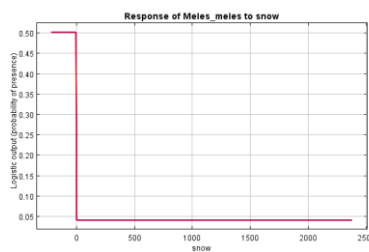
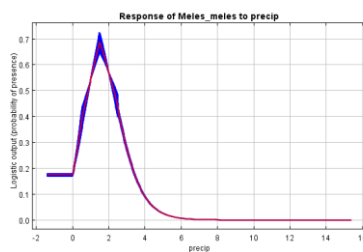
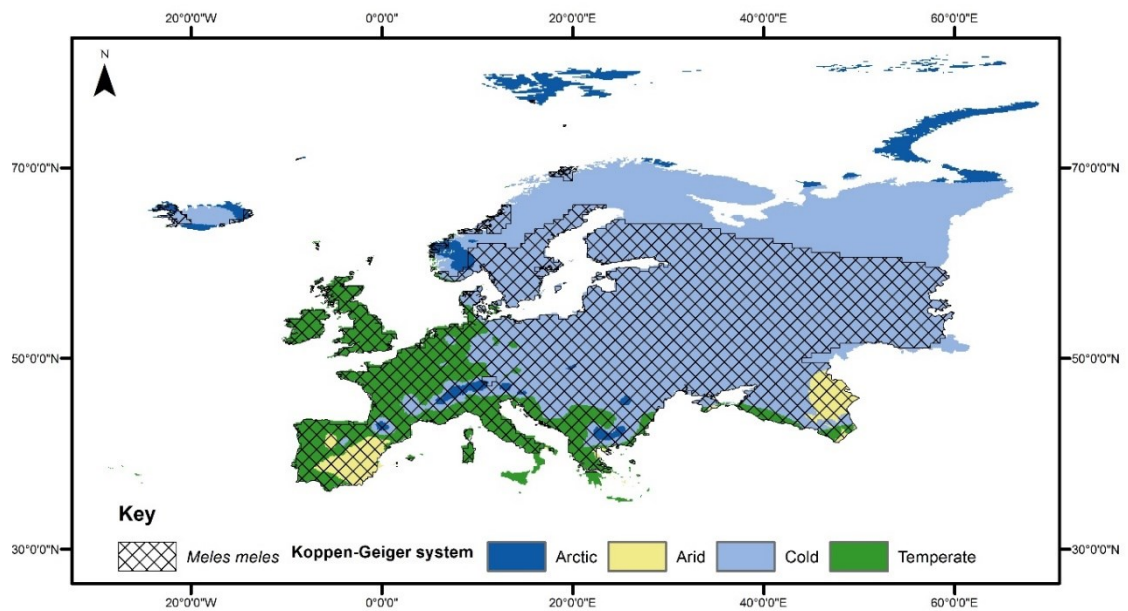
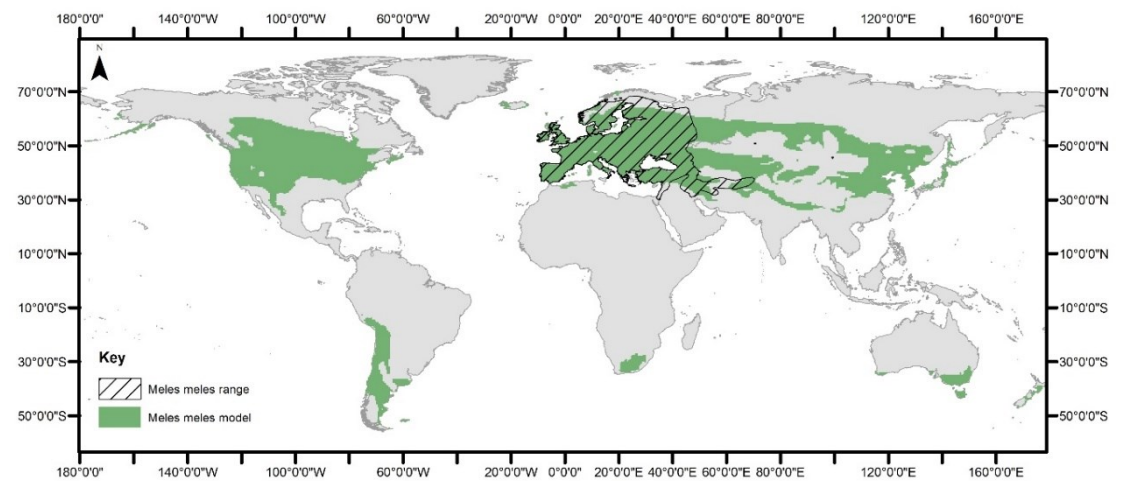


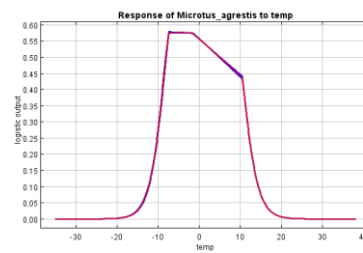
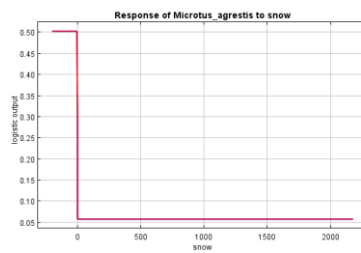
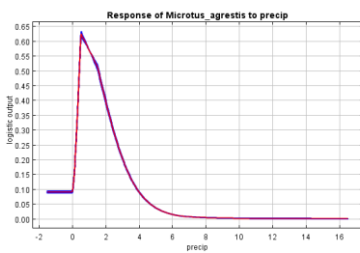
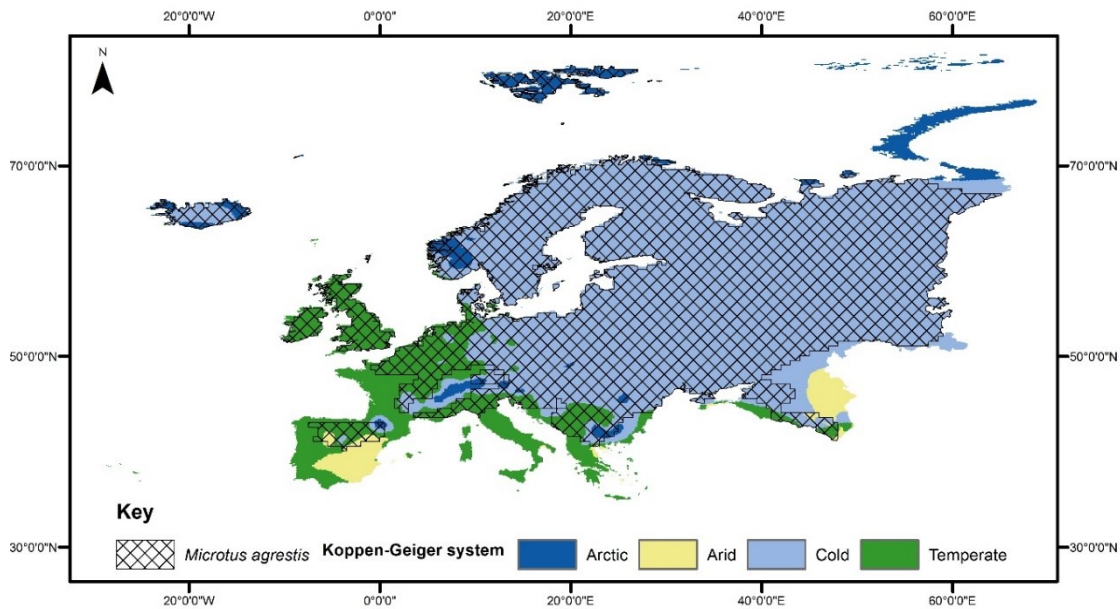
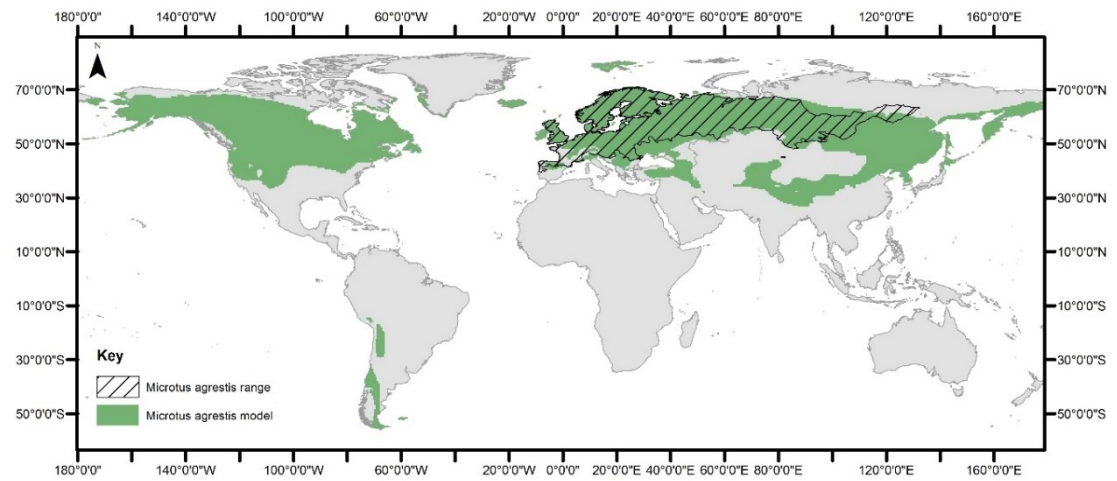
2.41 *Lutra lutra*

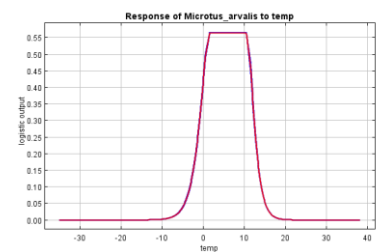
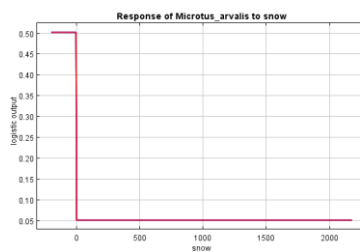
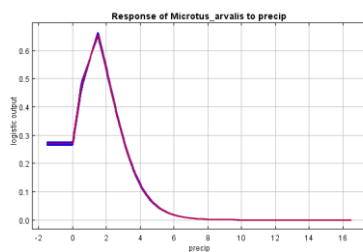
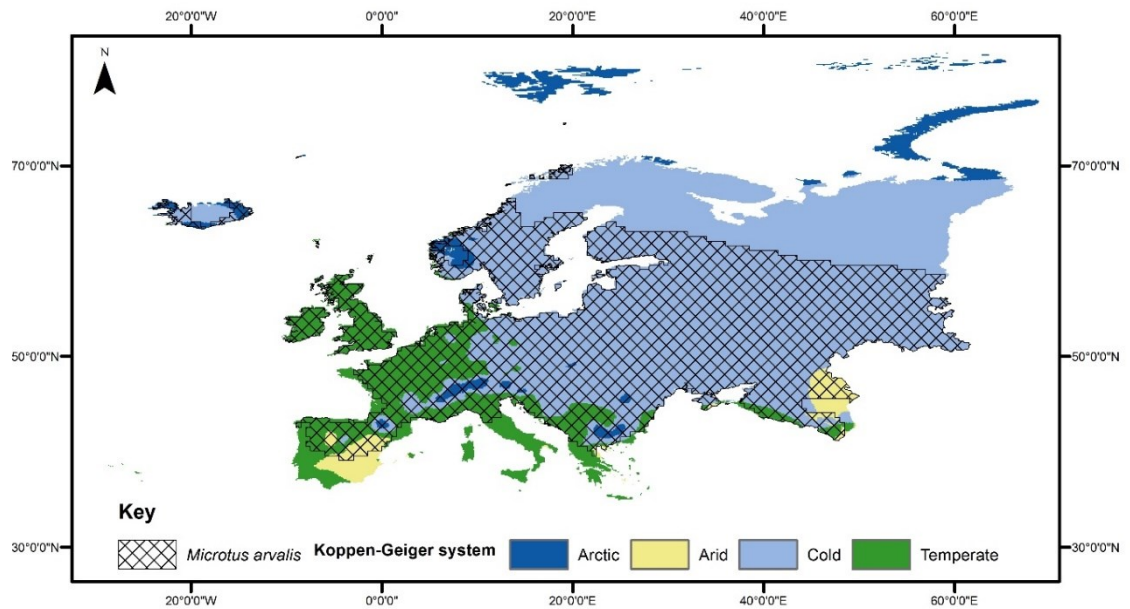
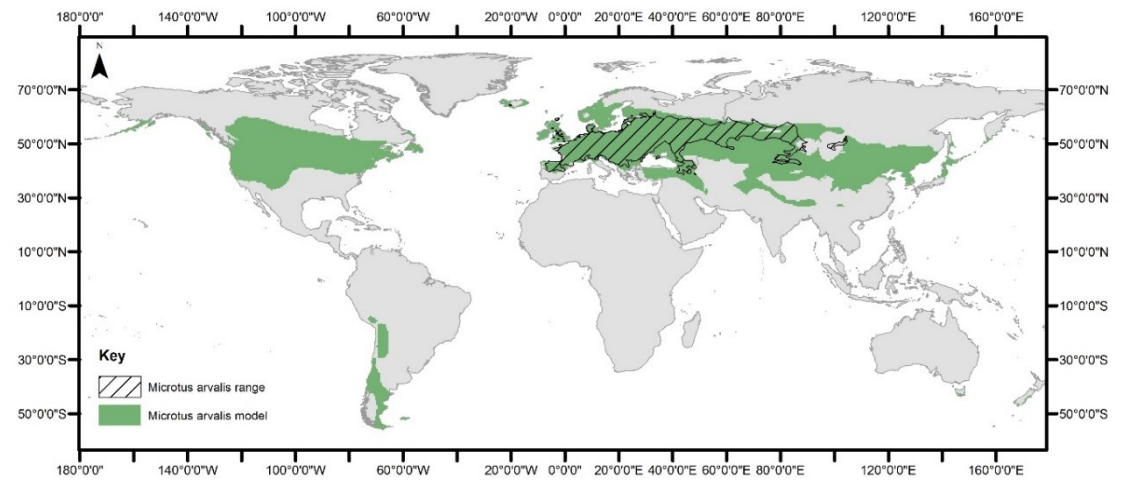
2.42 *Lynx lynx*

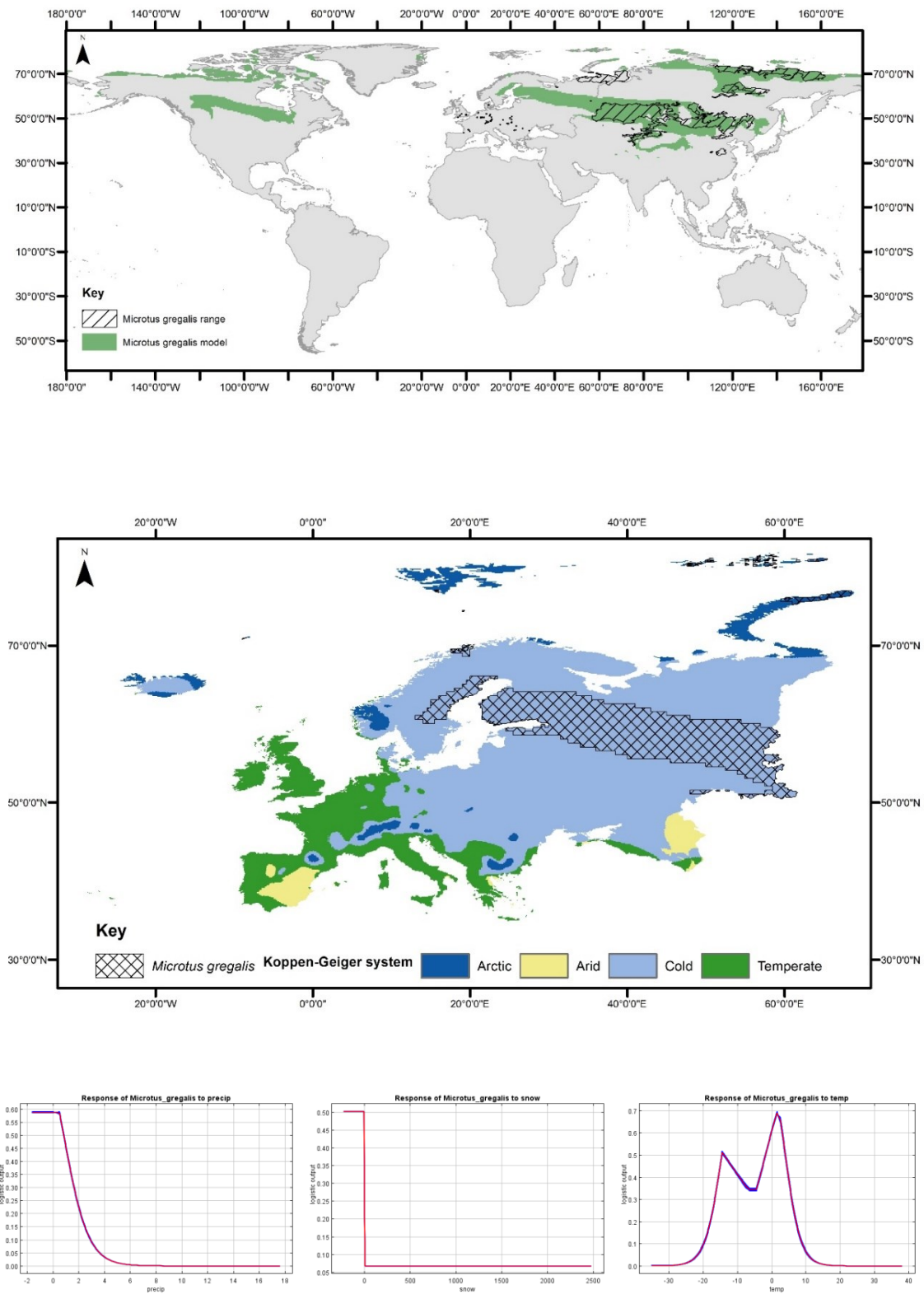


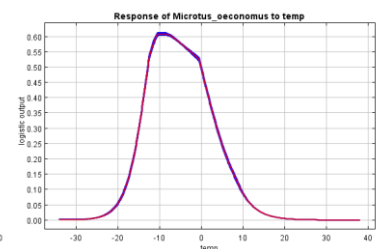
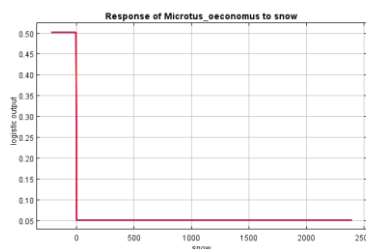
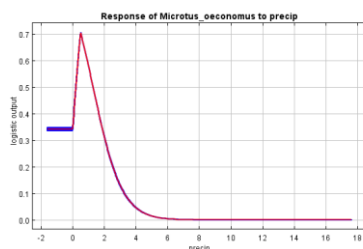
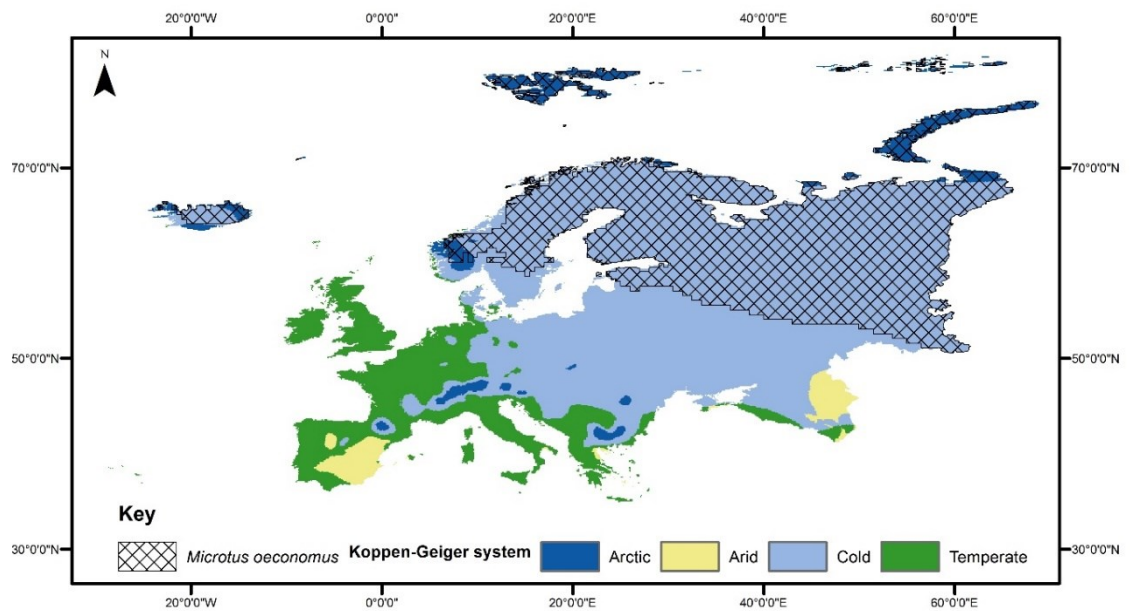
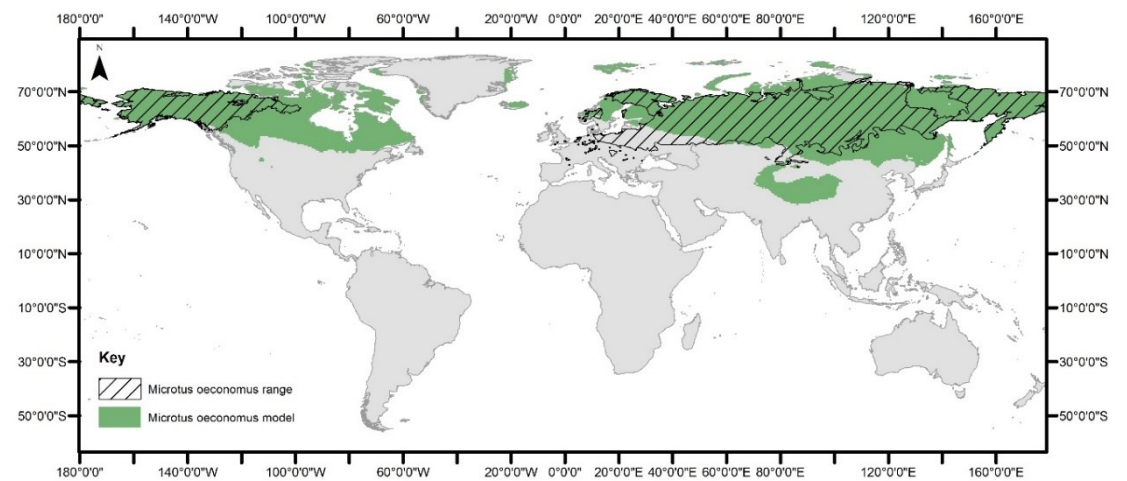
2.43 *Lynx pardinus*

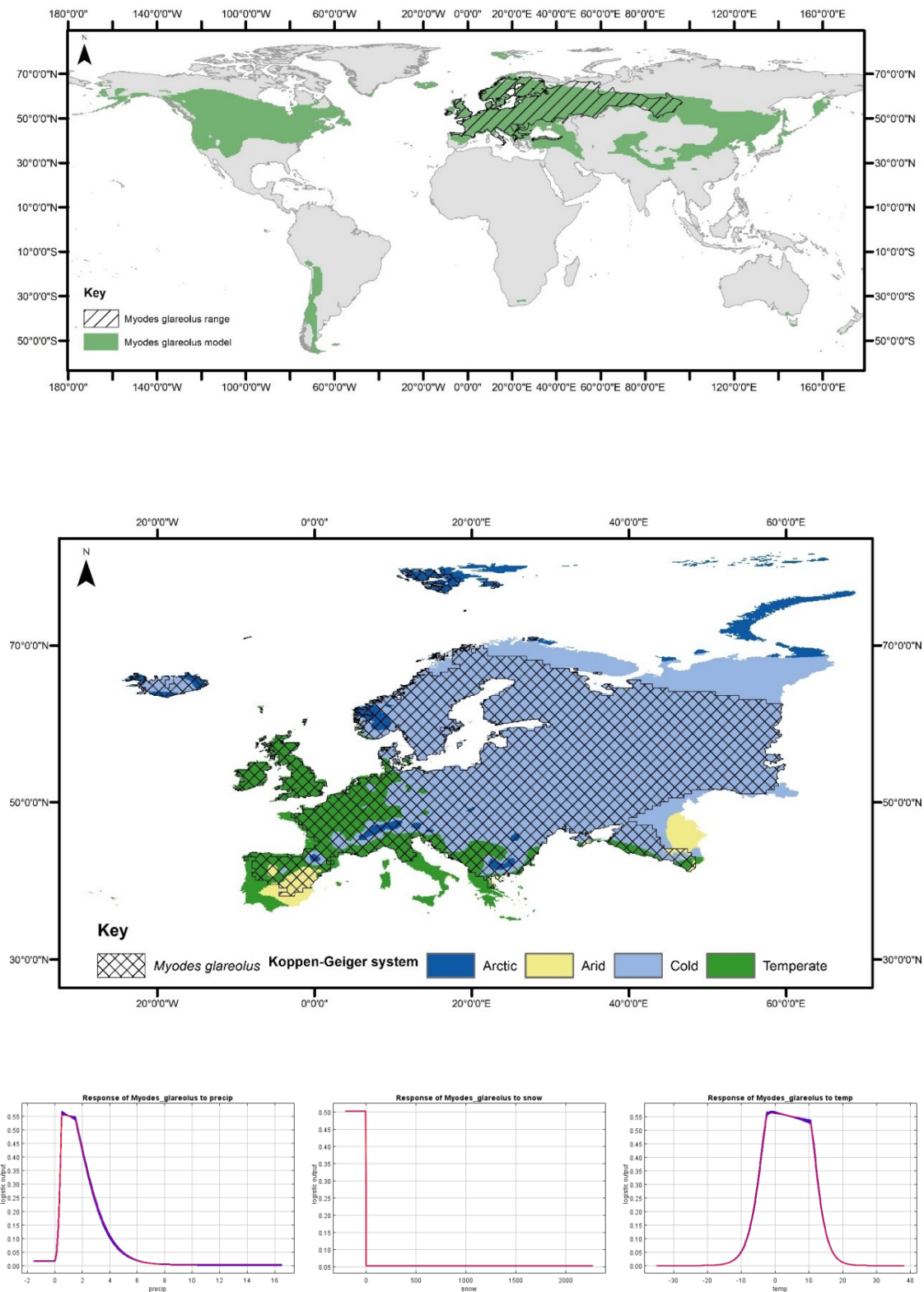
2.44 *Meles meles*

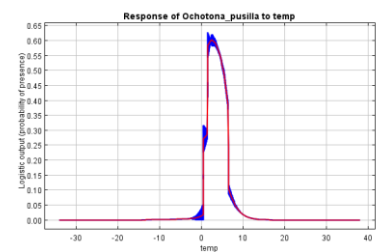
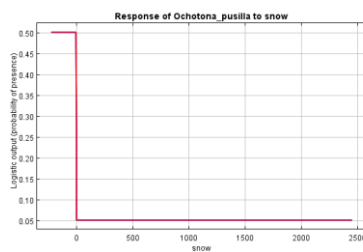
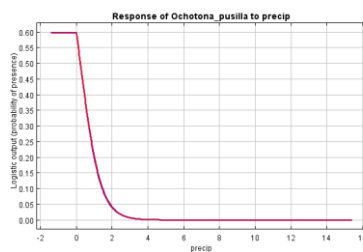
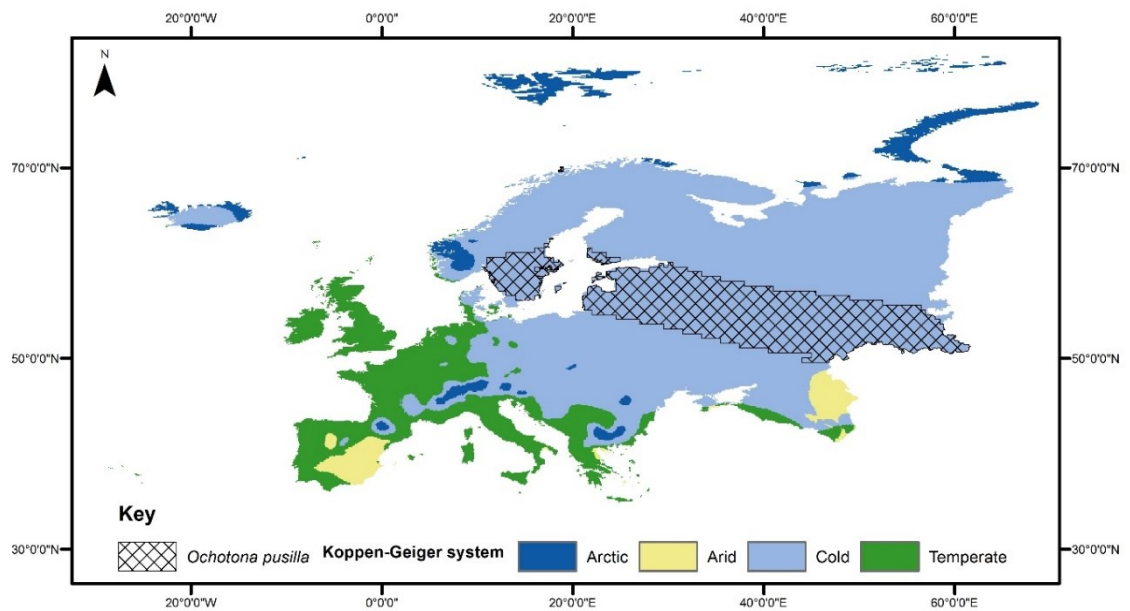
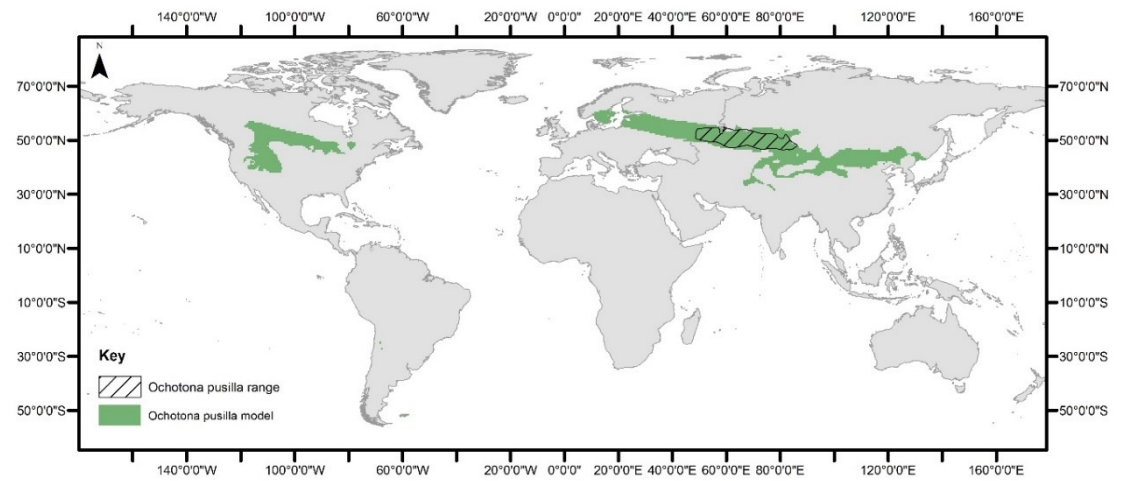
2.45 *Microtus agrestis*

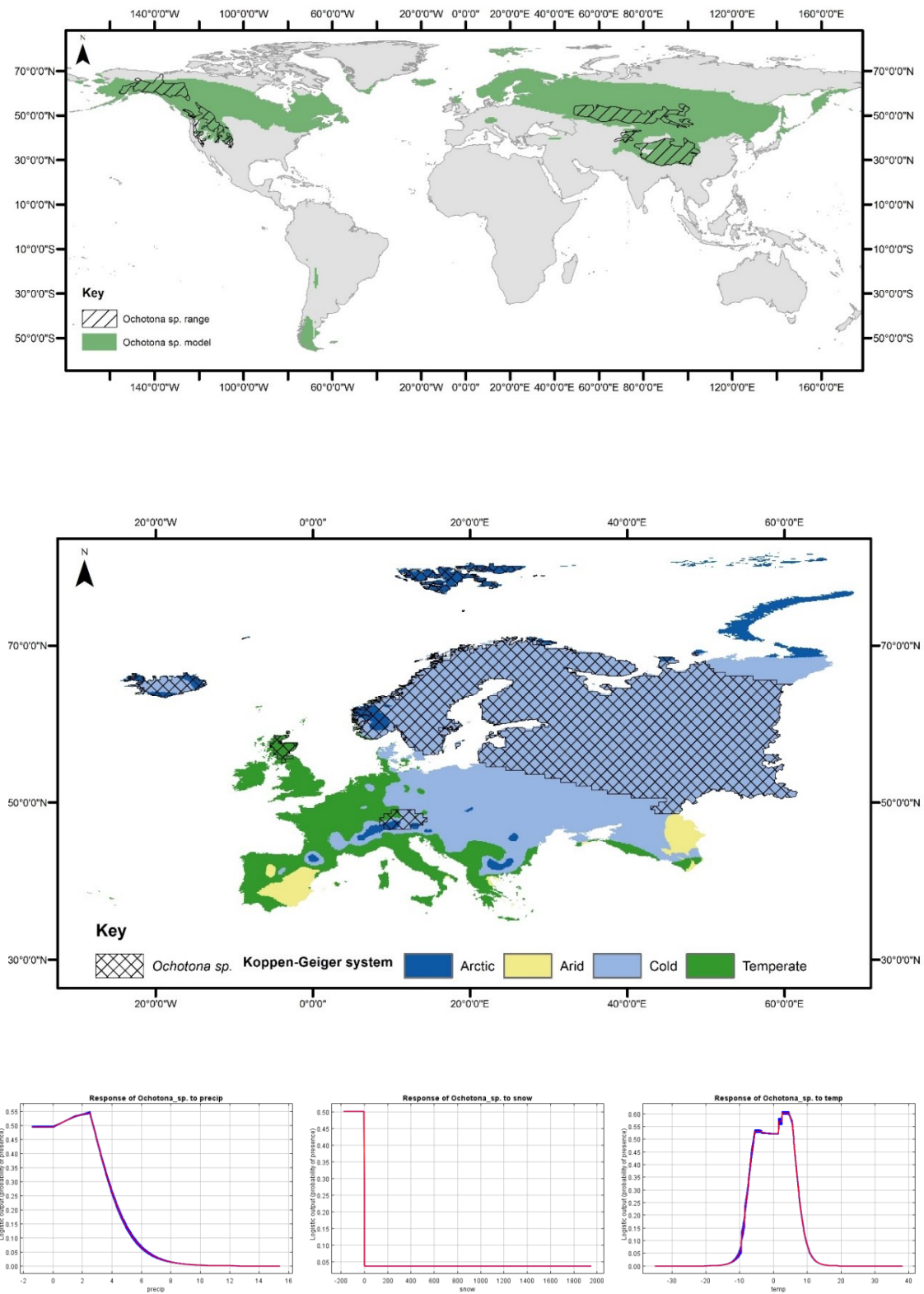
2.46 *Microtus arvalis*

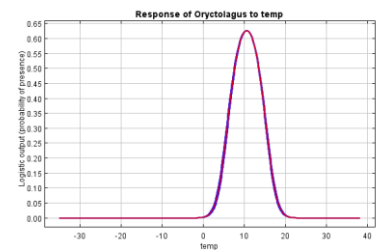
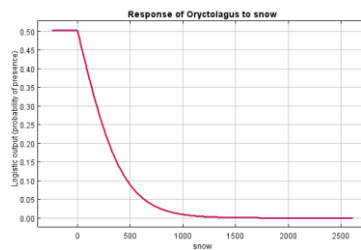
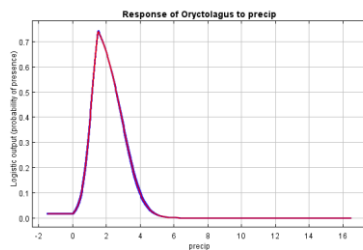
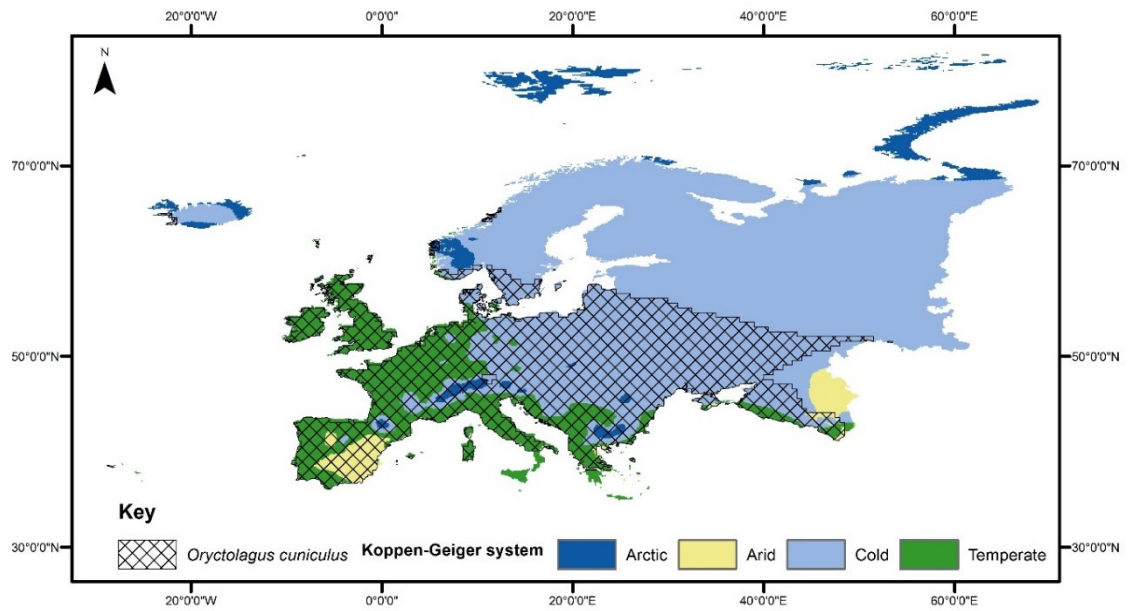
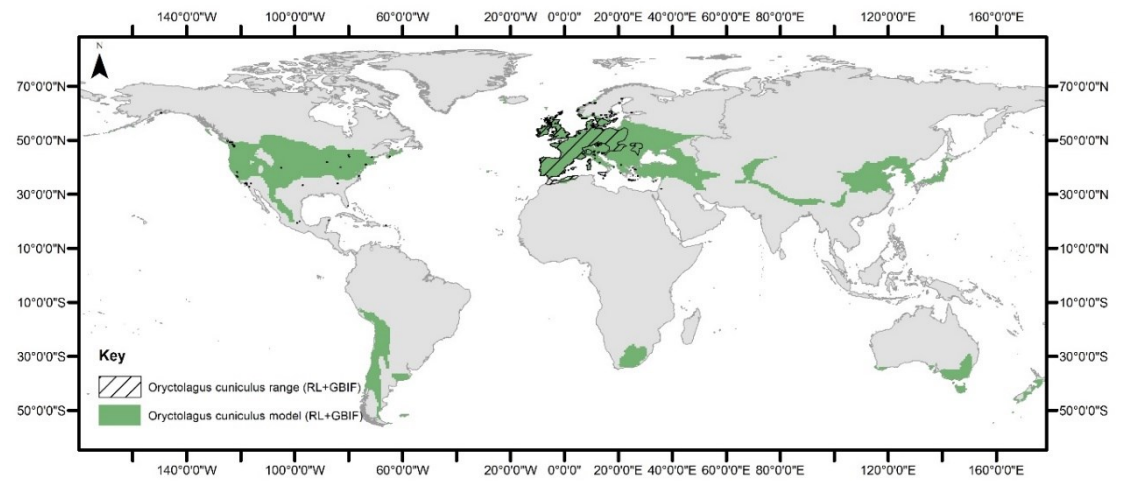
2.47 *Microtus gregalis*

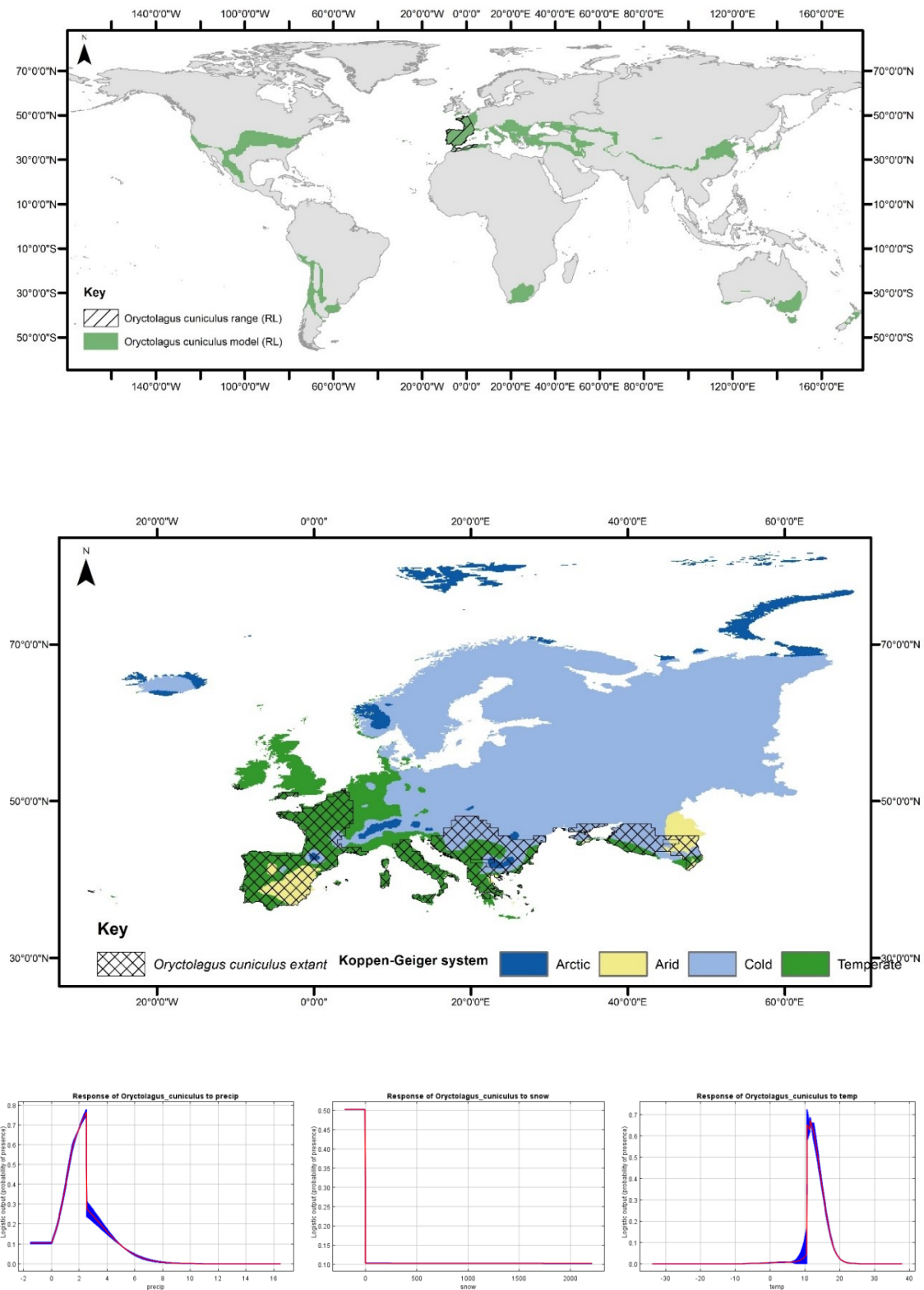
2.48 *Microtus oeconomus*

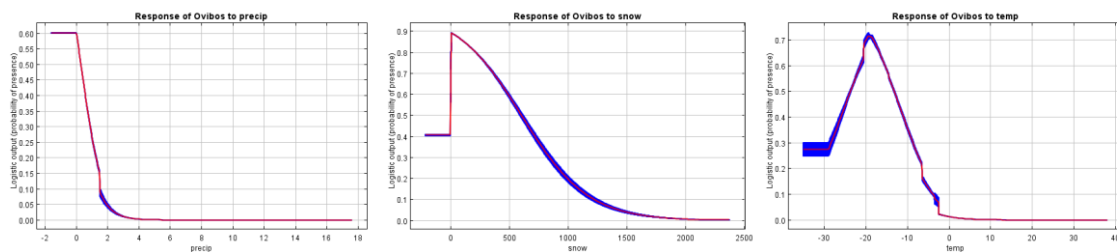
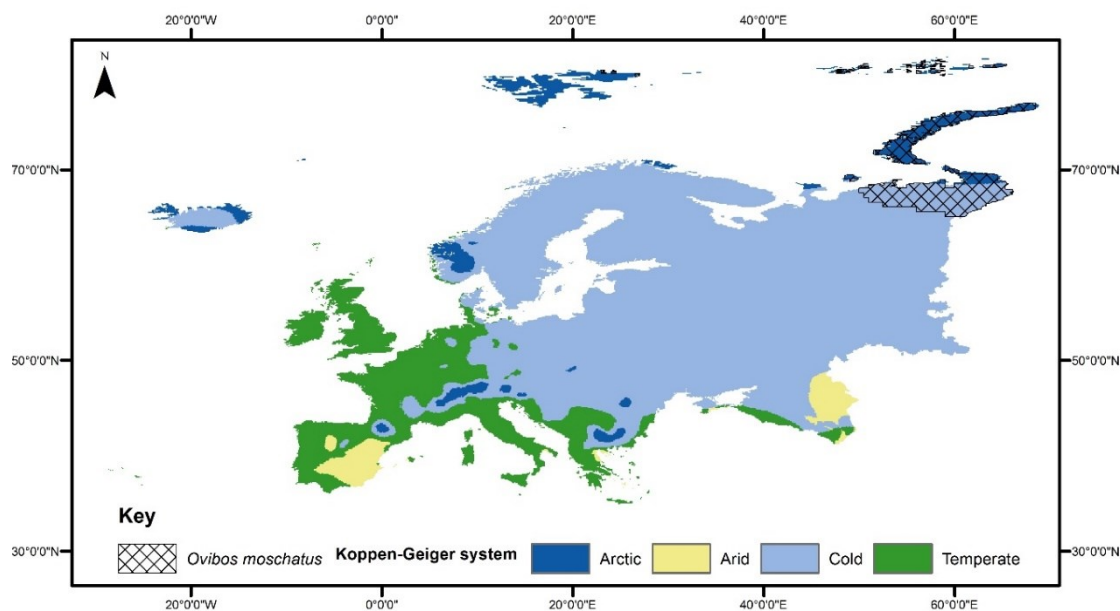
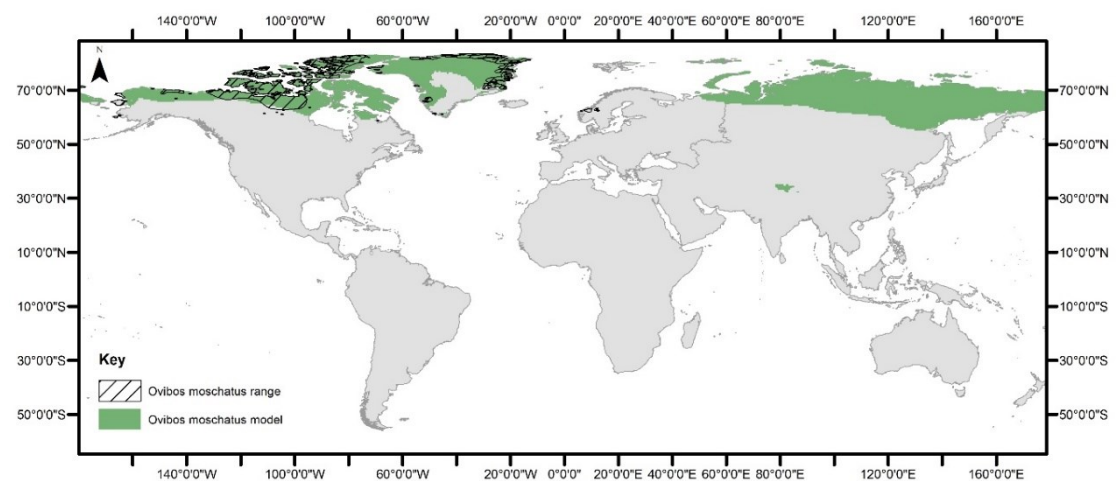
2.49 *Myodes glareolus*

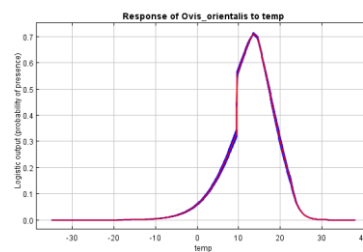
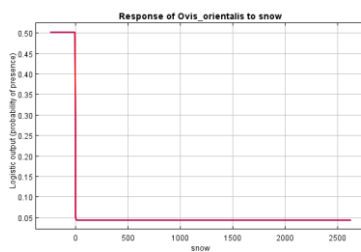
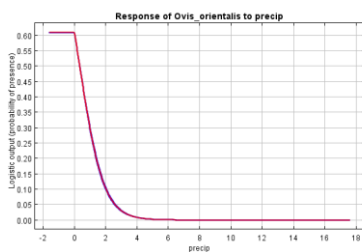
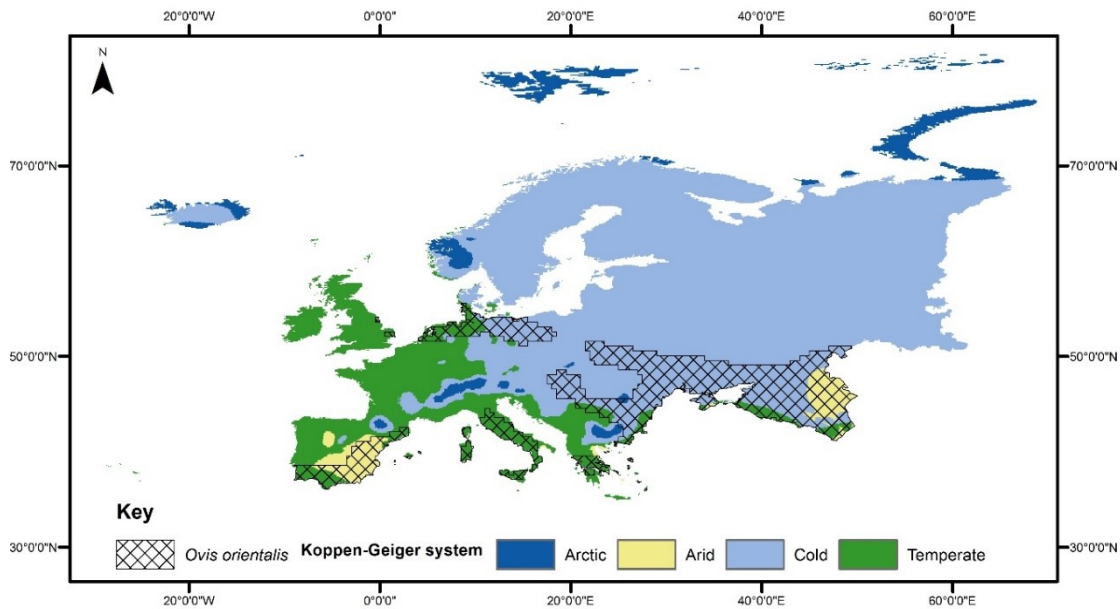
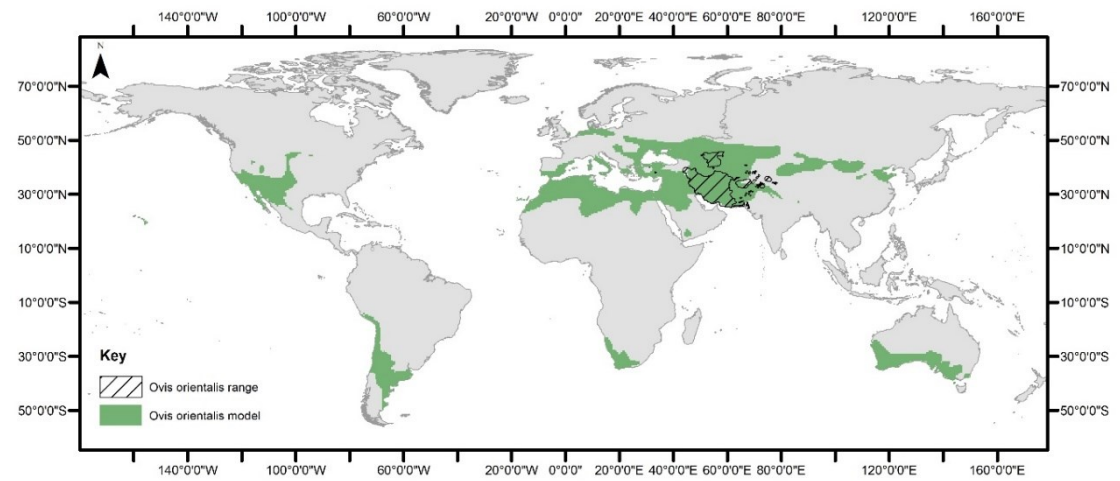
2.50 *Ochotona pusilla*

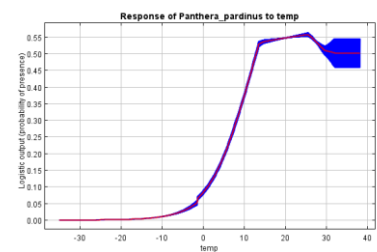
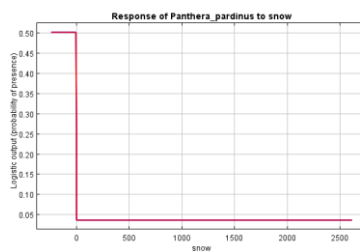
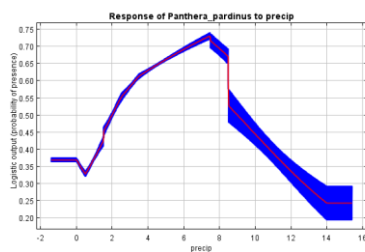
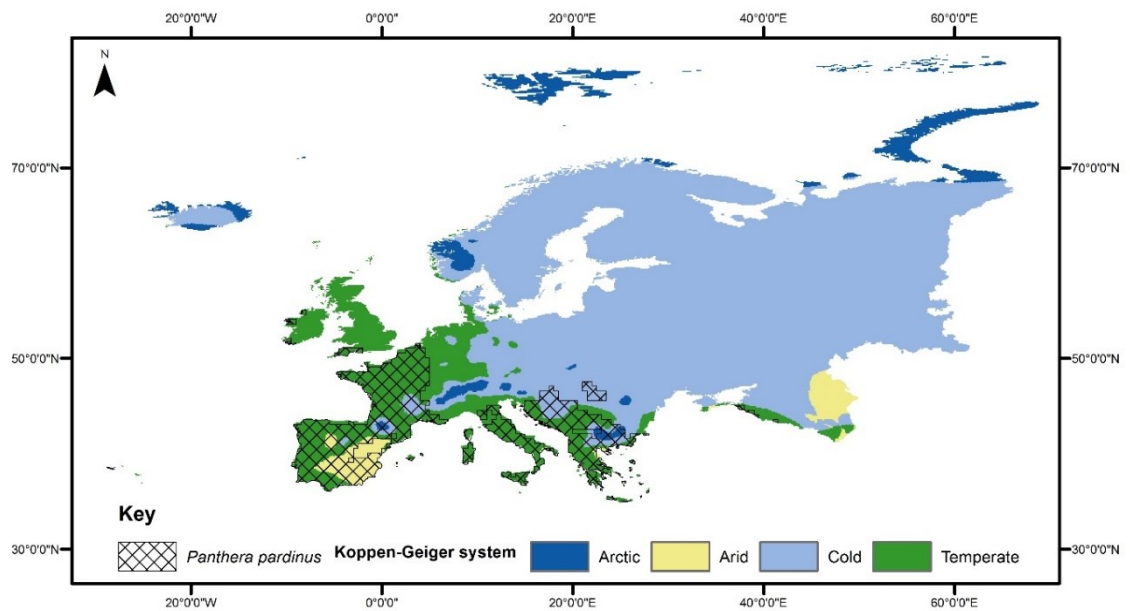
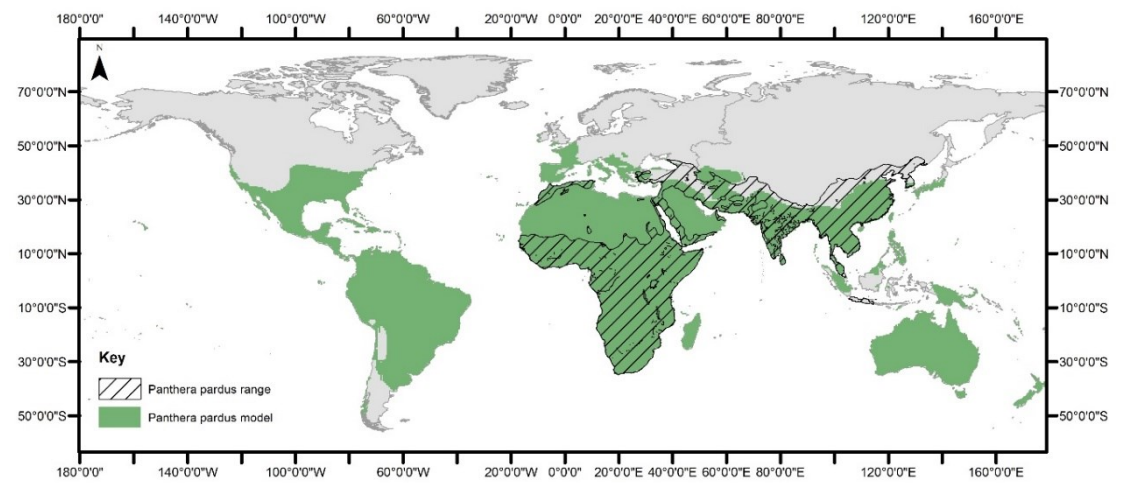
2.51 *Ochotona* sp.

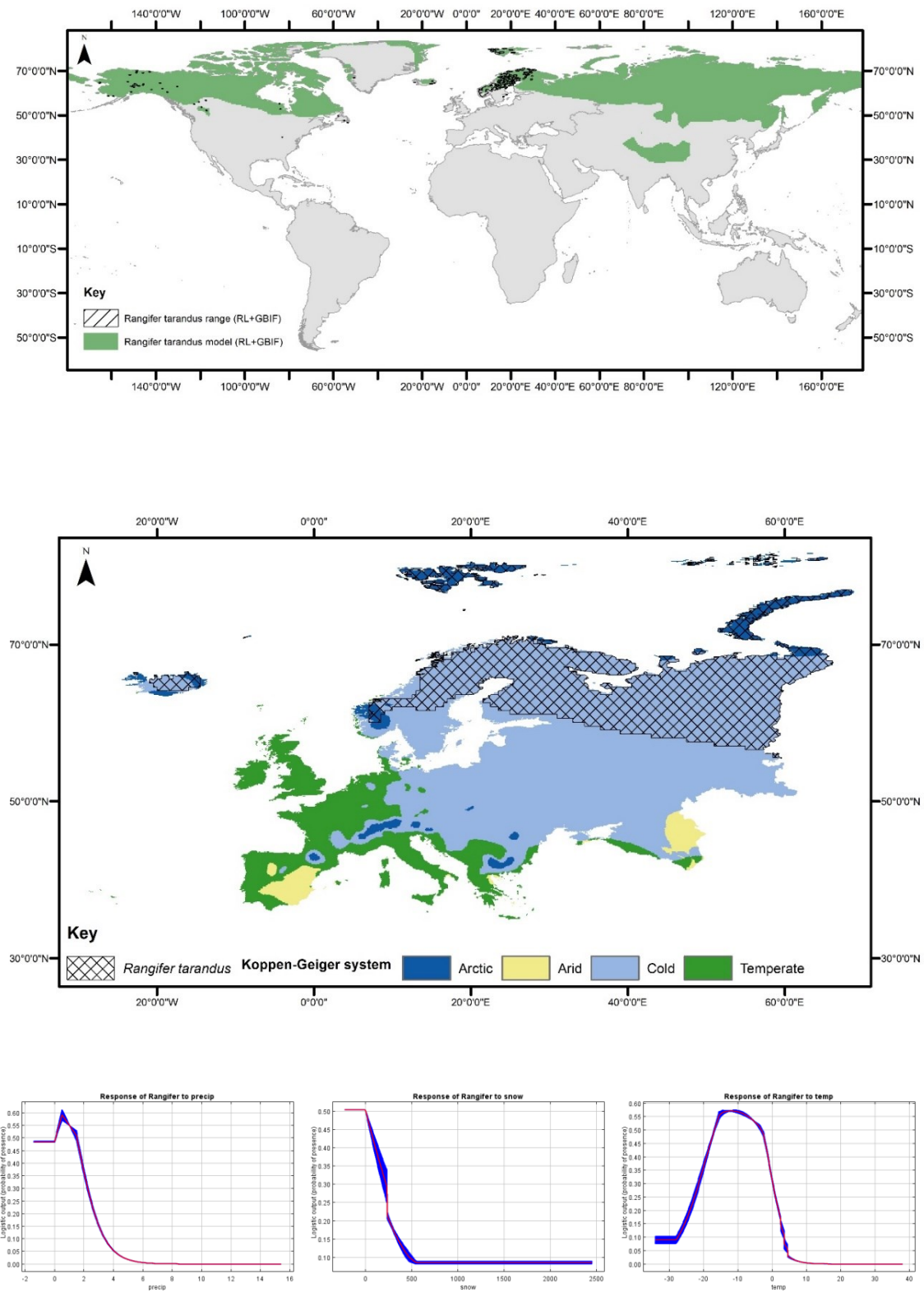
2.52 *Oryctolagus cuniculus* (RL+GBIF)

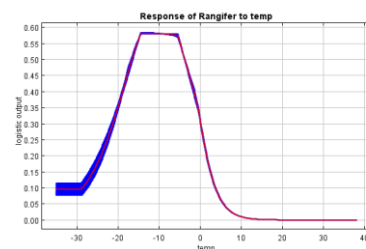
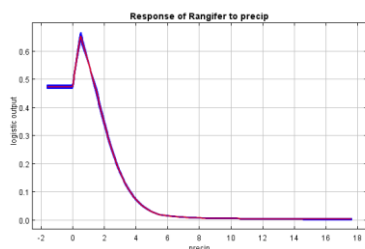
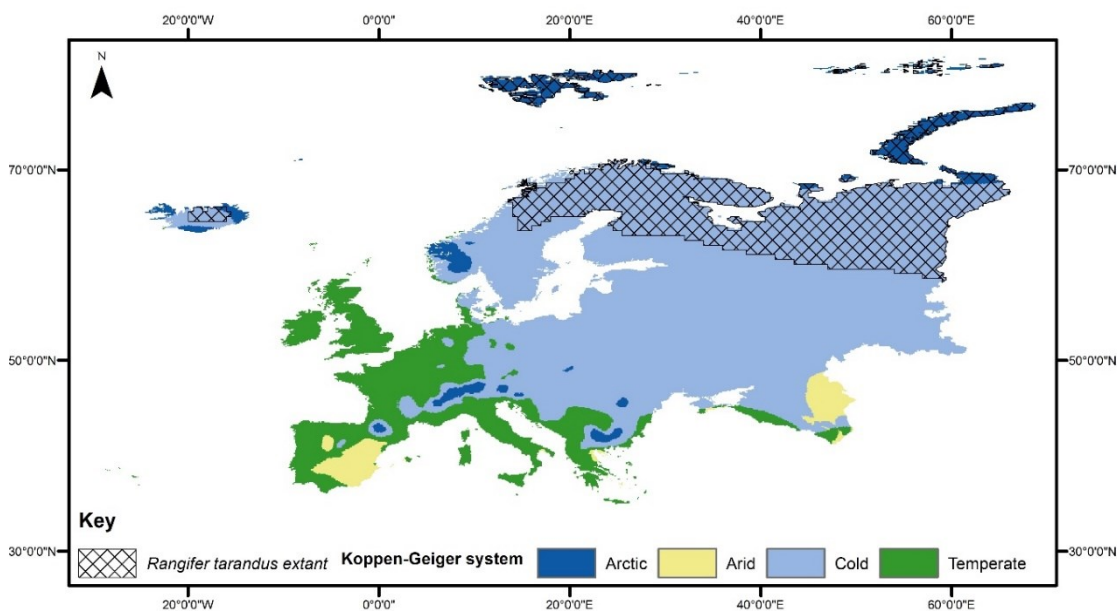
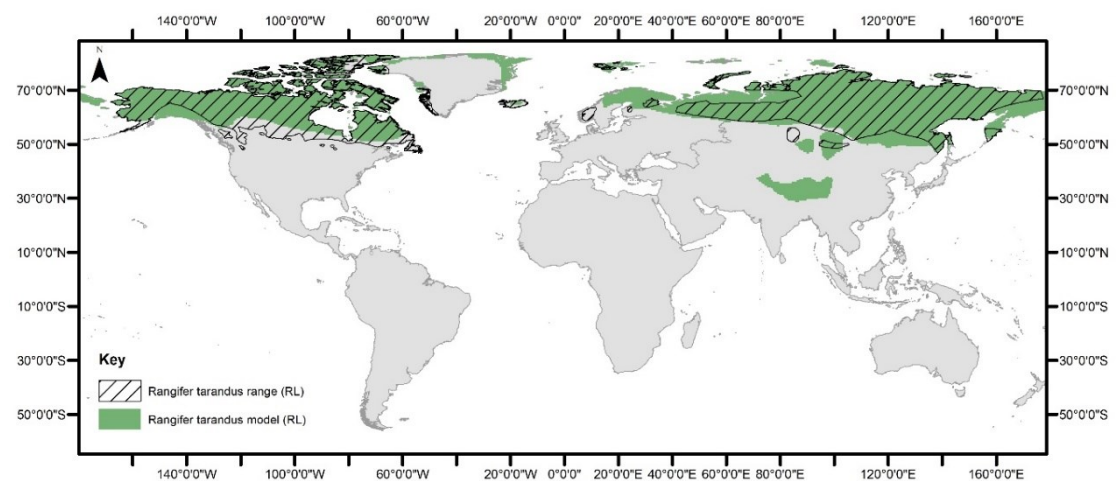
2.53 *Oryctolagus cuniculus* (RL)

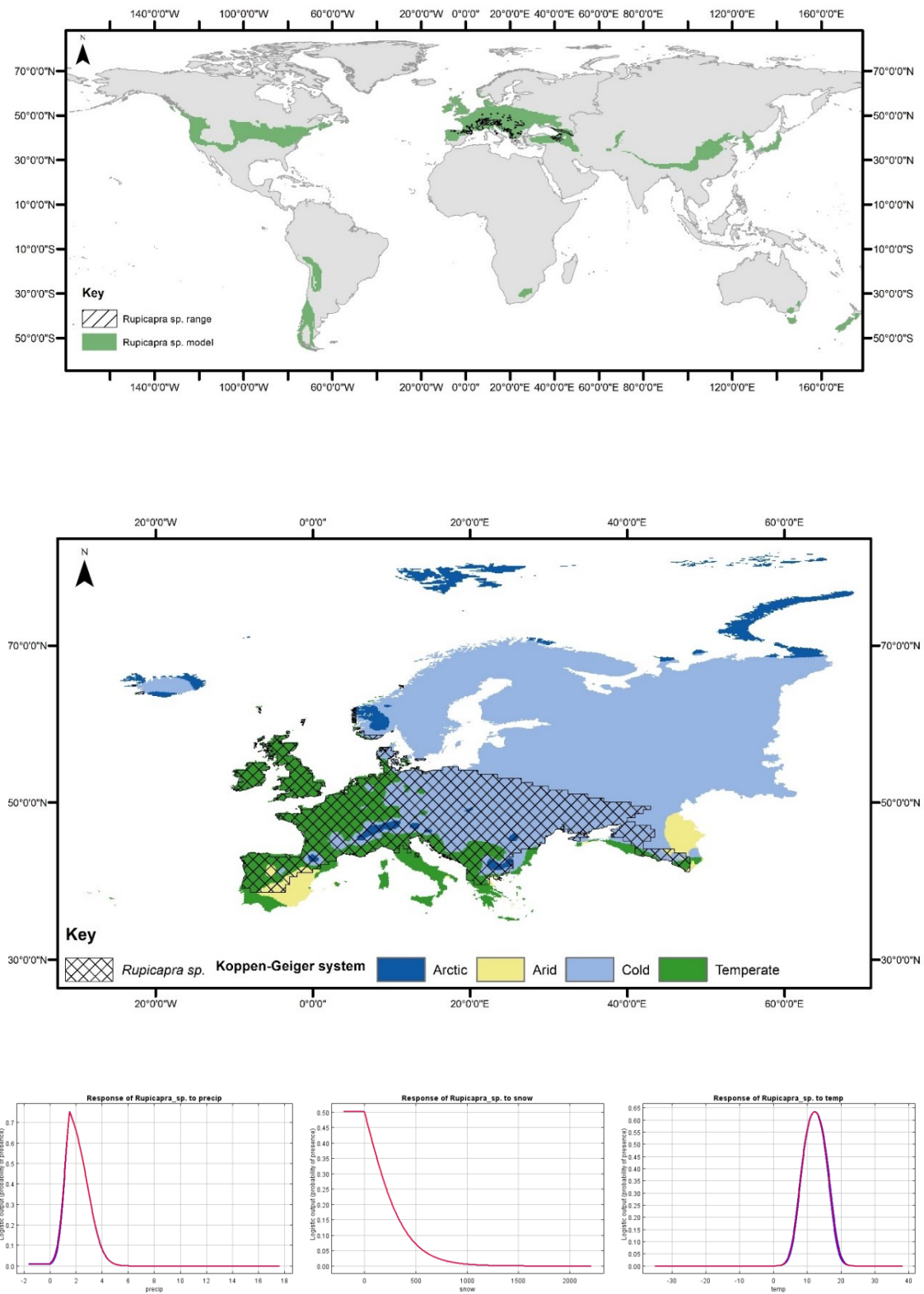
2.54 *Ovibos moschatus*

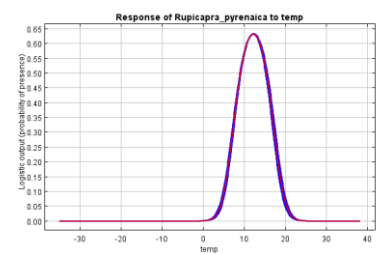
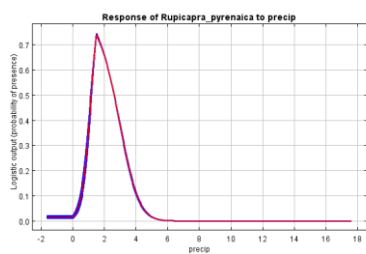
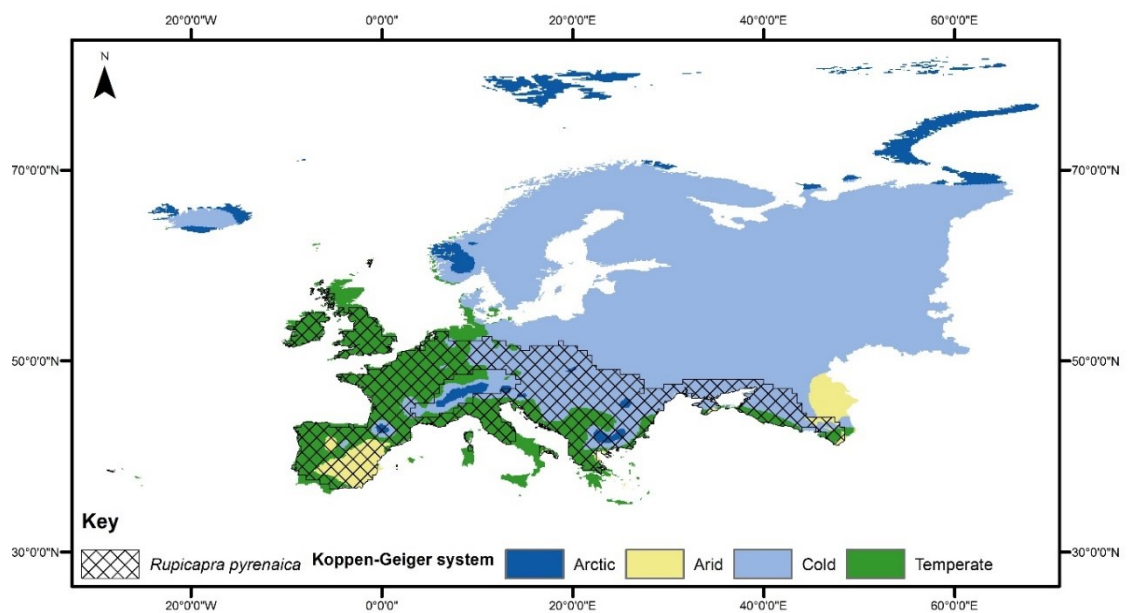
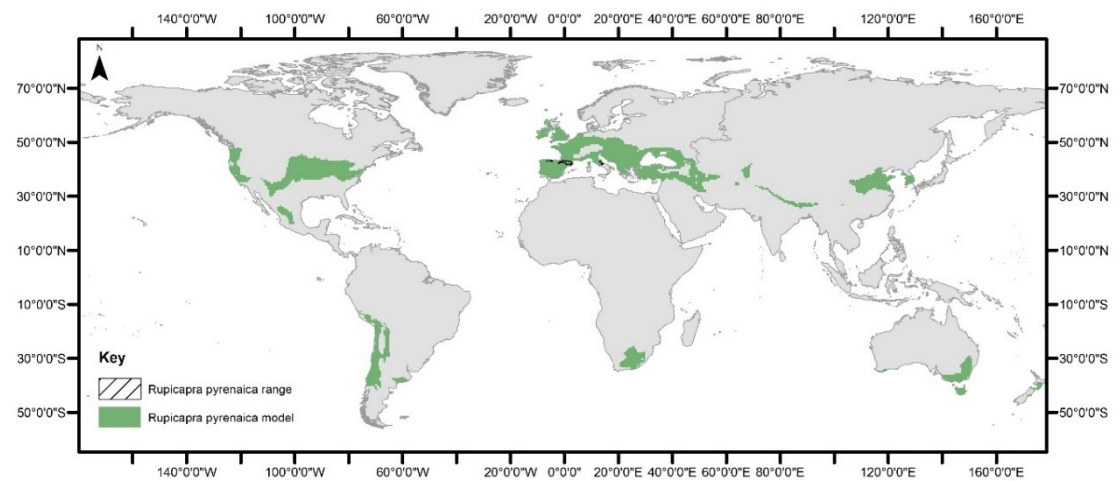
2.55 *Ovis orientalis*

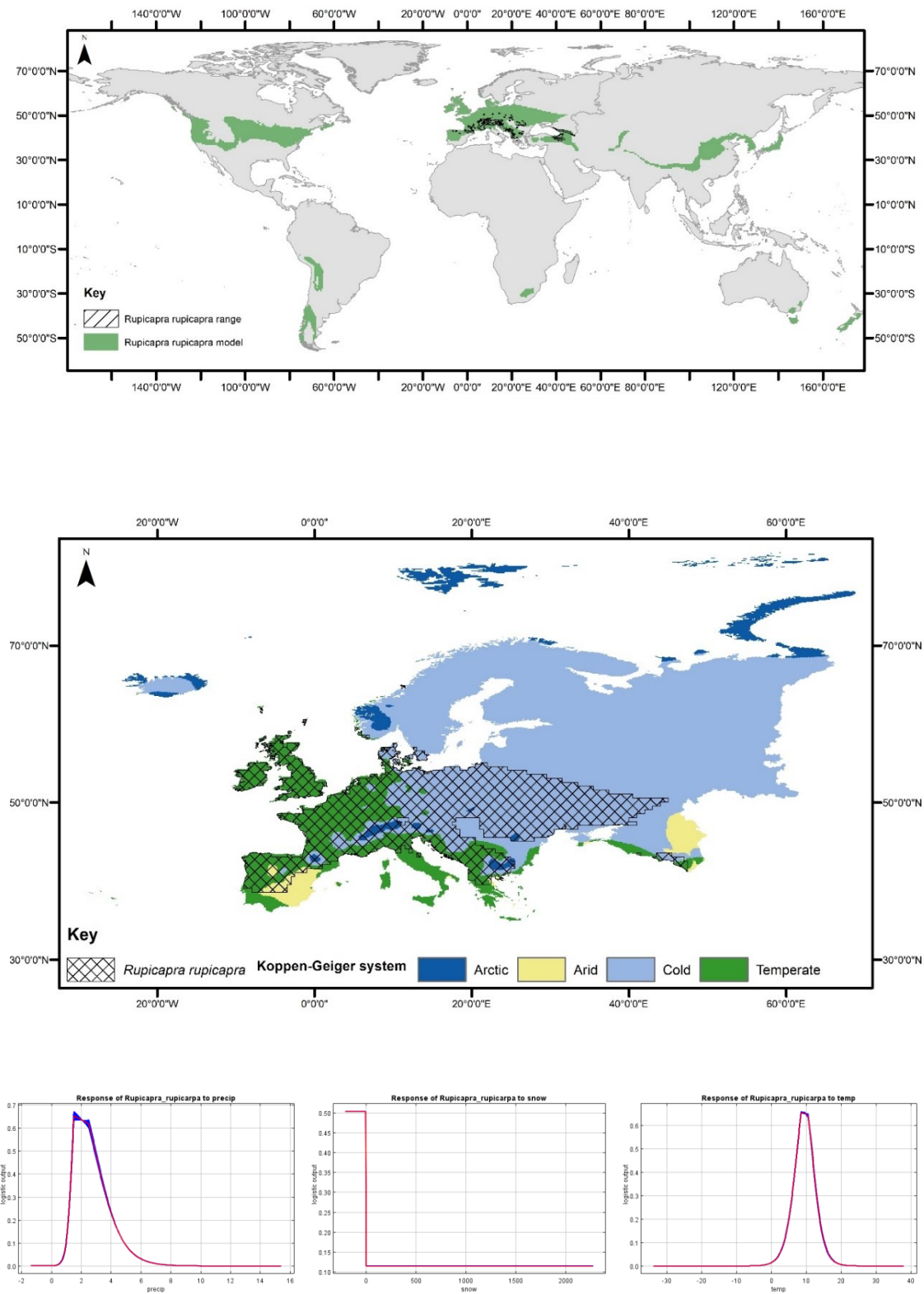
2.56 *Panthera pardus*

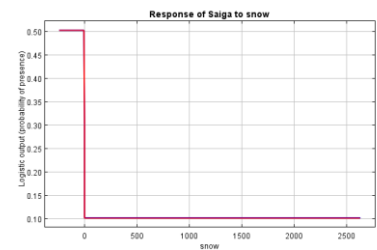
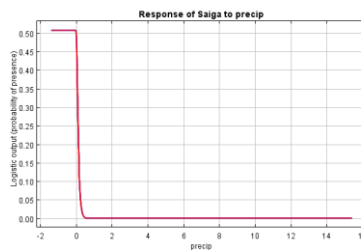
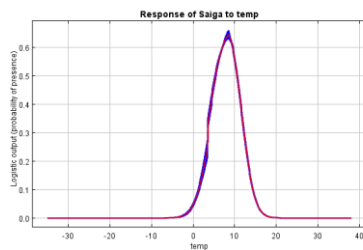
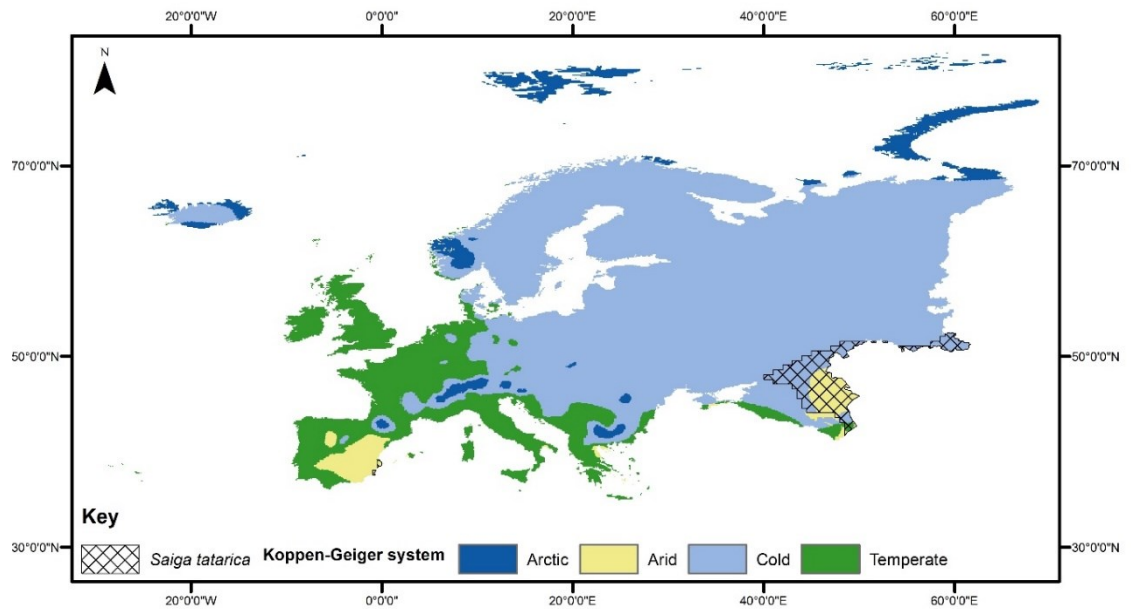
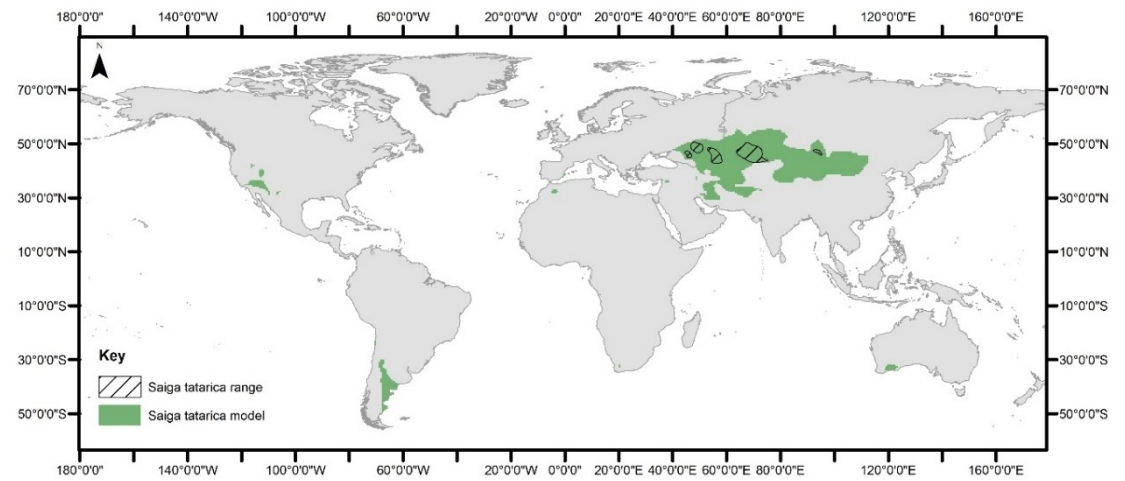
2.57 *Rangifer tarandus* (RL+GBIF)

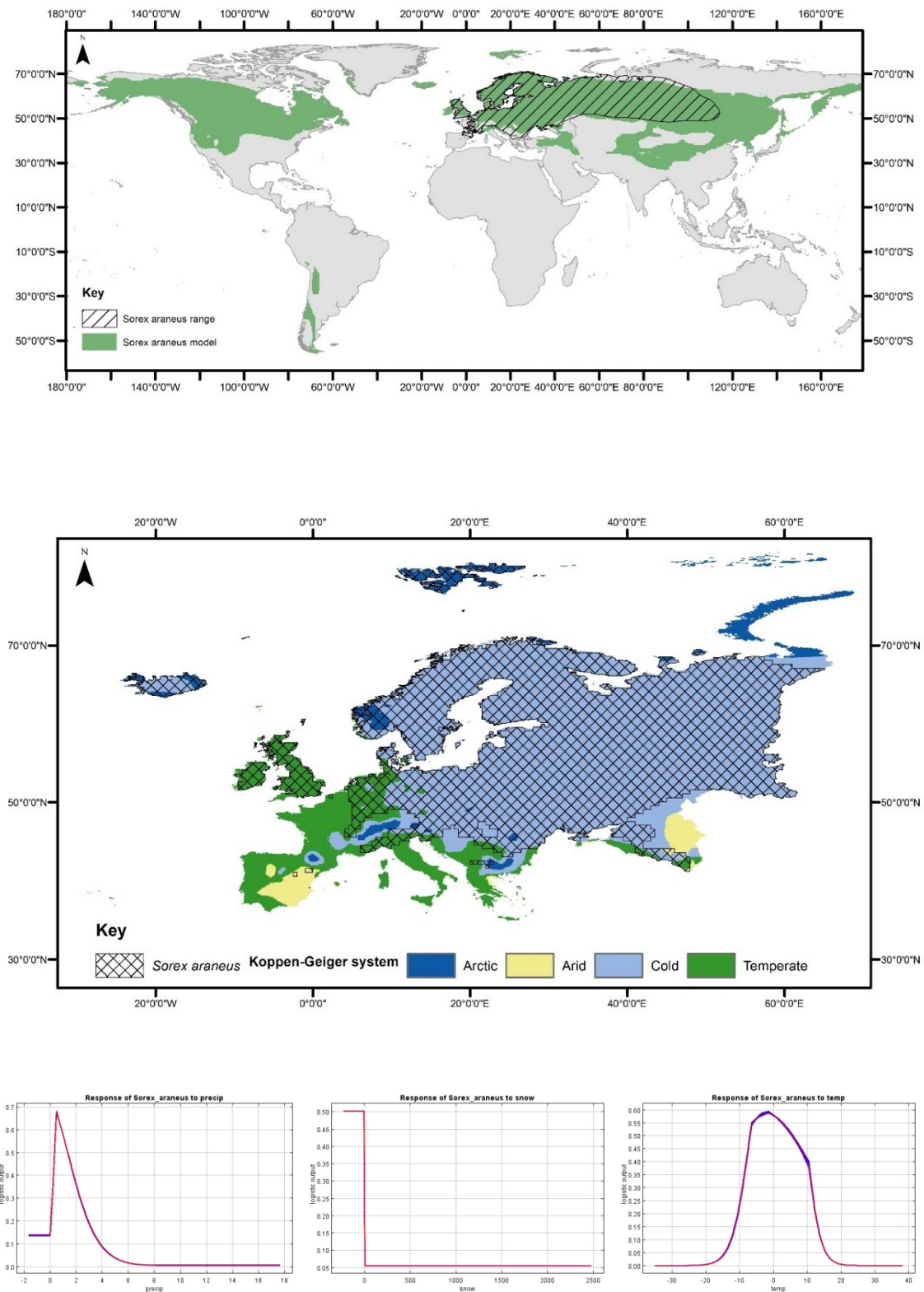
2.58 *Rangifer tarandus* (RL)

2.59 *Rupicapra* sp.

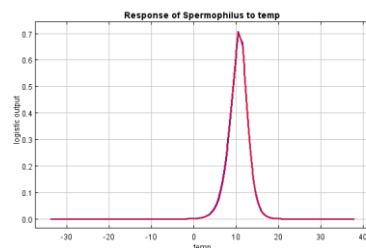
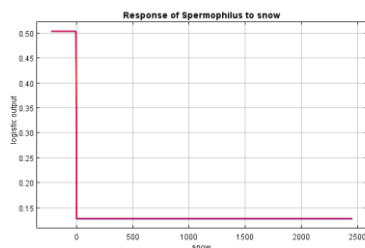
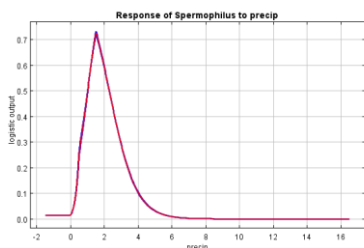
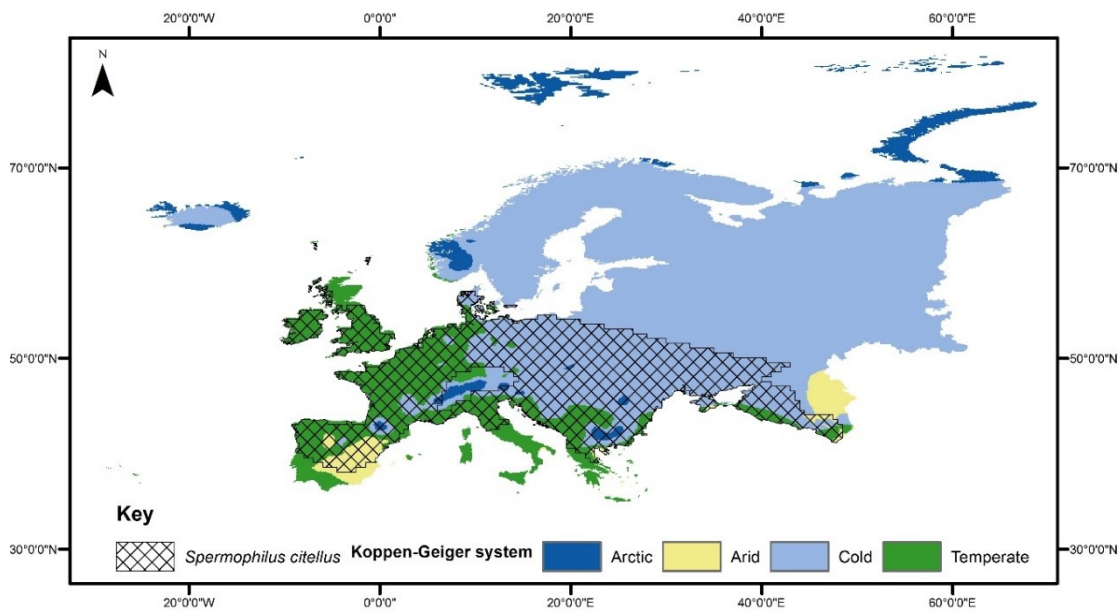
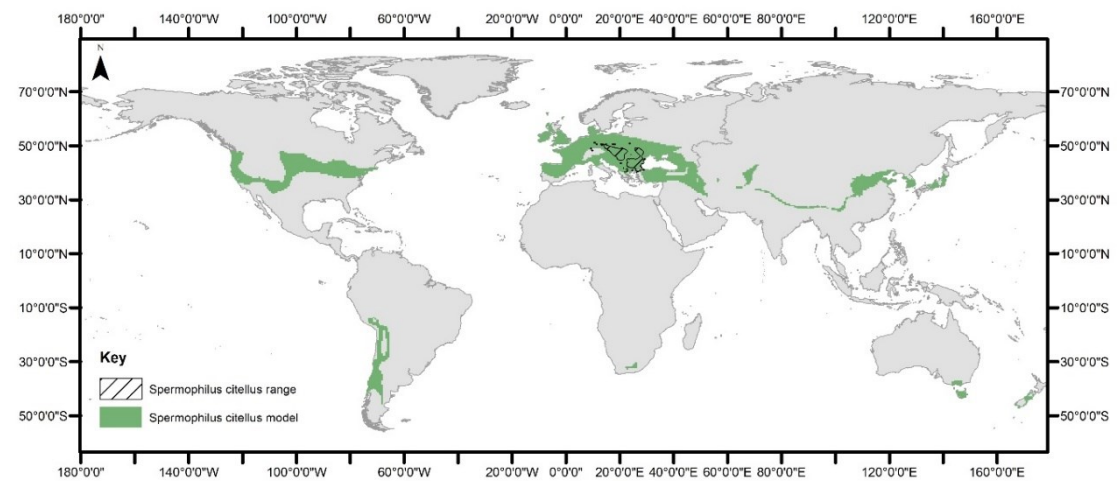
2.60 *Rupicapra pyrenaica*

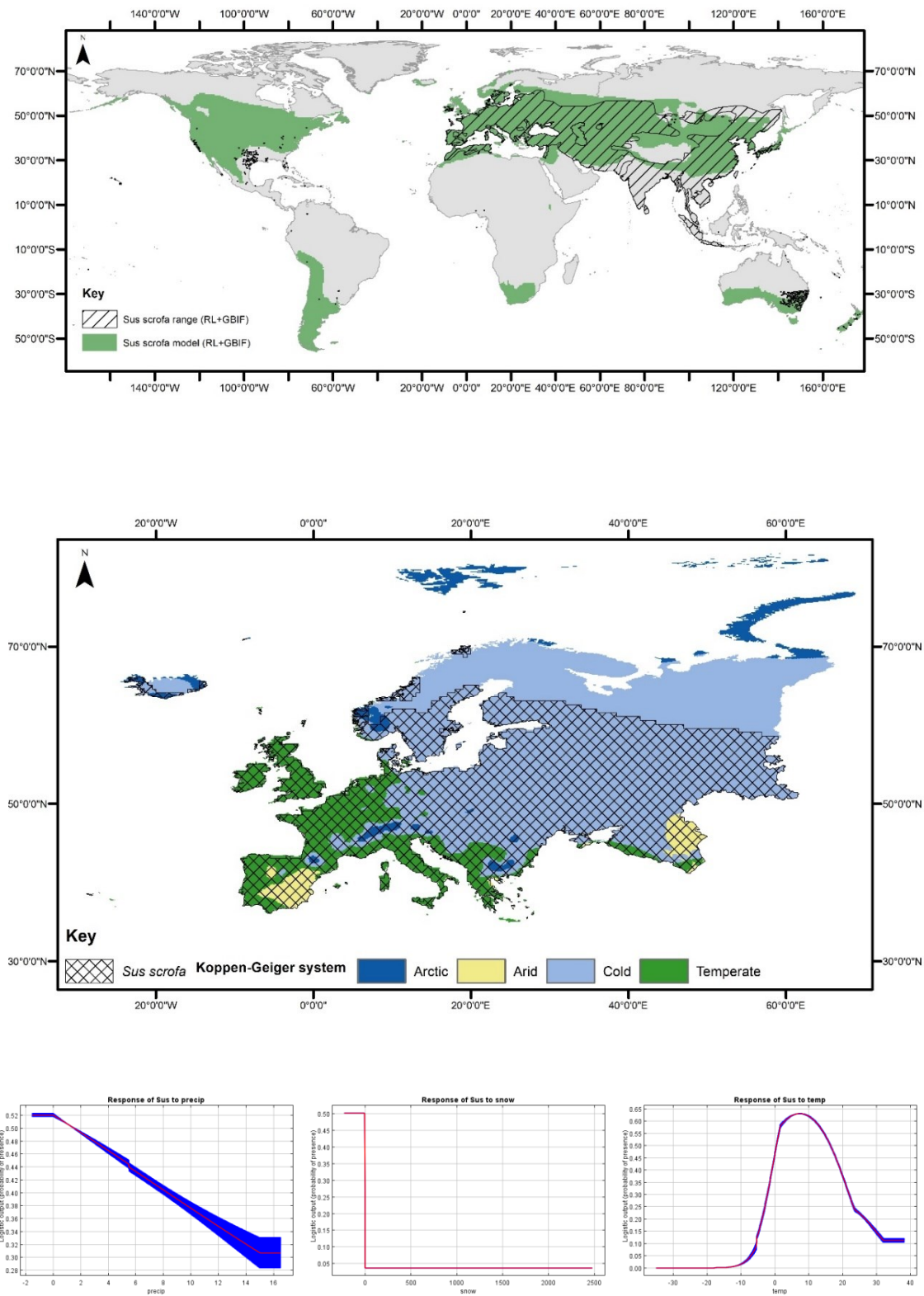
2.61 *Rupicapra rupicapra*

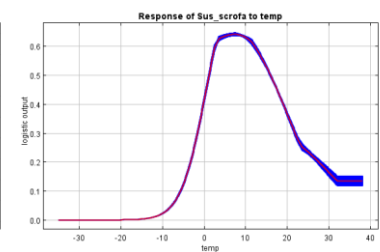
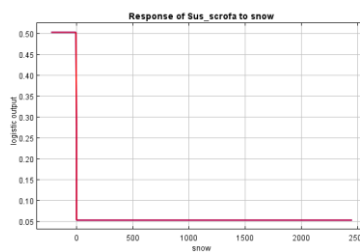
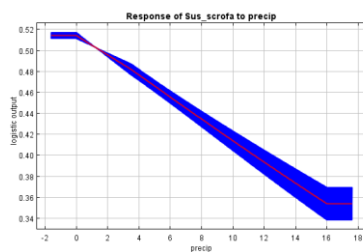
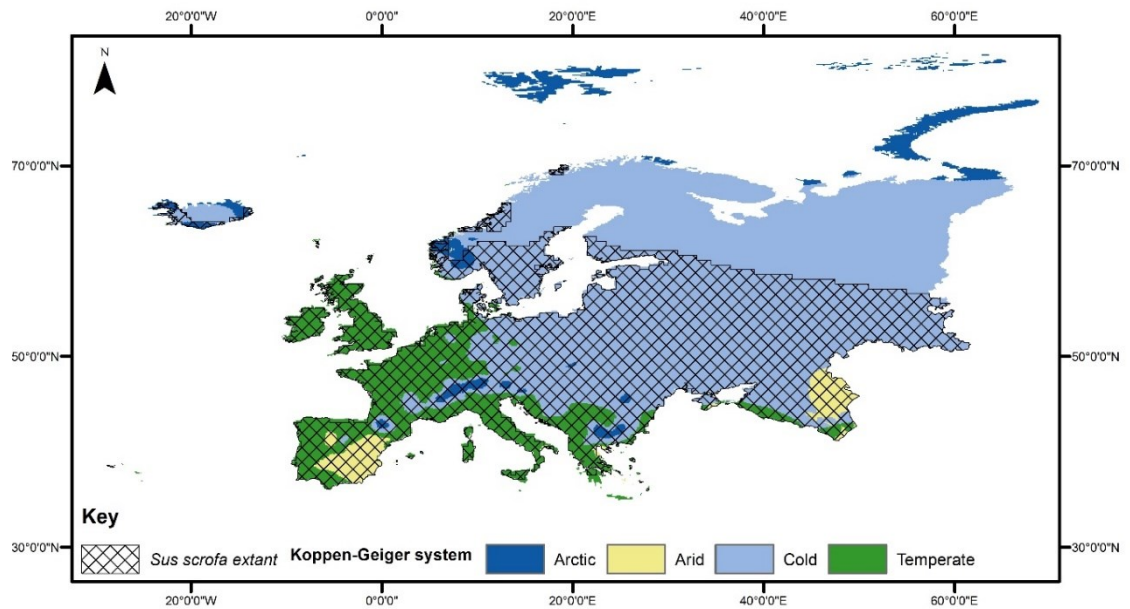
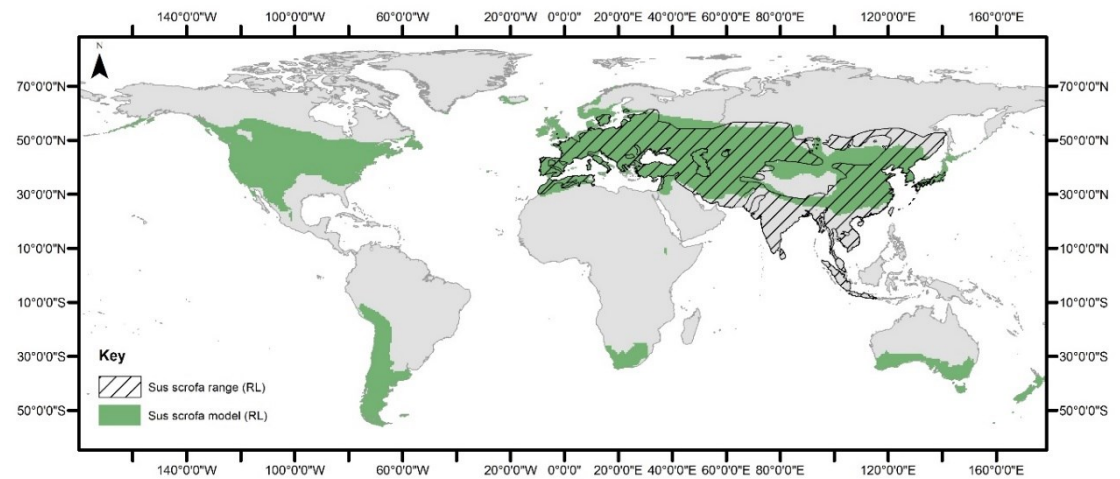
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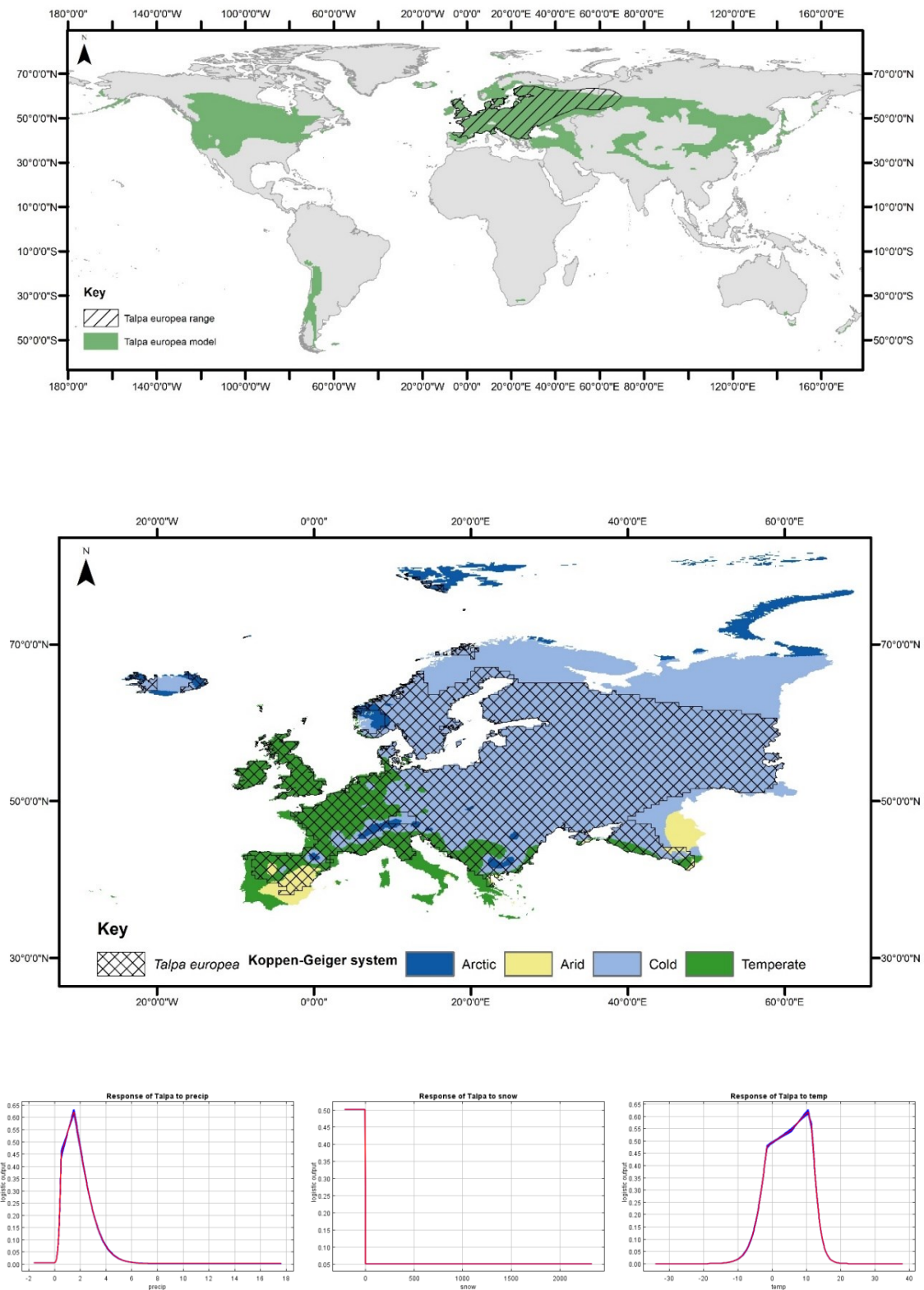
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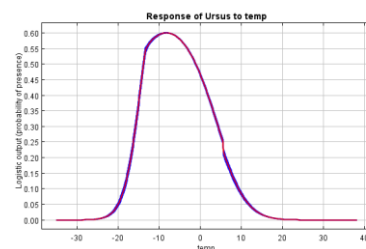
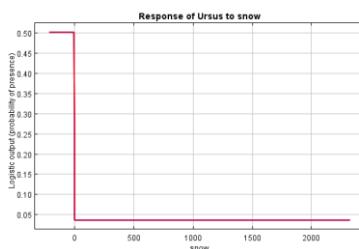
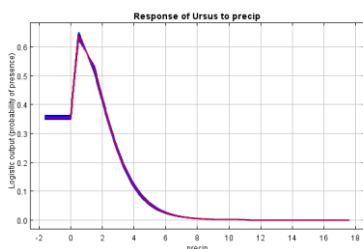
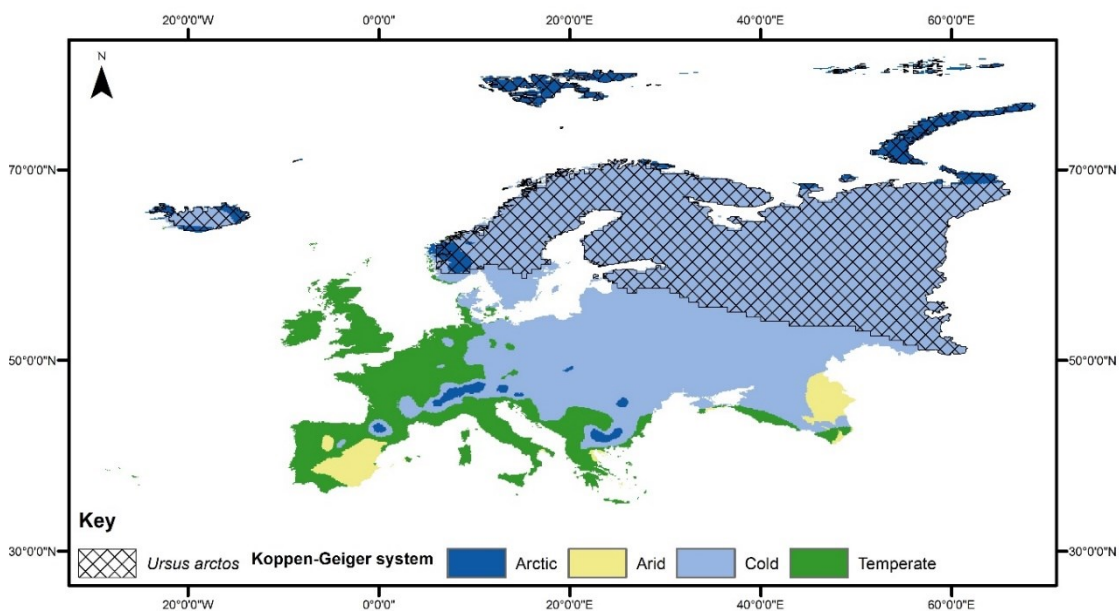
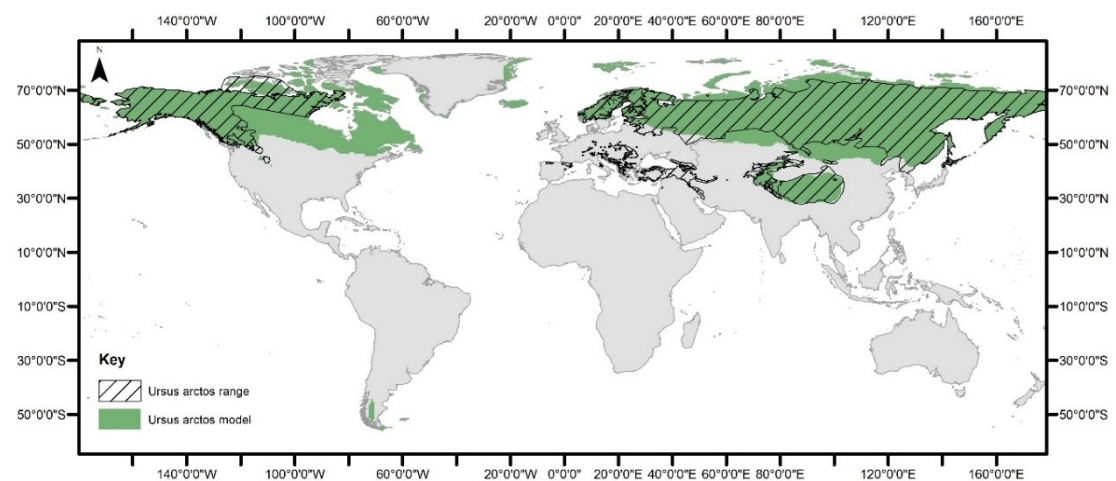
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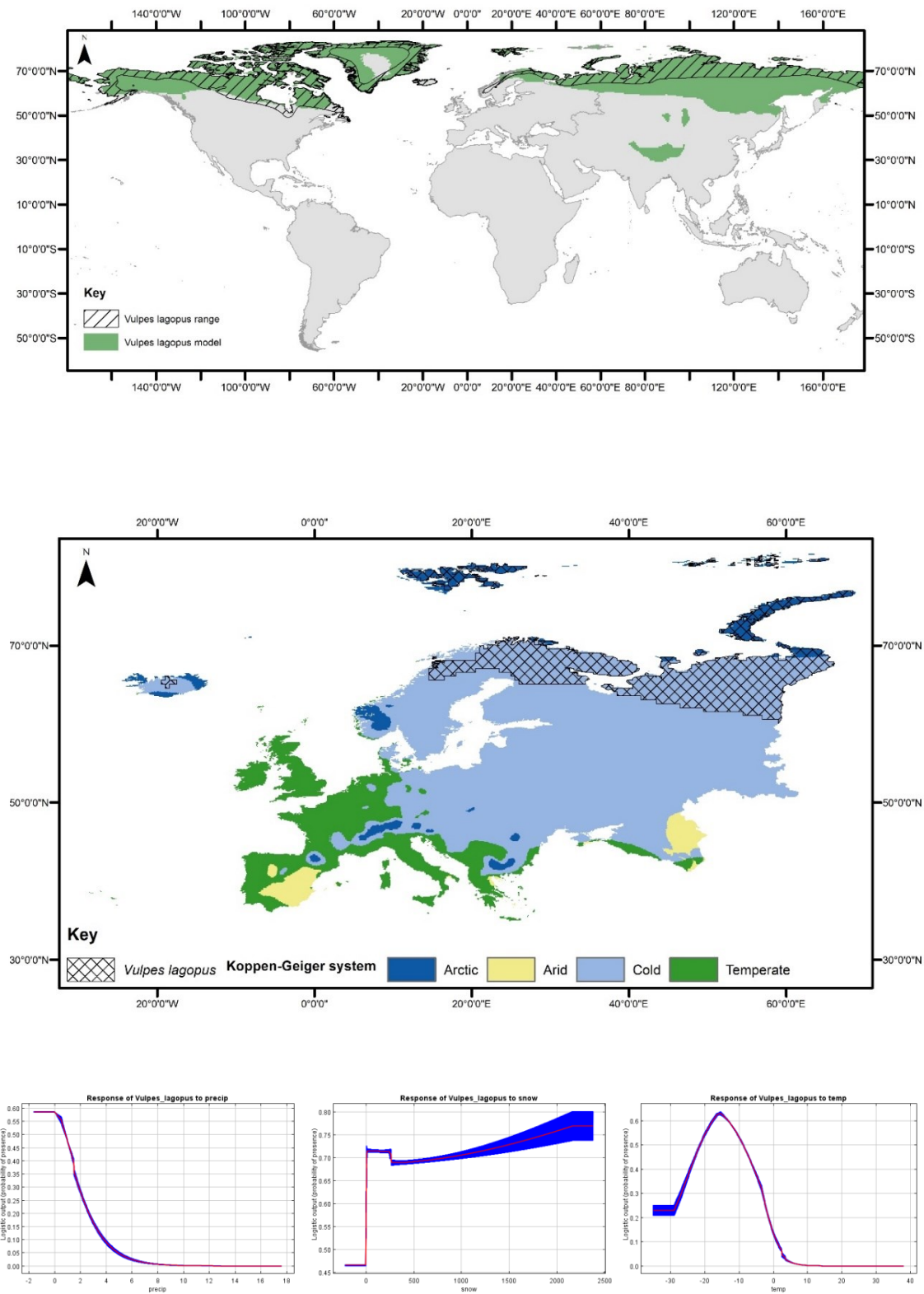


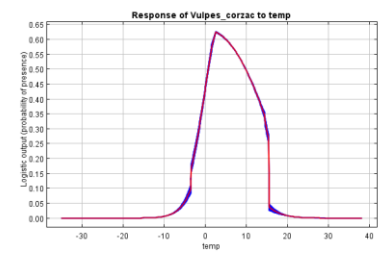
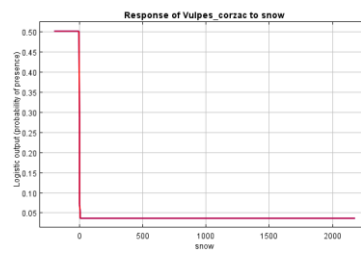
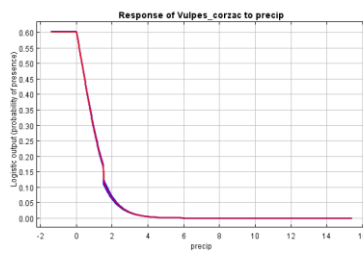
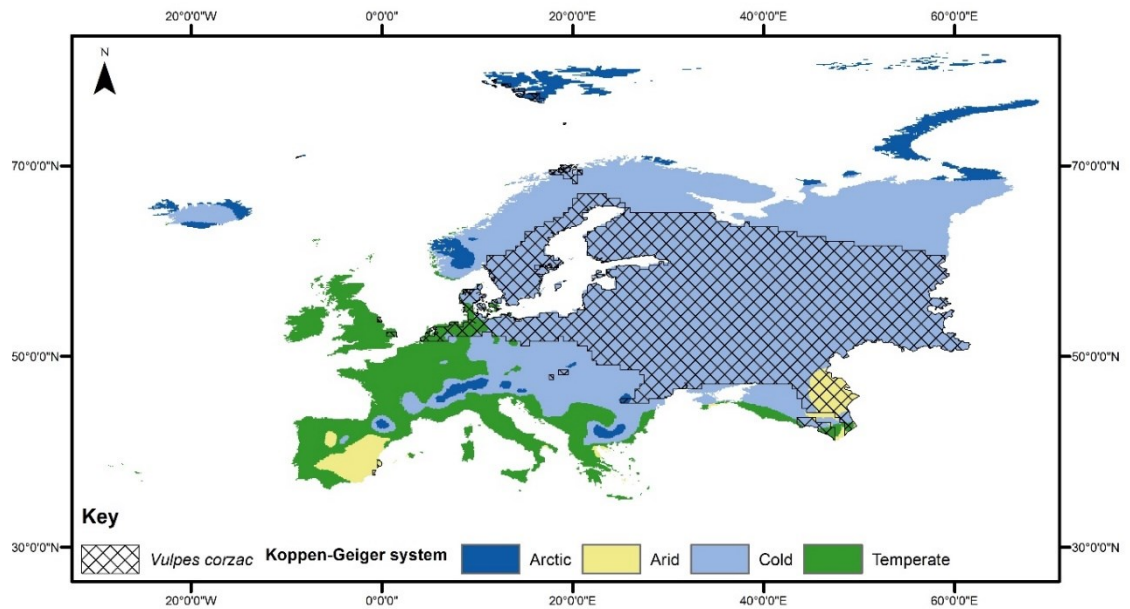
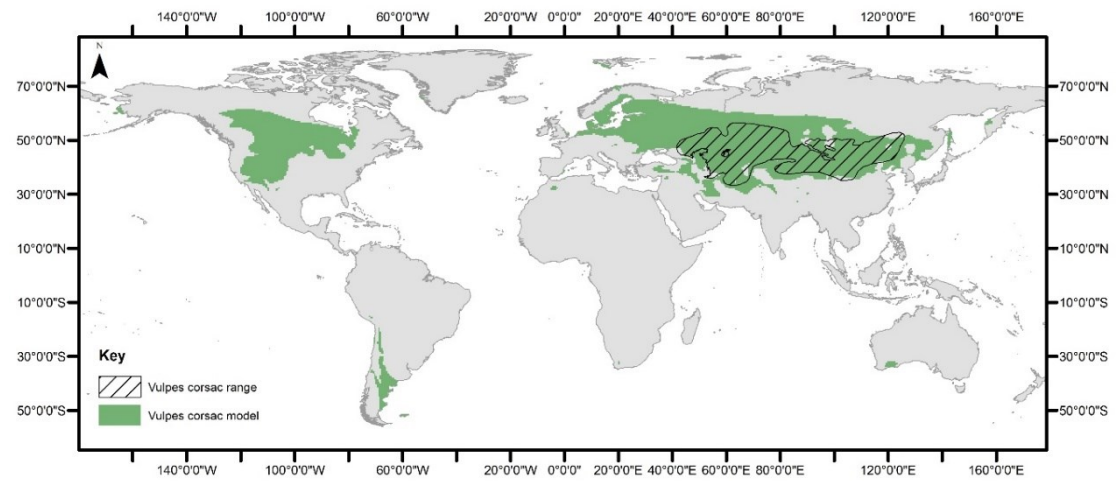
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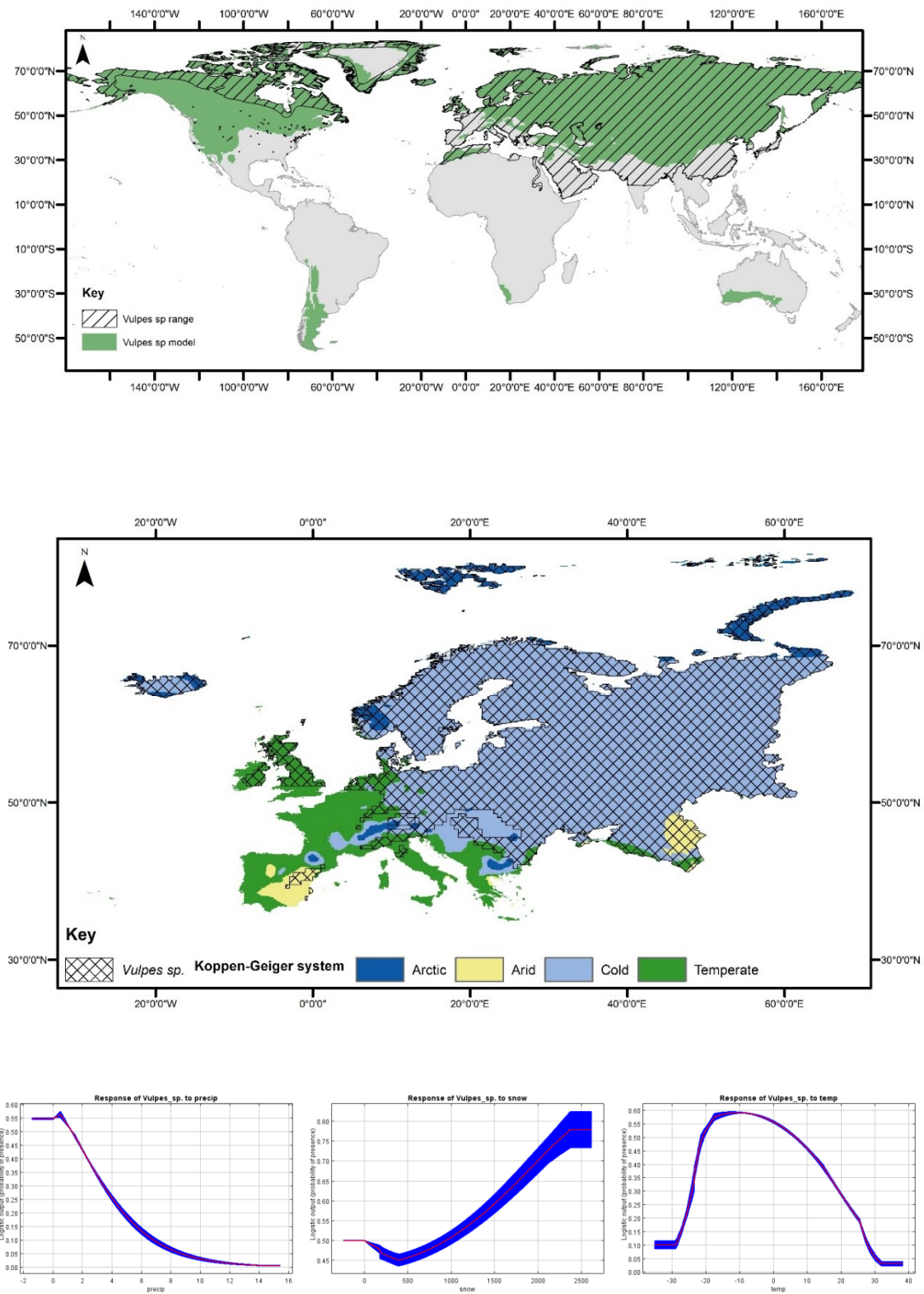
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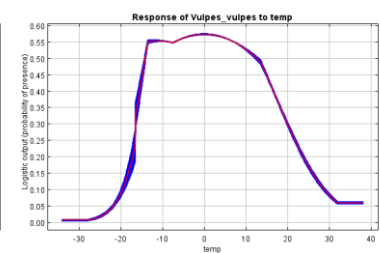
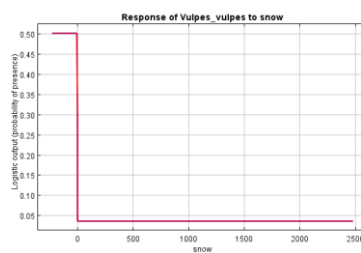
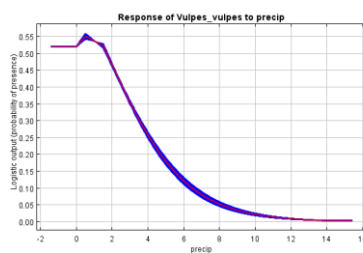
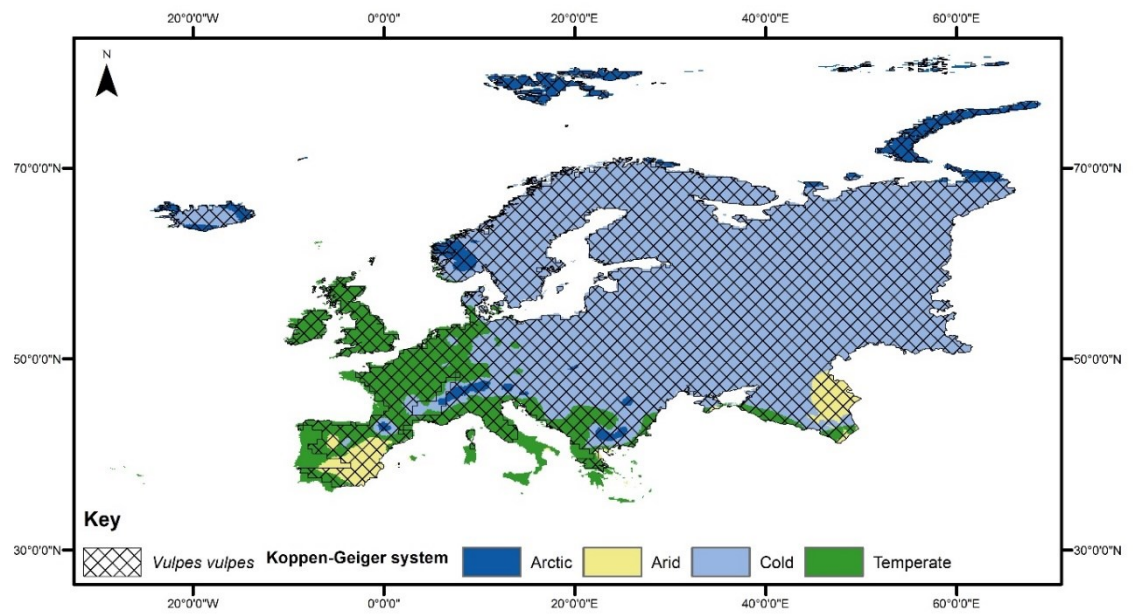
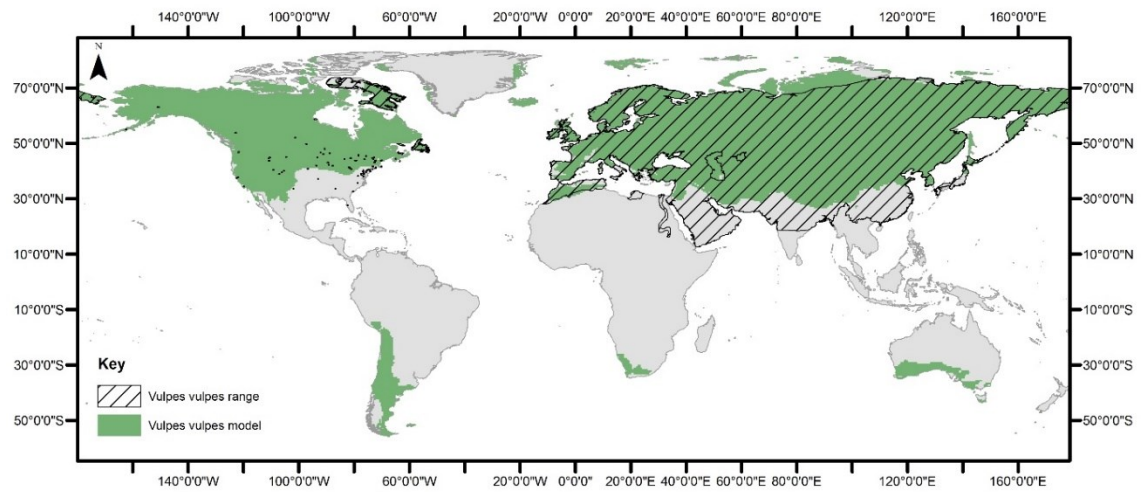
2.67 *Talpa europea*

2.68 *Ursus arctos*

2.69 *Vulpes lagopus*

2.70 *Vulpes corsac*

2.71 *Vulpes* sp.

2.72 *Vulpes vulpes*

2.73 Comparison between biomes and Köppen-Geiger climate system

Table 2.1 Comparison between the biomes (Biome) of the ecoregions of the world and the Köppen-Geiger climate system (Warm % / Arid%/ Temperate %/ Cold% / Arctic %) categories indicate percentage area cover of the different biomes.

Biome	Warm %	Arid %	Temperate %	Cold %	Arctic %
Tropical and Subtropical Moist Broadleaf Forests	54.9	0.7	19.0		
Tropical and Subtropical Dry Broadleaf Forests	7.7	1.0	2.0		
Tropical and Subtropical Coniferous Forests	0.9	0.4	1.3		
Temperate Broadleaf and Mixed Forests		1.6	27.8	16.1	0.2
Temperate Coniferous Forests		1.3	6.6	5.4	0.1
Boreal Forests/Taiga				45.9	0.3
Tropical and subtropical grasslands, savannas, and shrublands	30.4	15.7	18.4		
Temperate Grasslands, Savannas, and Shrublands		8.8	8.0	12.0	
Flooded Grasslands and Savannas	1.6	0.7	0.7	0.4	
Montane Grasslands and Shrublands	0.7	5.8	4.8	2.3	0.4
Tundra			0.1	15.4	27.1
Mediterranean Forests, Woodlands, and Scrub		3.5	8.9	0.1	
Deserts and Xeric Shrublands	2.5	59.3	1.4	1.2	
Mangroves	1.0				
Lakes	0.4	1.0	0.6	1.1	
Rock and Ice		0.1	0.3	0.2	71.9

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3 Appendix Chapter 4

The appendix is ordered alphabetically, which the models for each taxon as a separate section.

3.0 Model performande extinct taxa

Taxon	AUC	Threshold
Equus ferus	0.93	0.55
Panthera leo	0.95	0.22
Crocota crocuta	0.98	0.38
Mammuthus primigenius	0.94	0.25
Coelodonta	0.94	0.24

3.1 Symbology used for the maps

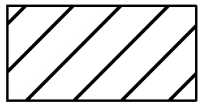
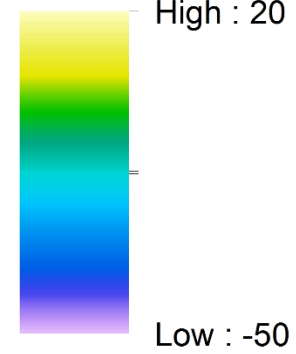
Quality Direct Date

- ✓ good
- ◻ fair
- ✕ poor

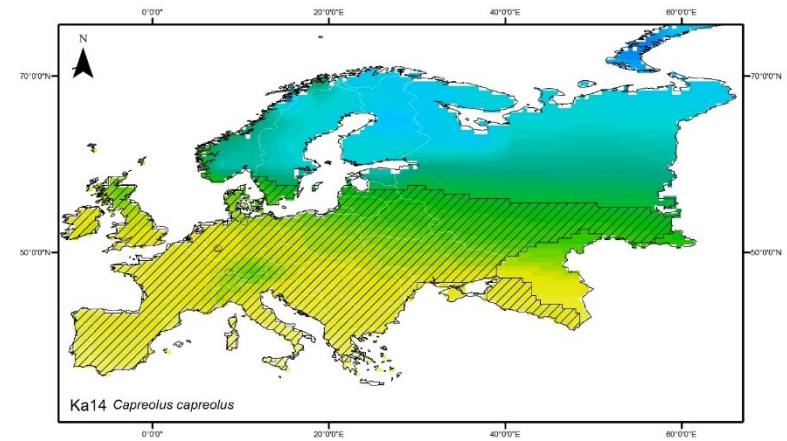
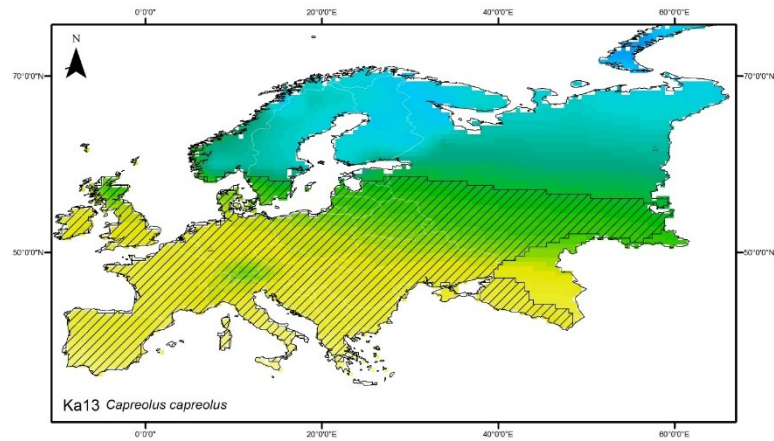
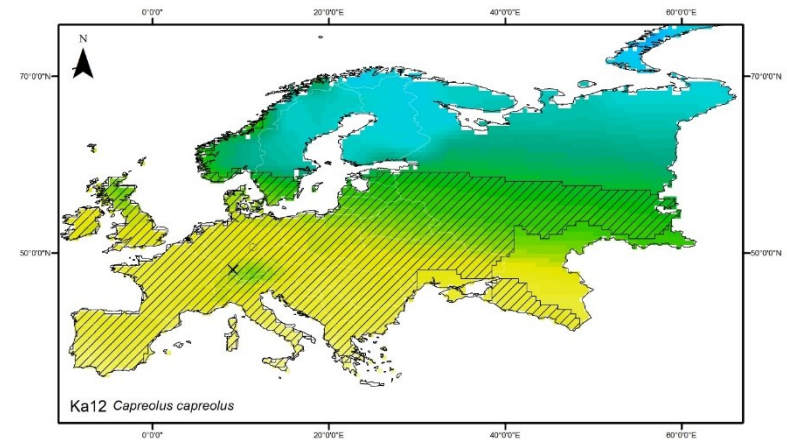
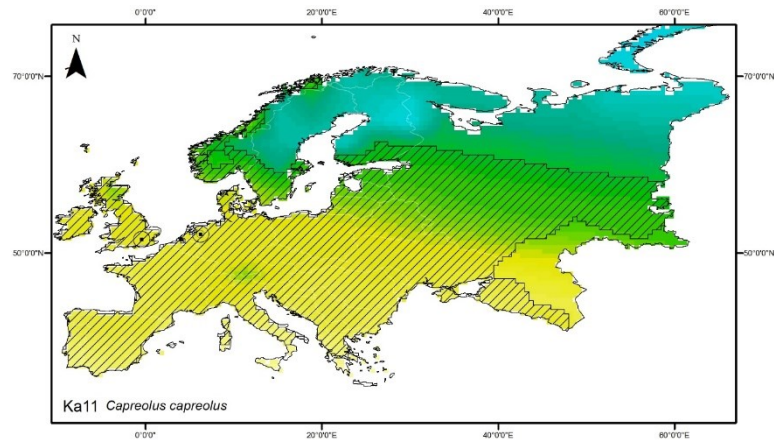
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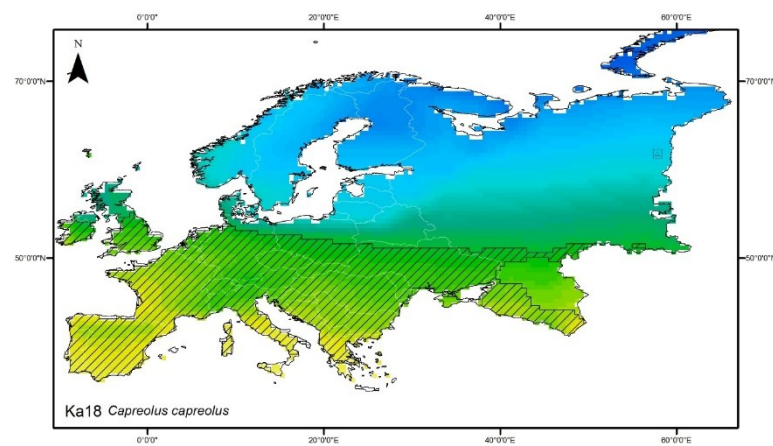
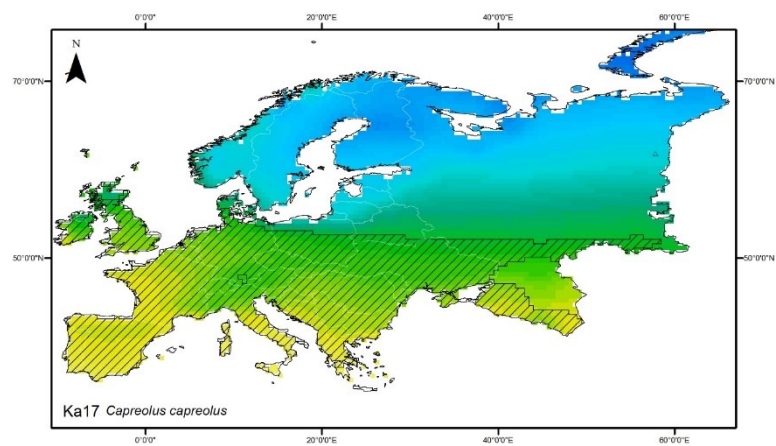
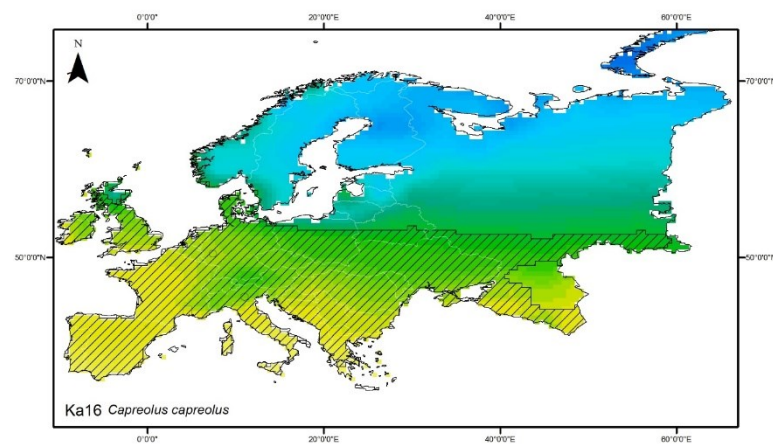
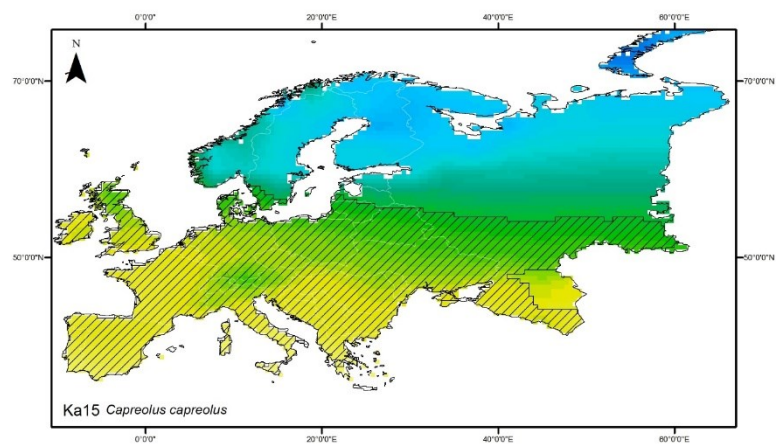
- ◻ good
- fair
- △ poor

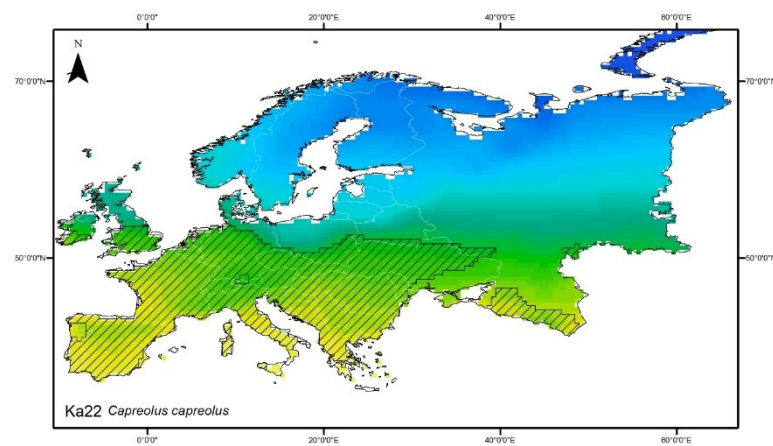
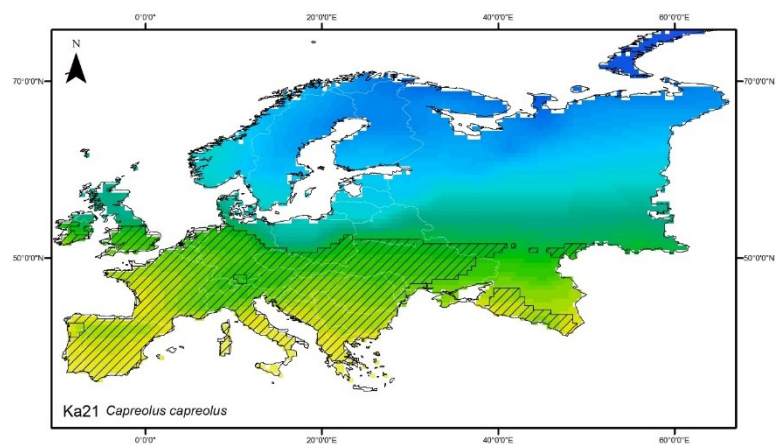
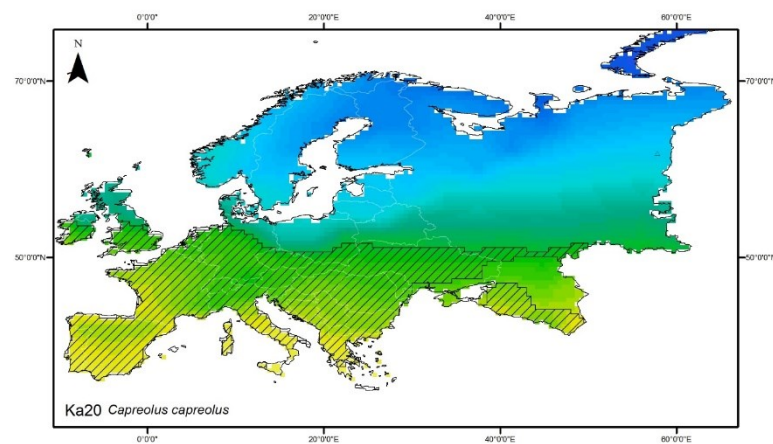
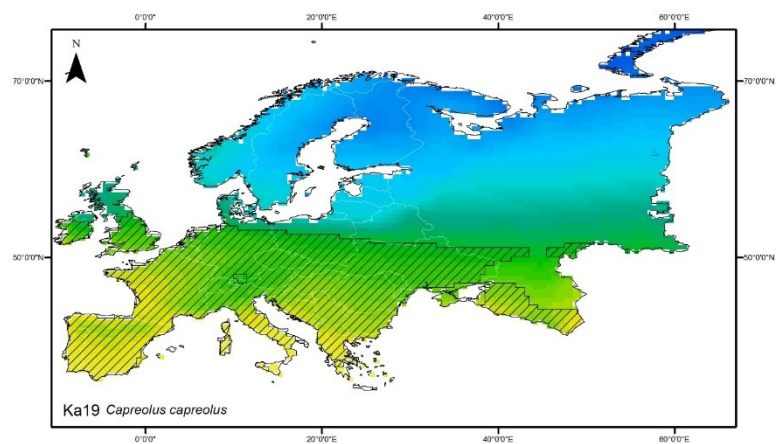
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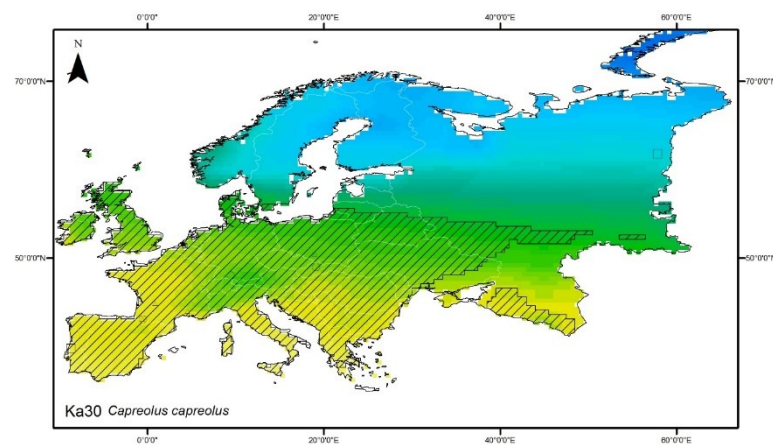
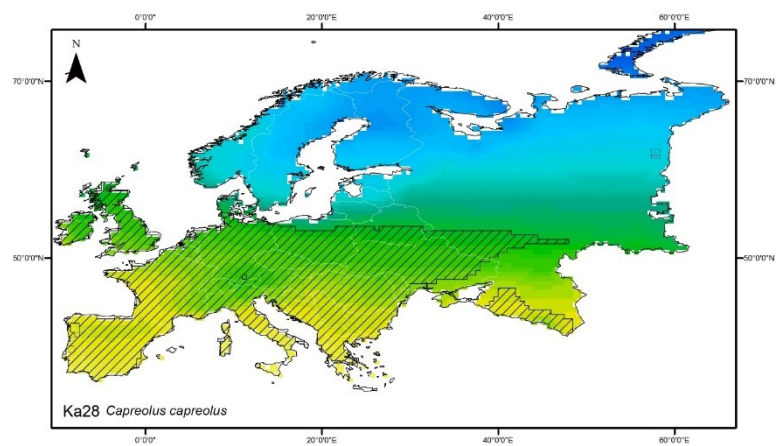
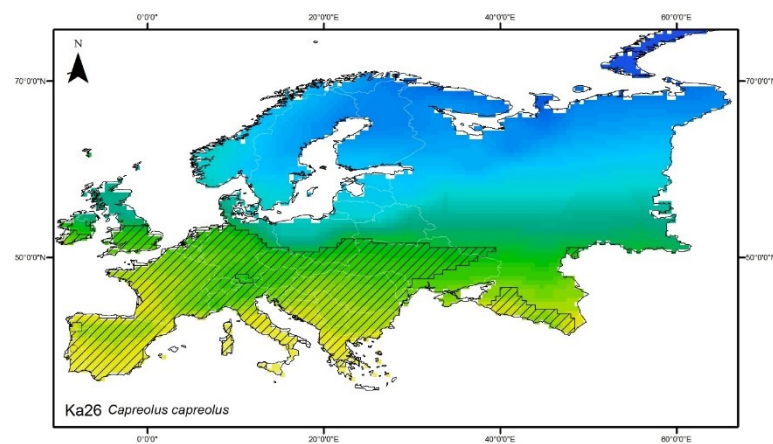
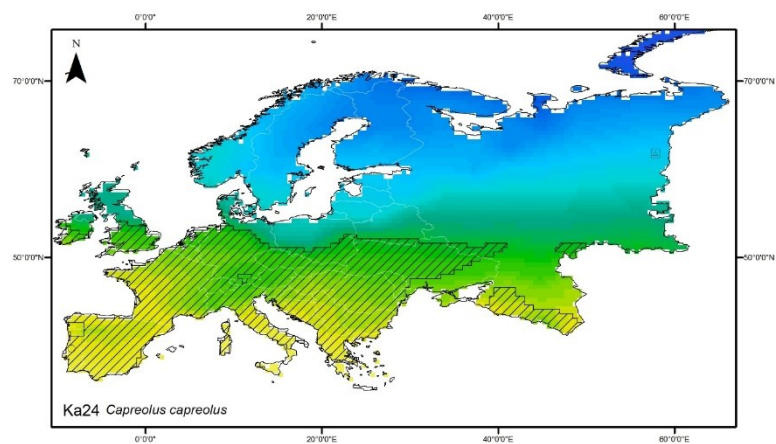


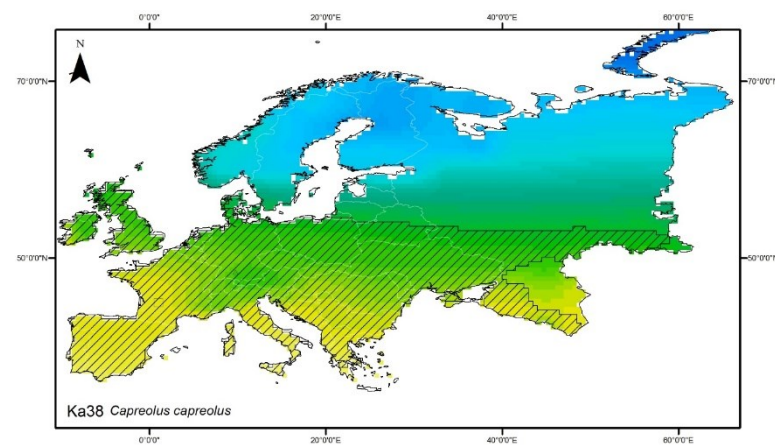
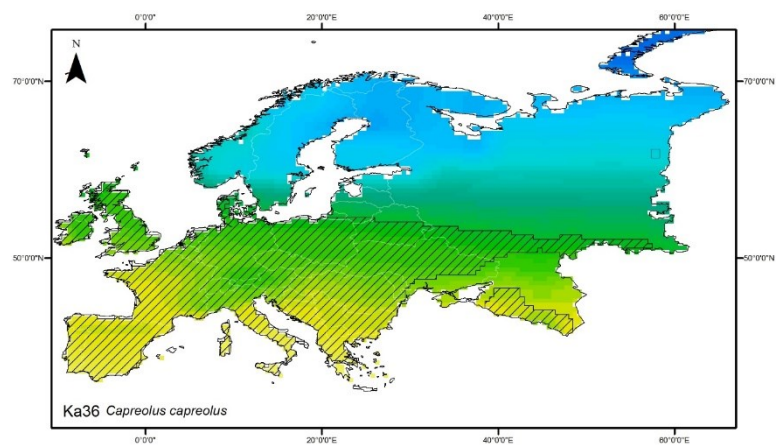
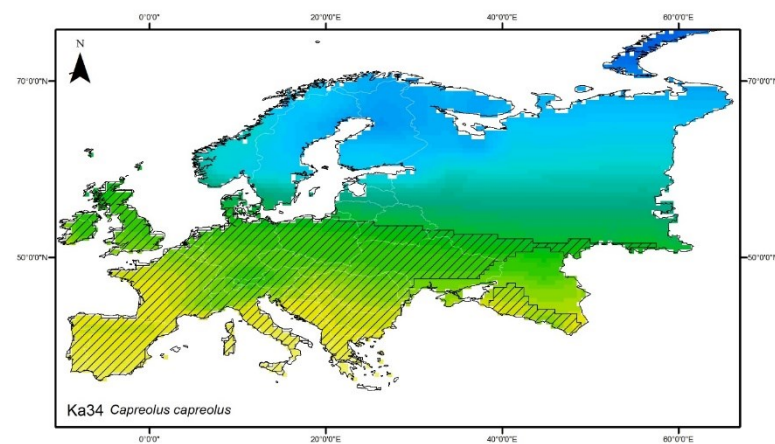
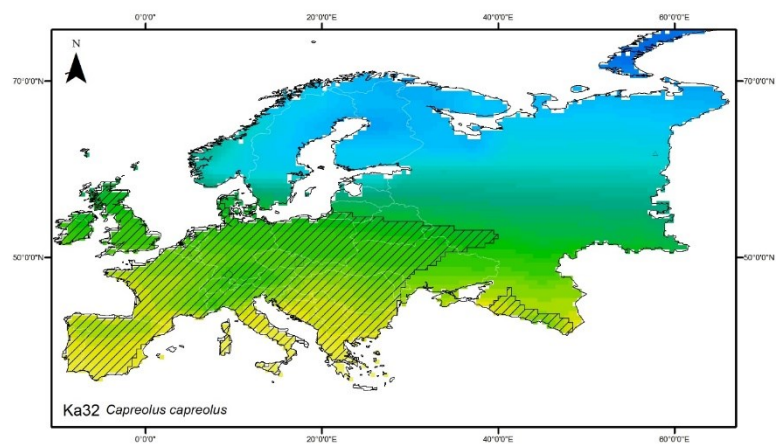
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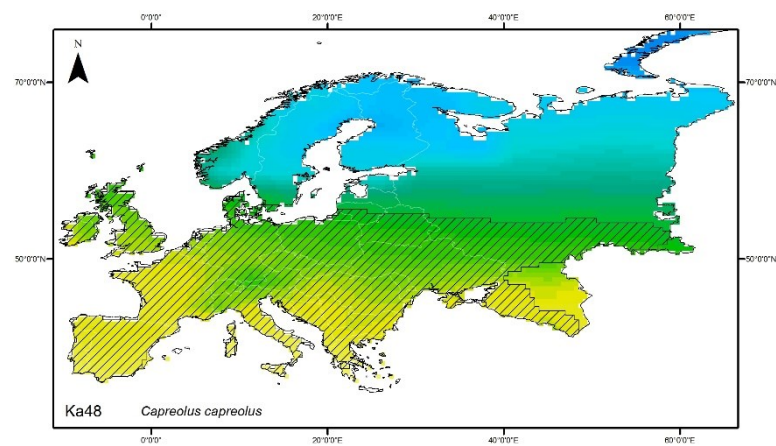
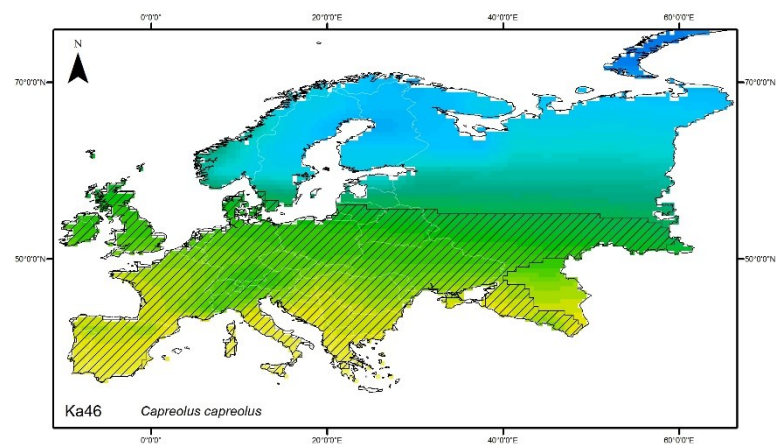
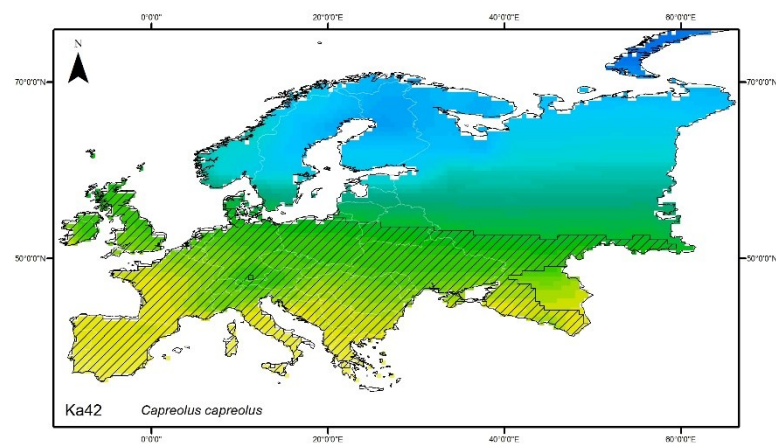
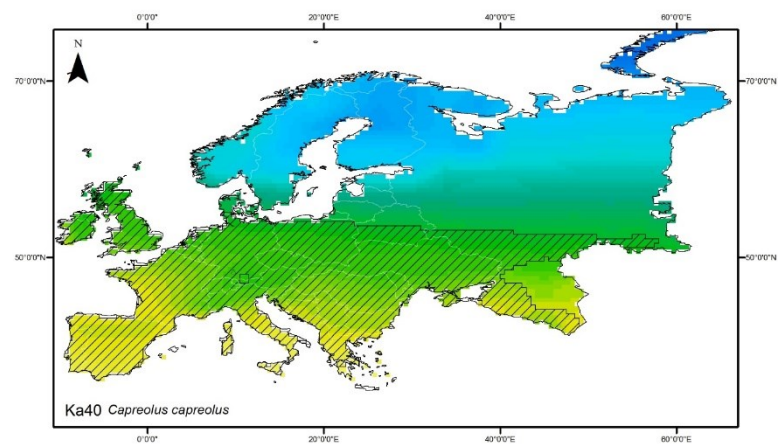
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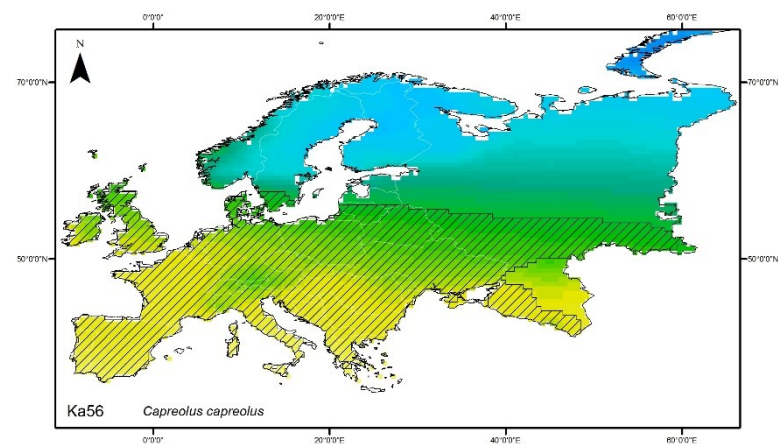
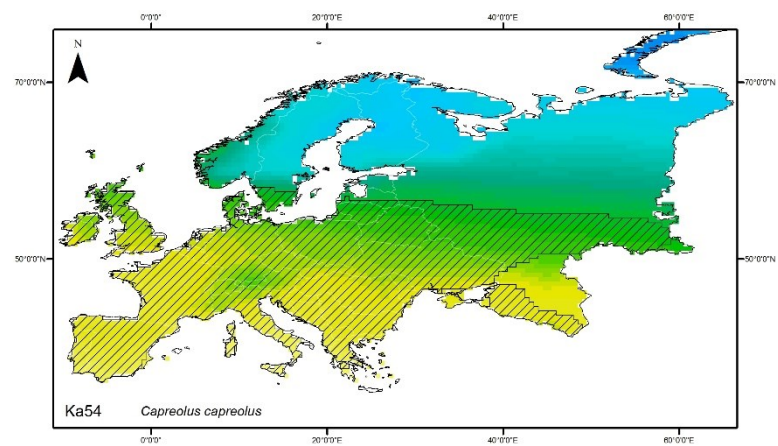
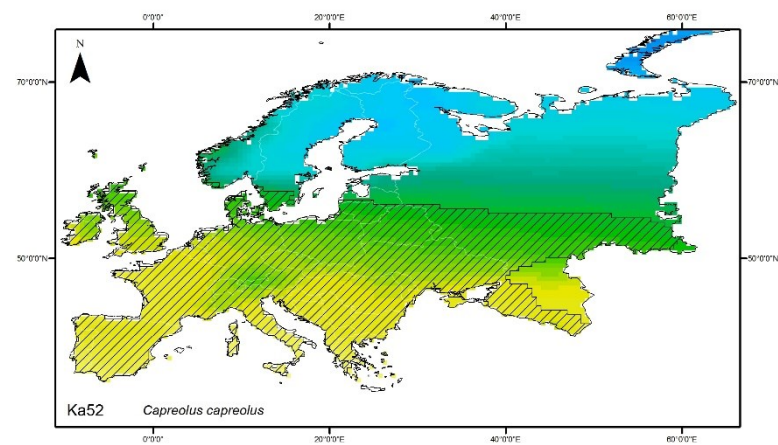
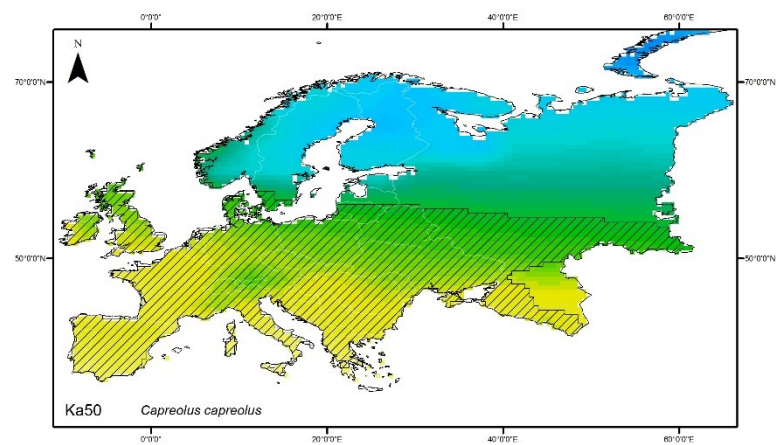


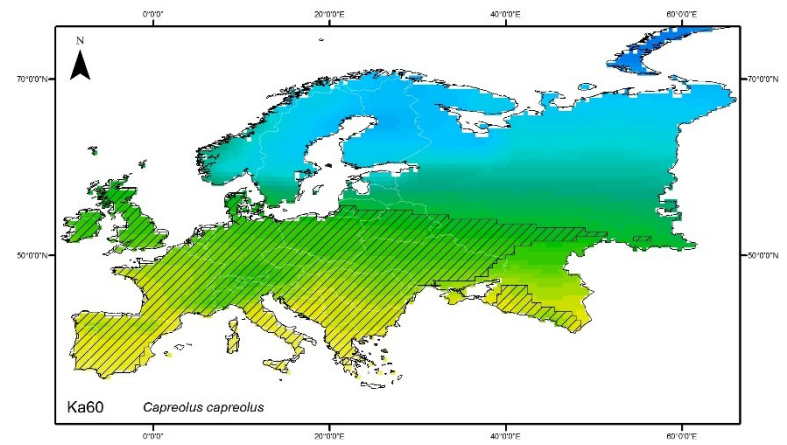
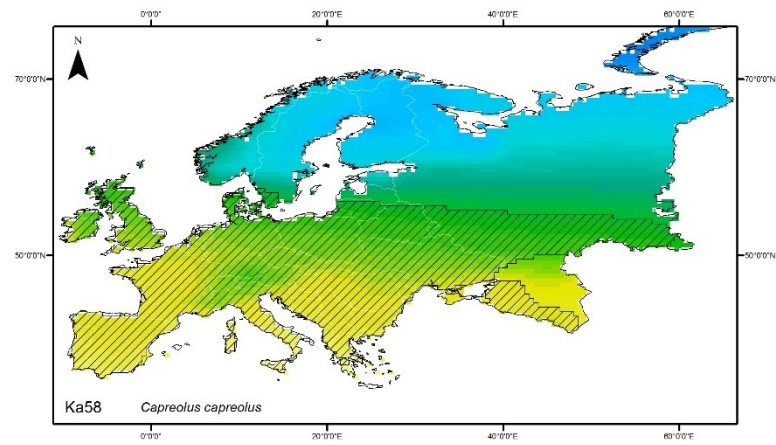


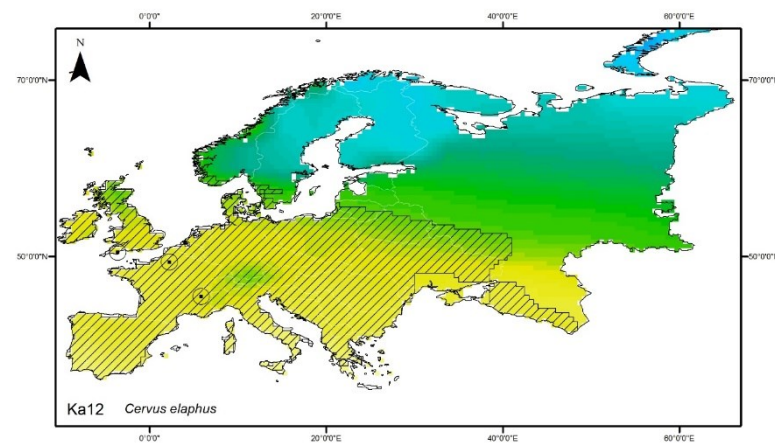
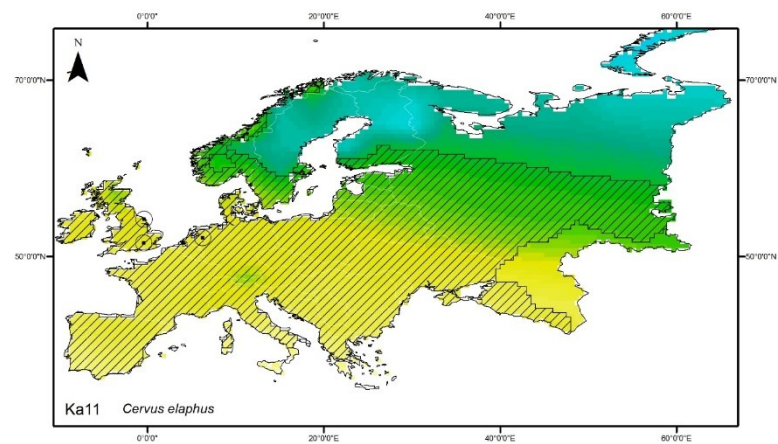
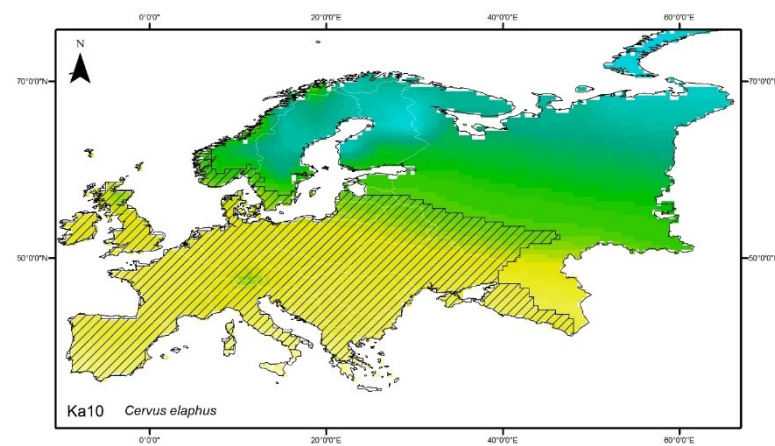
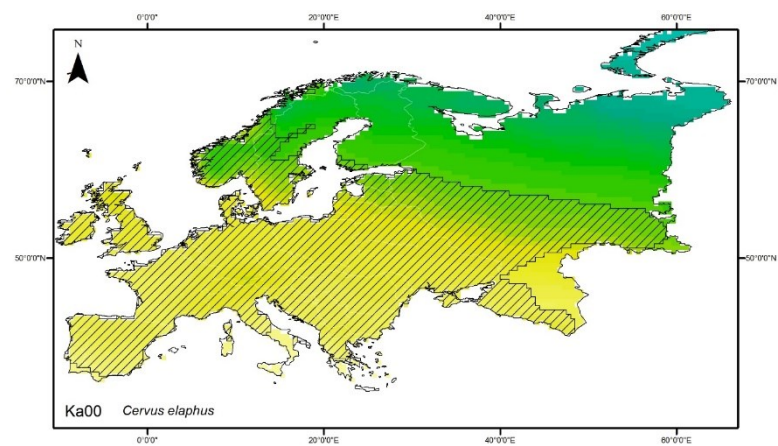


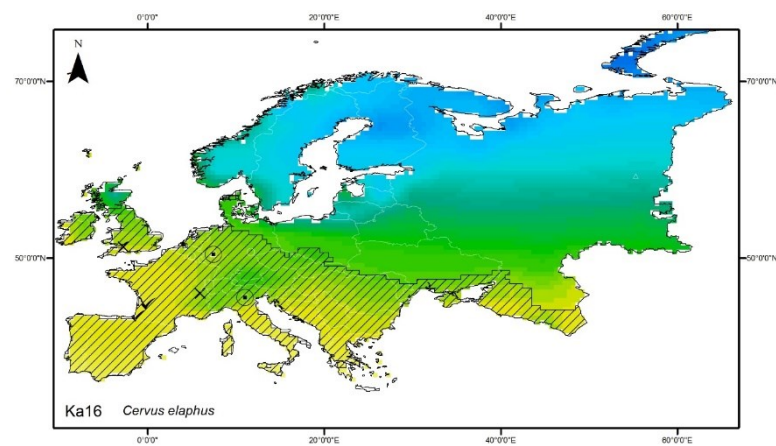
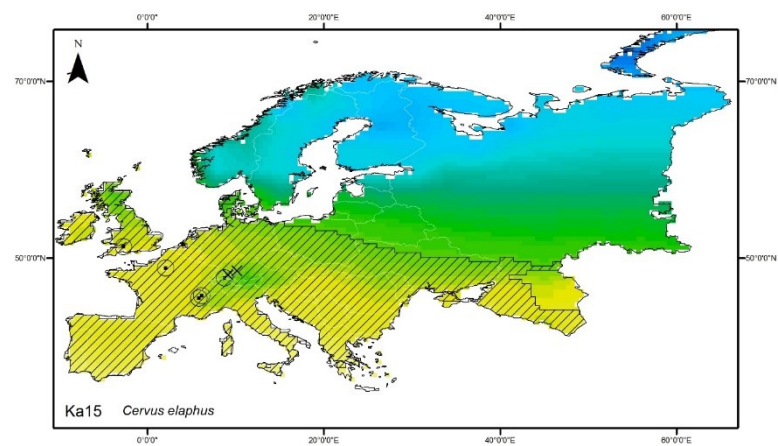
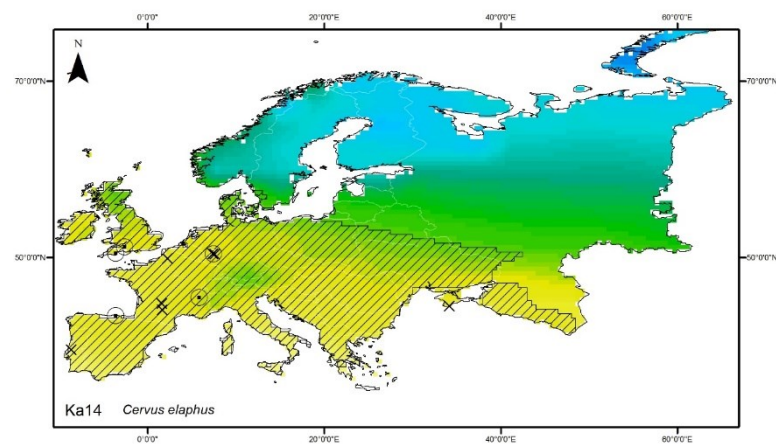
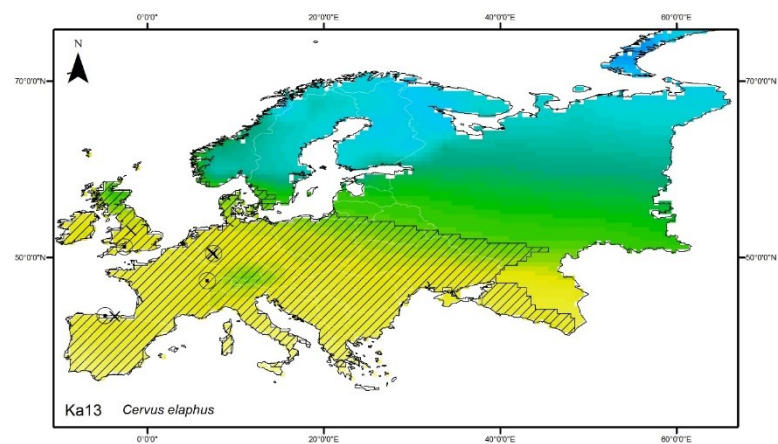


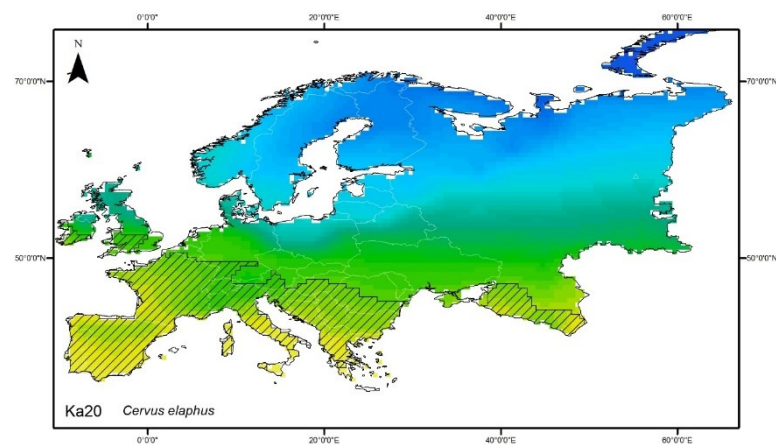
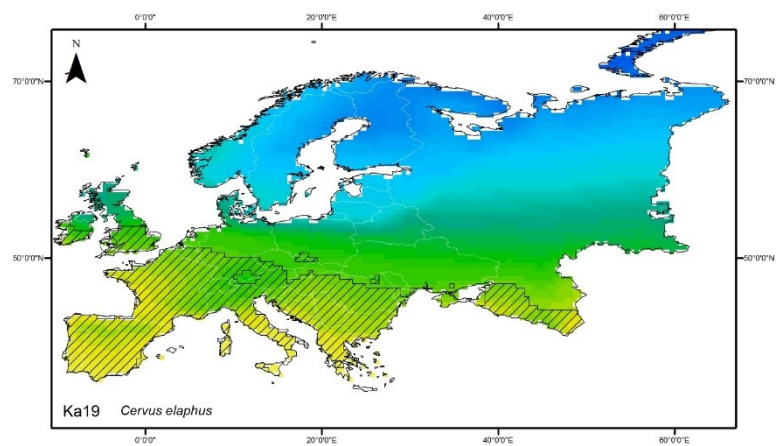
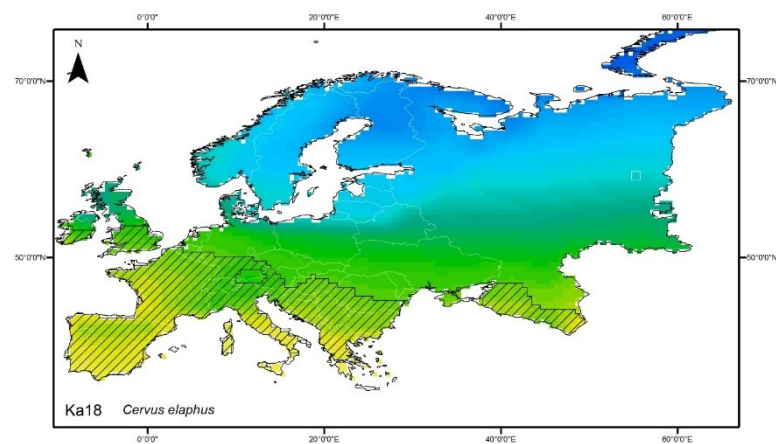
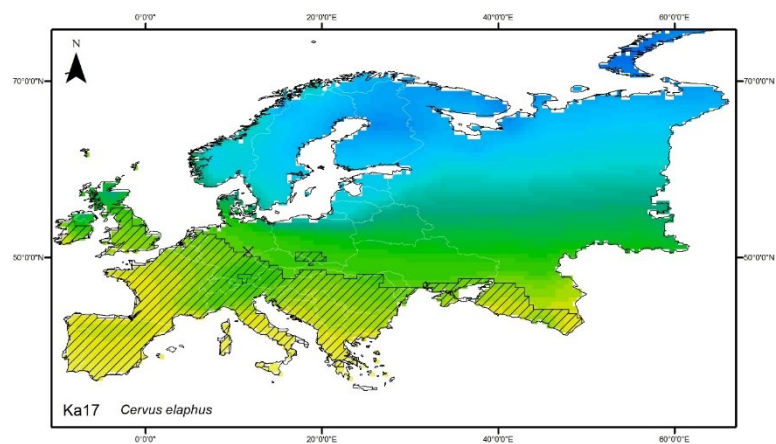


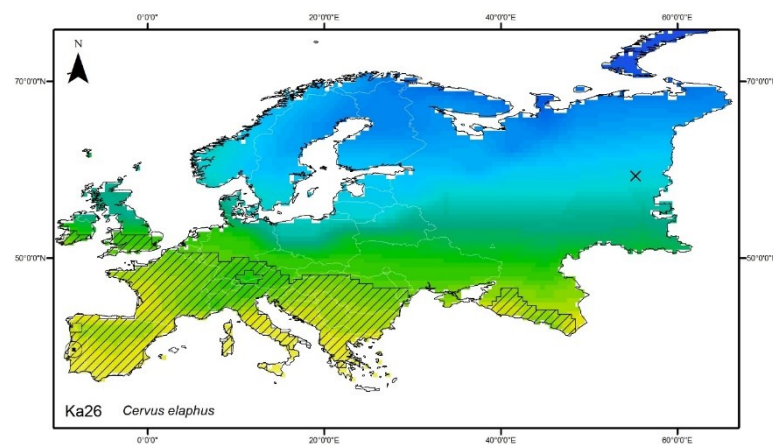
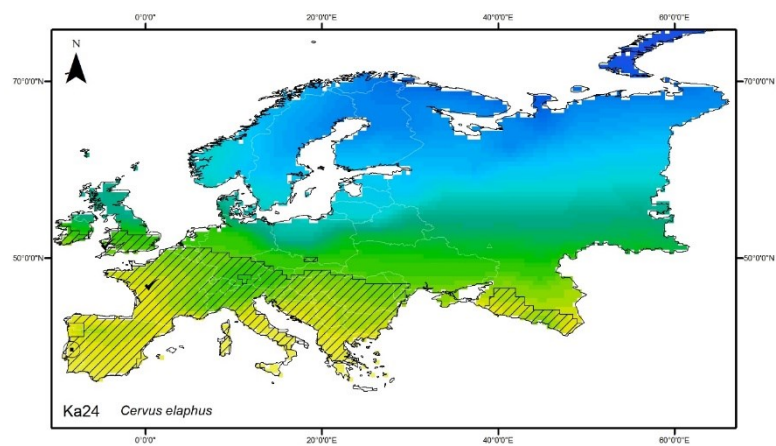
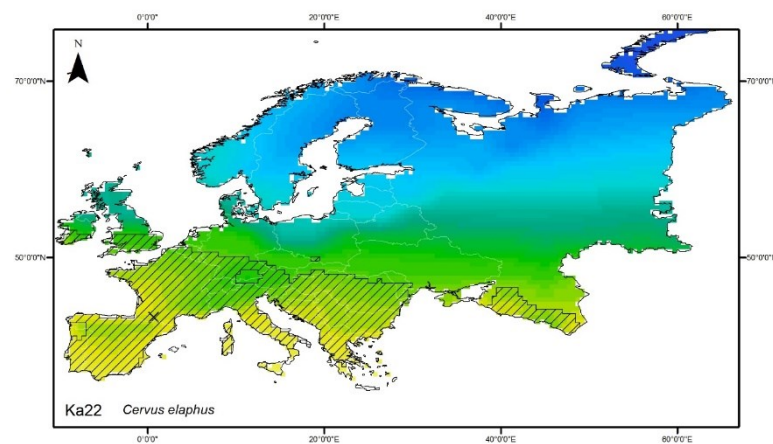
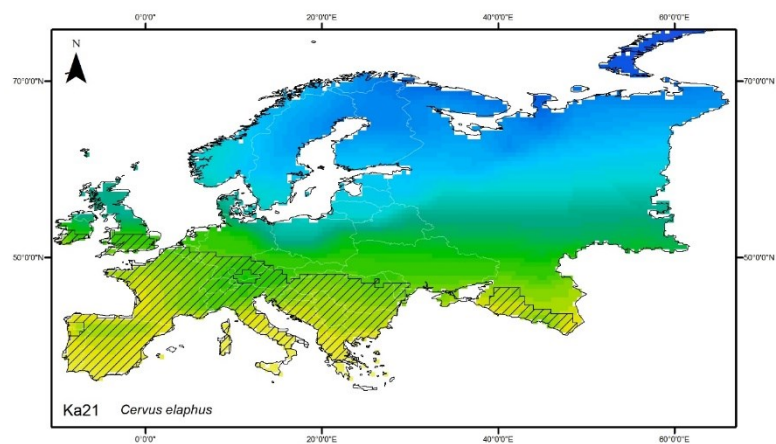


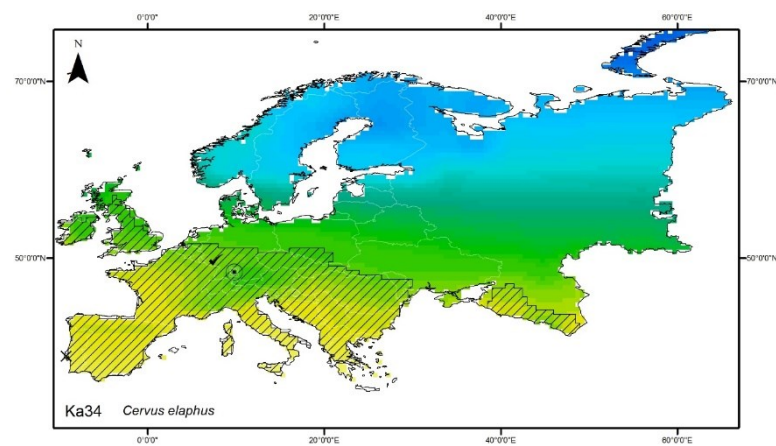
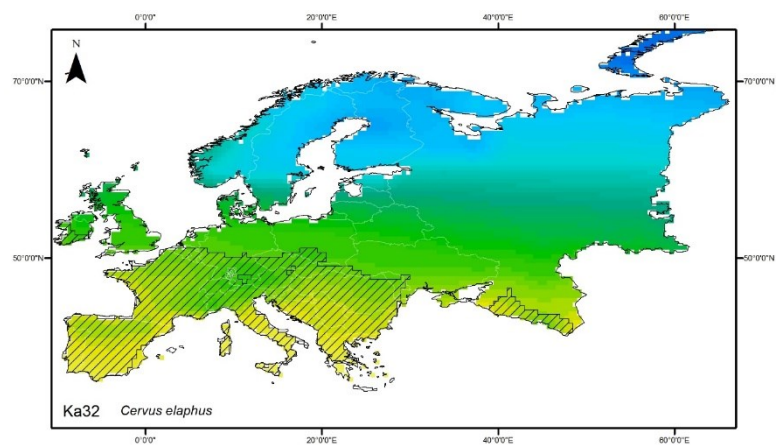
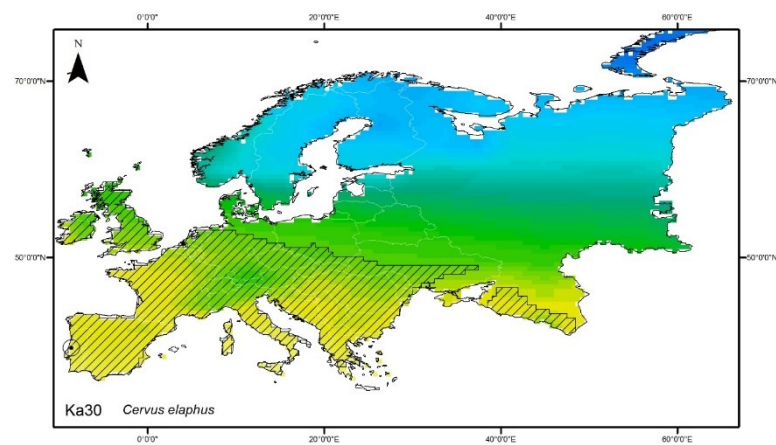
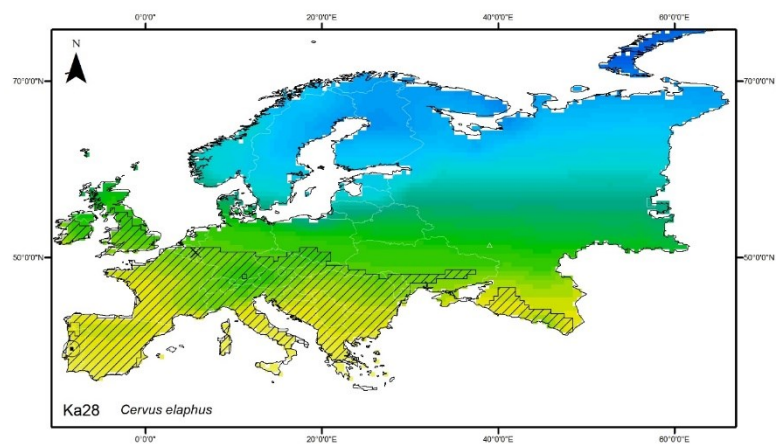


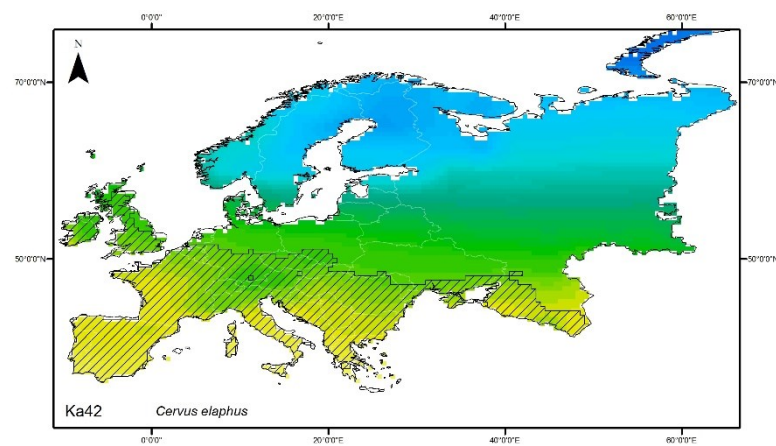
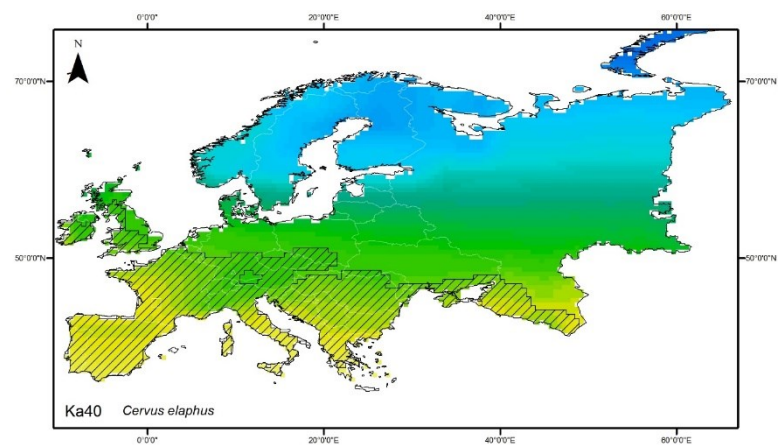
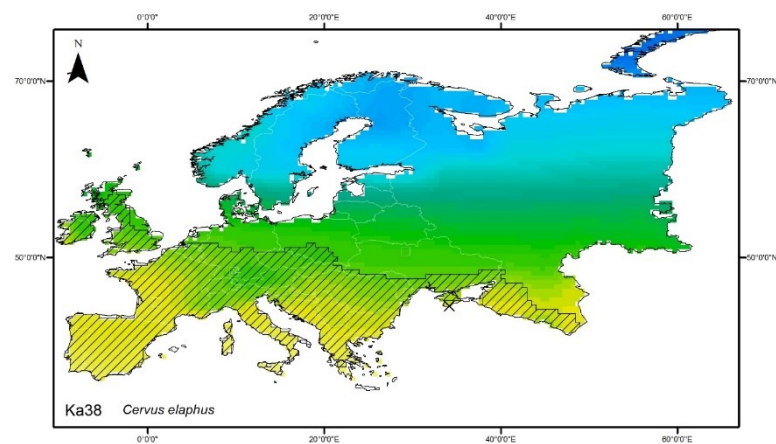
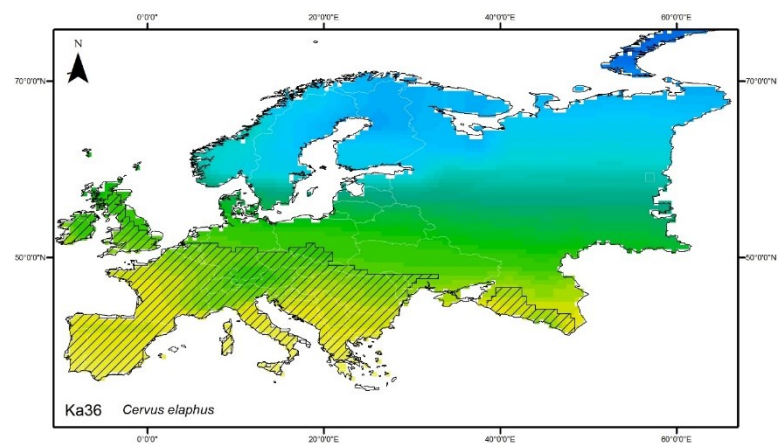
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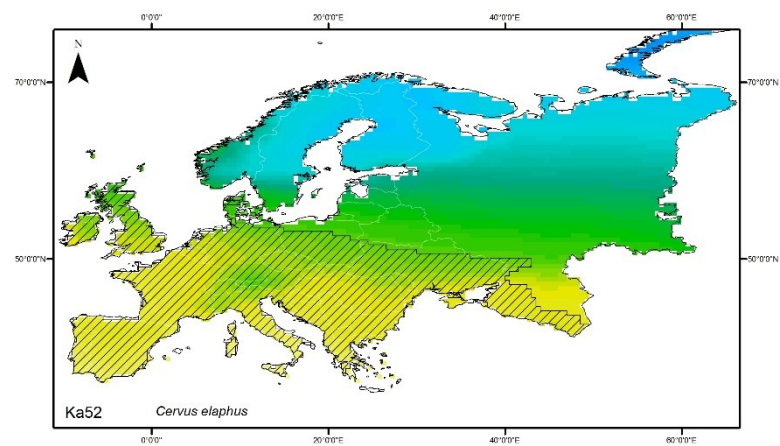
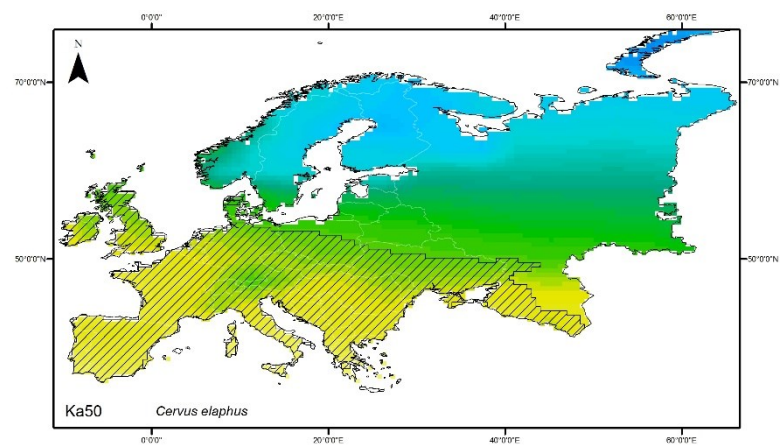
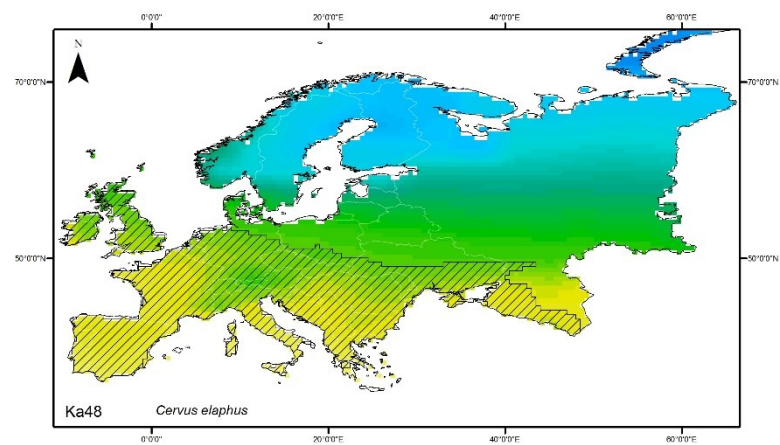
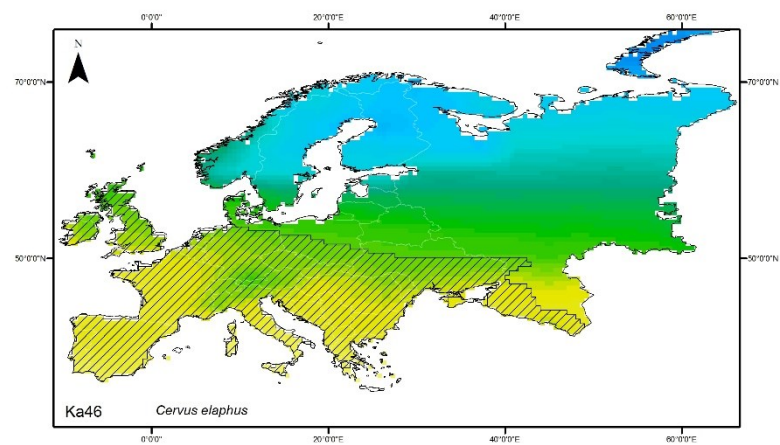


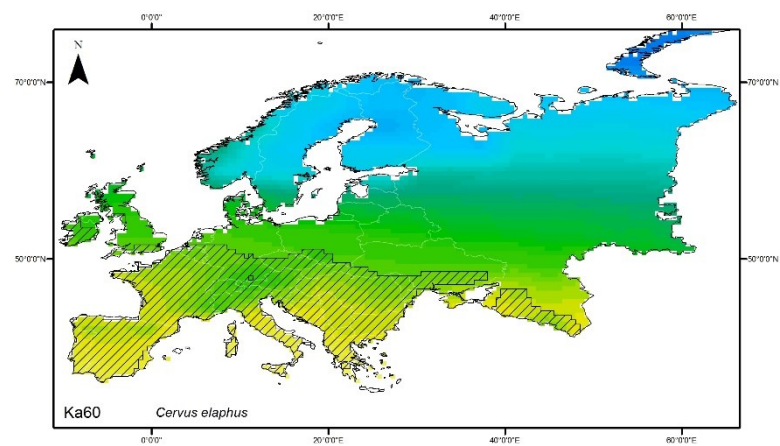
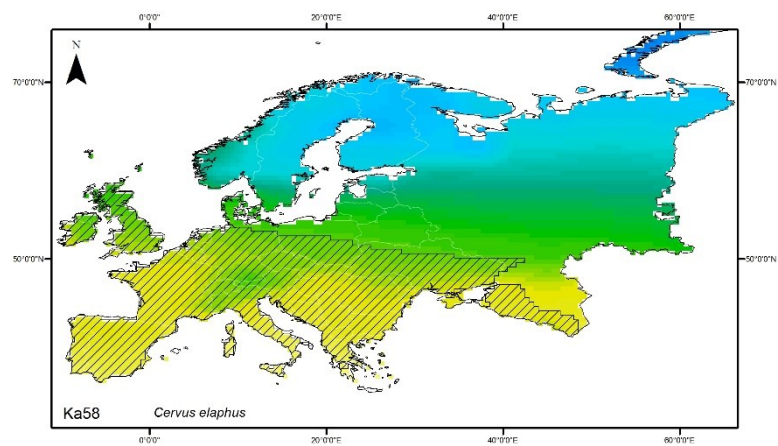
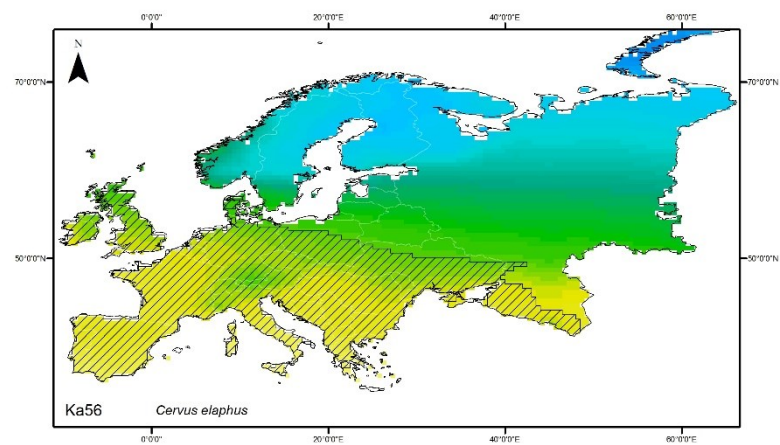
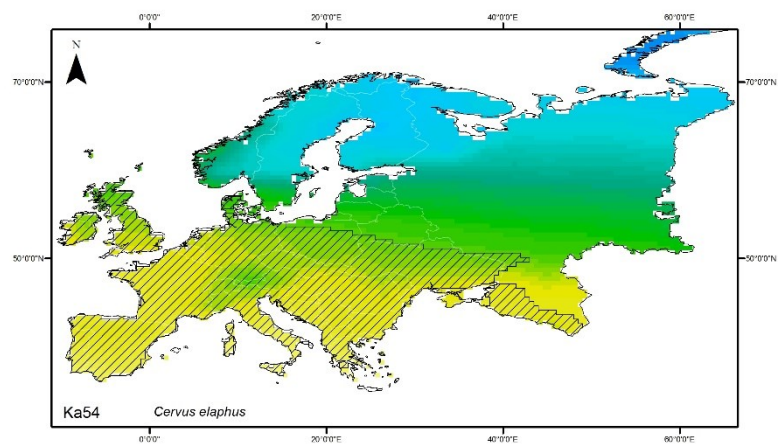


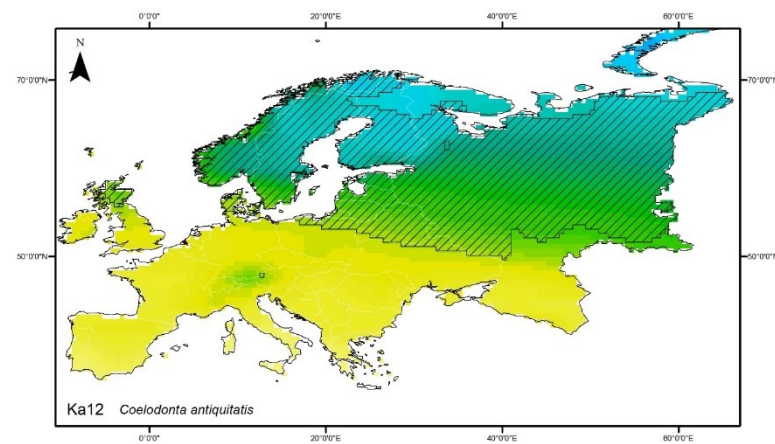
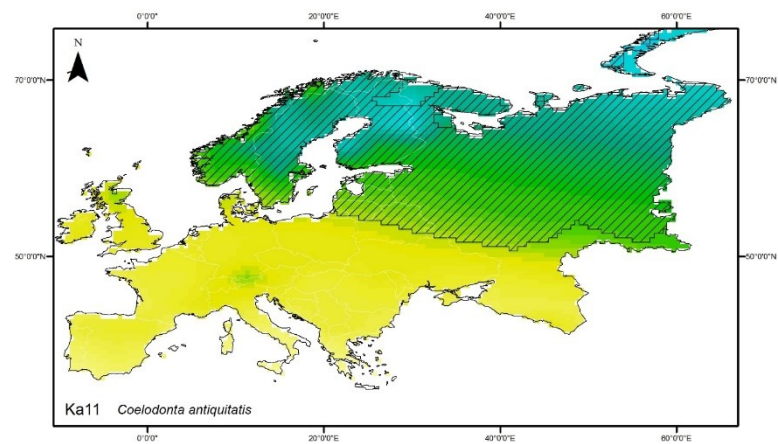
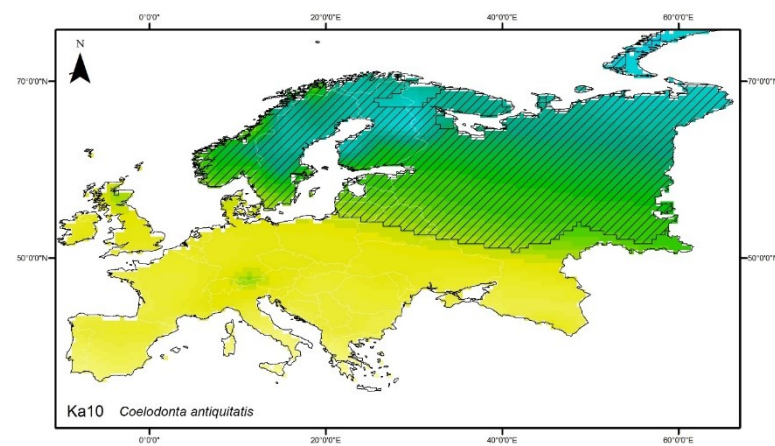
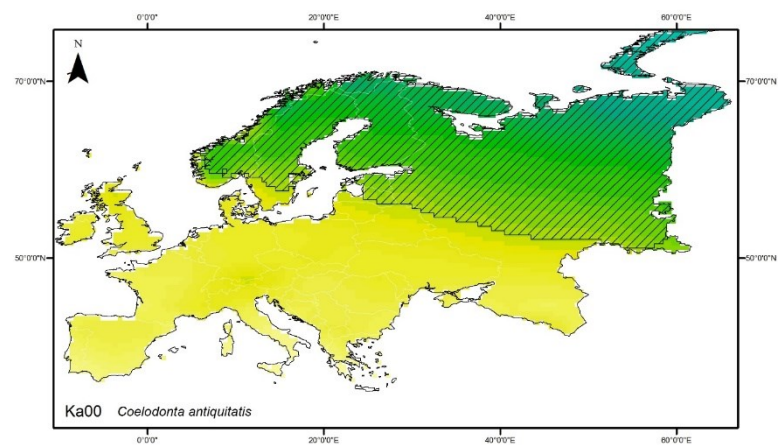


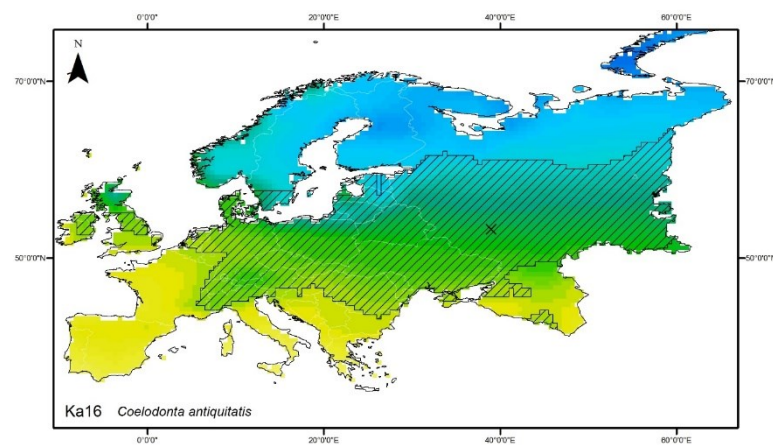
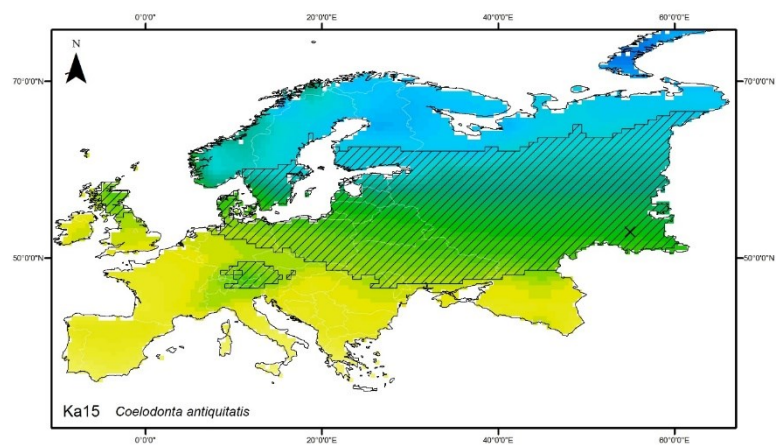
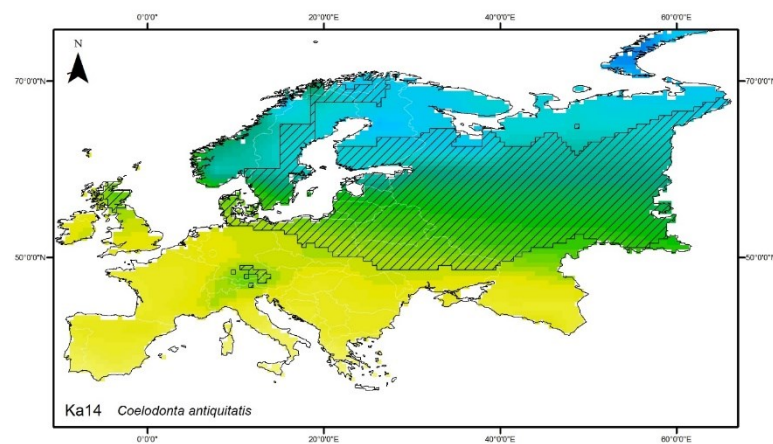
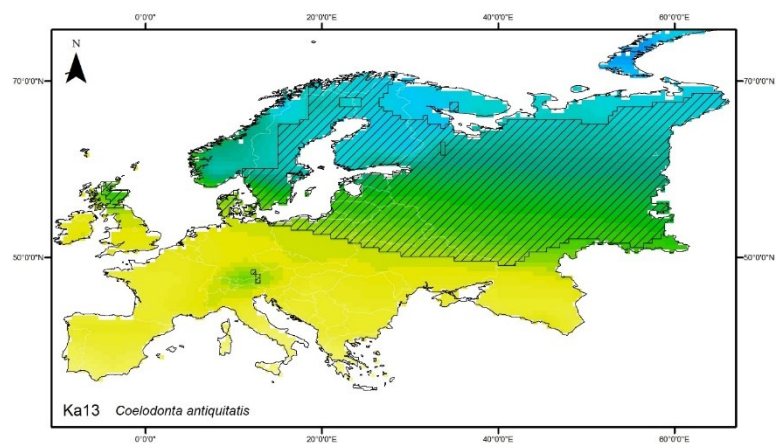


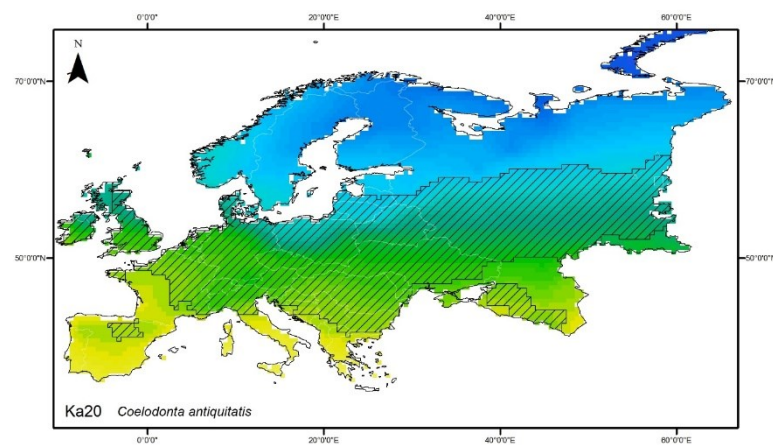
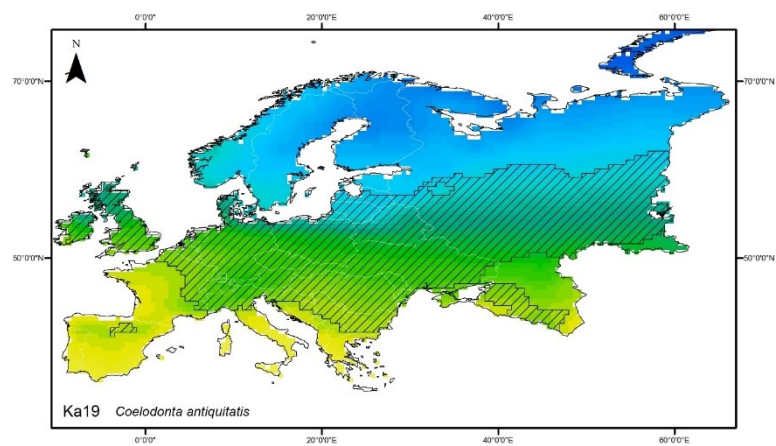
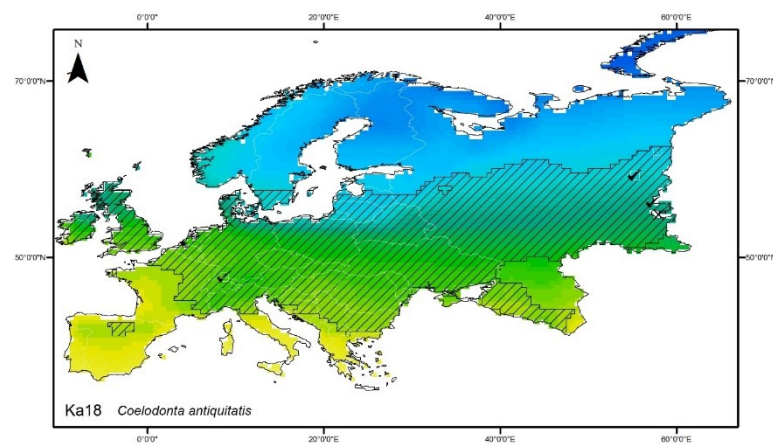
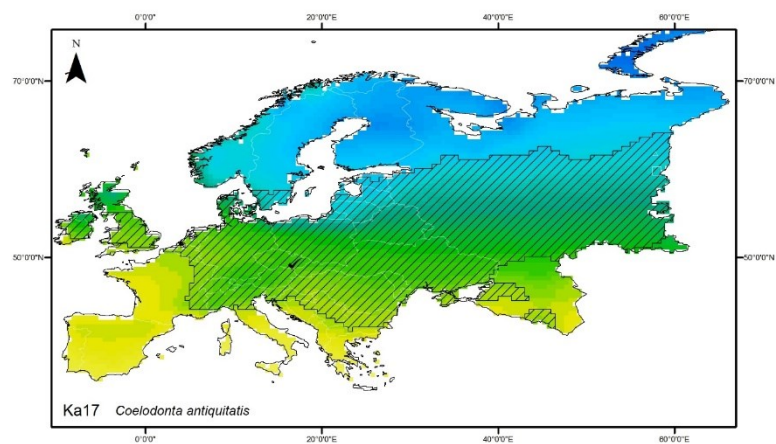


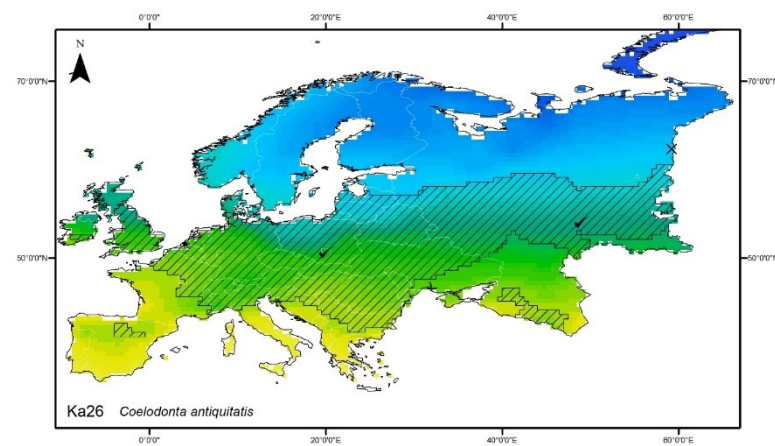
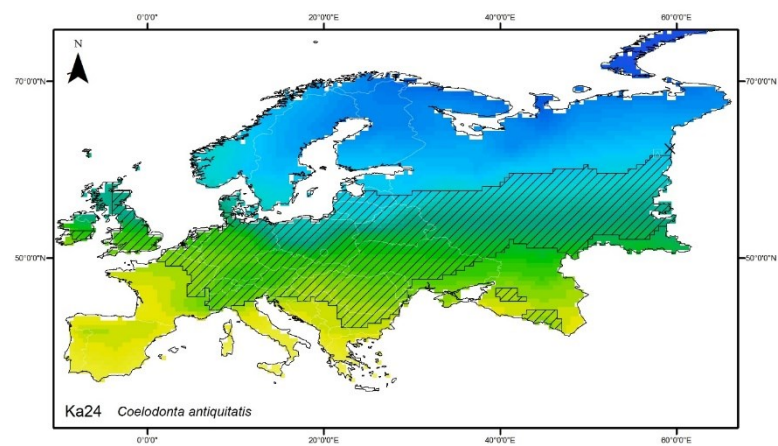
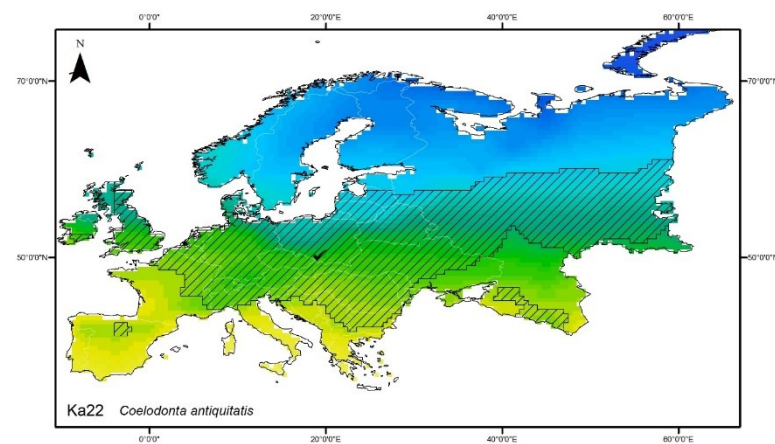
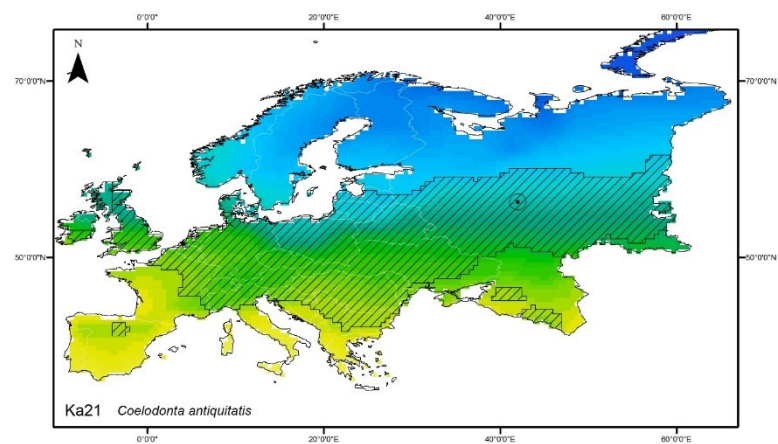


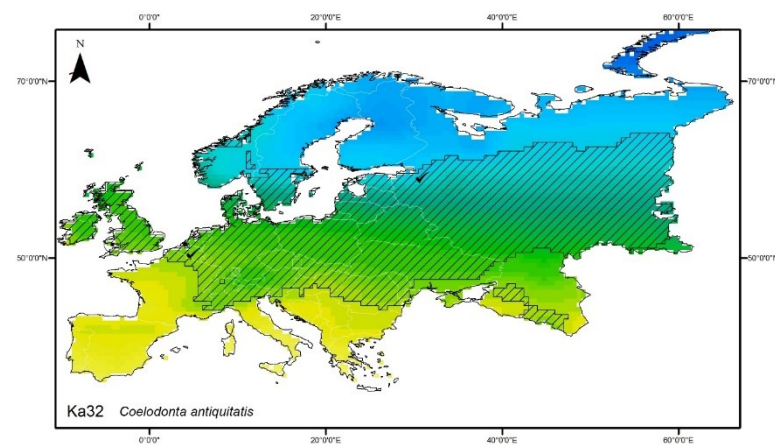
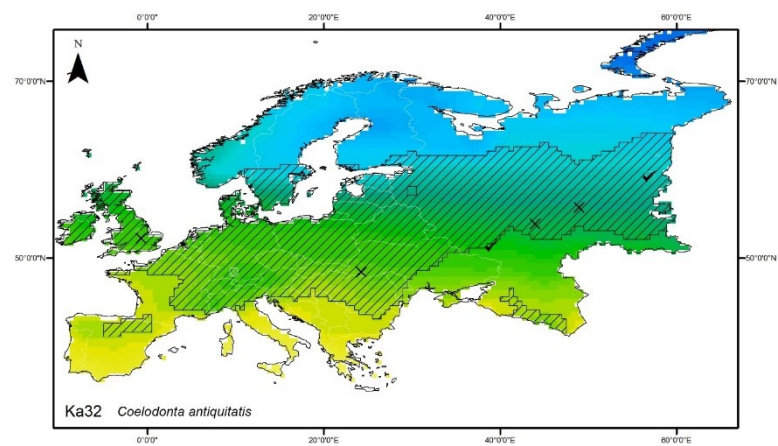
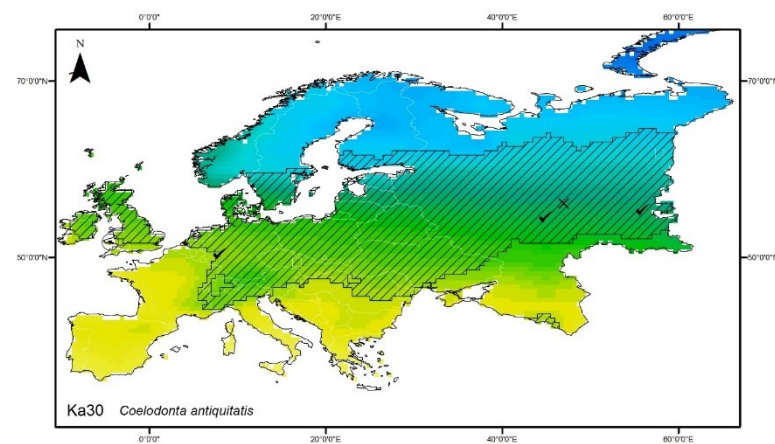
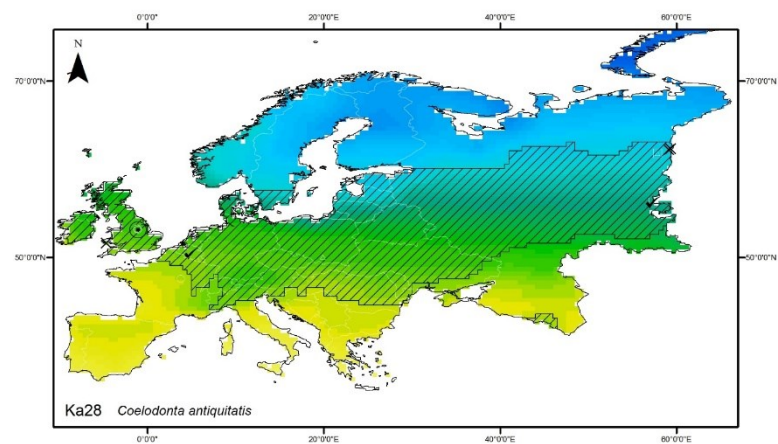


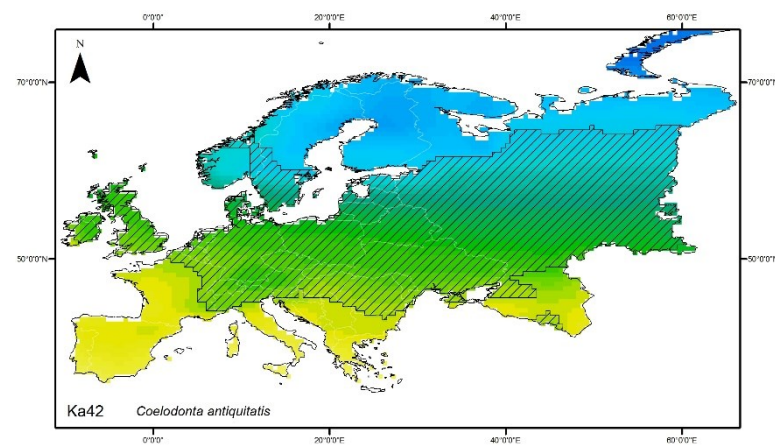
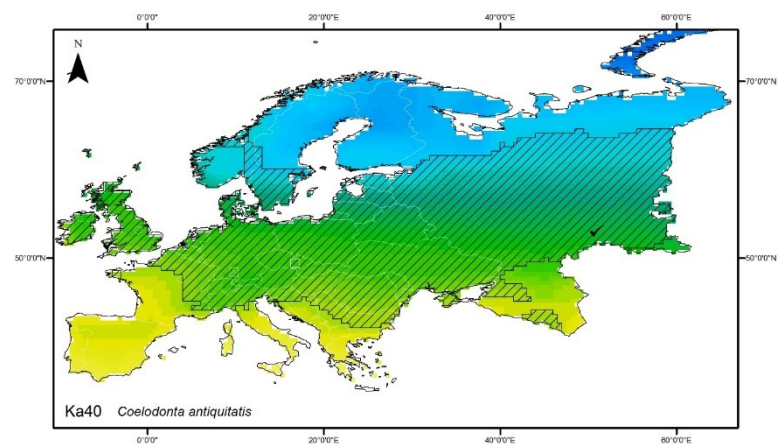
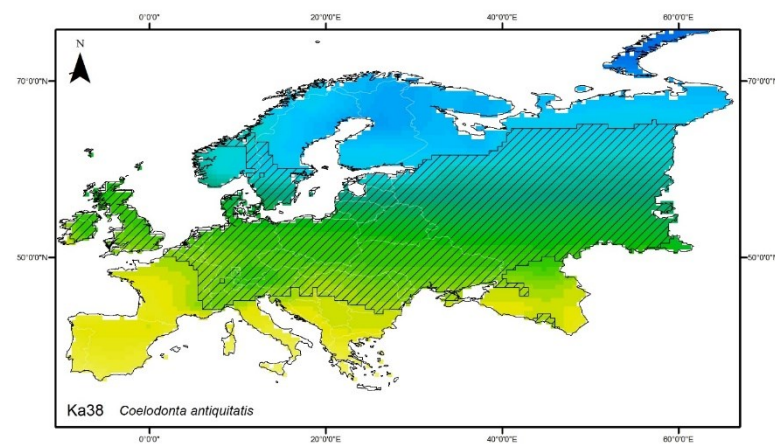
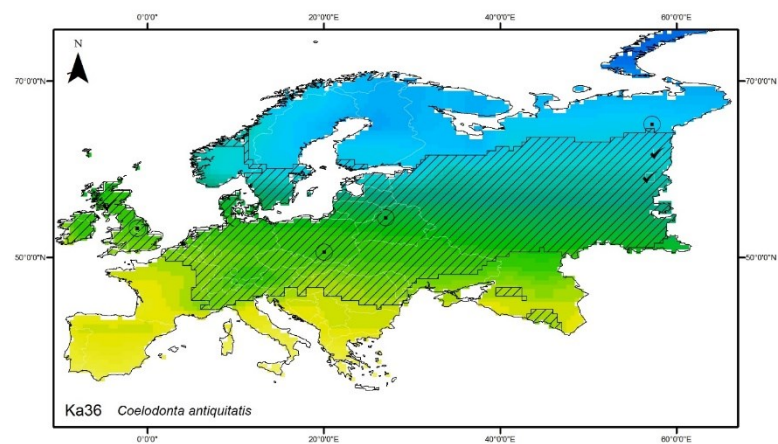
3.4 *Coelodonta antiquitatis*

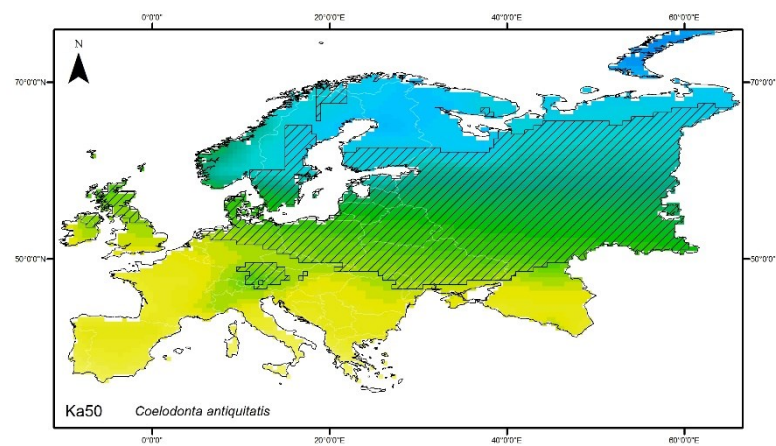
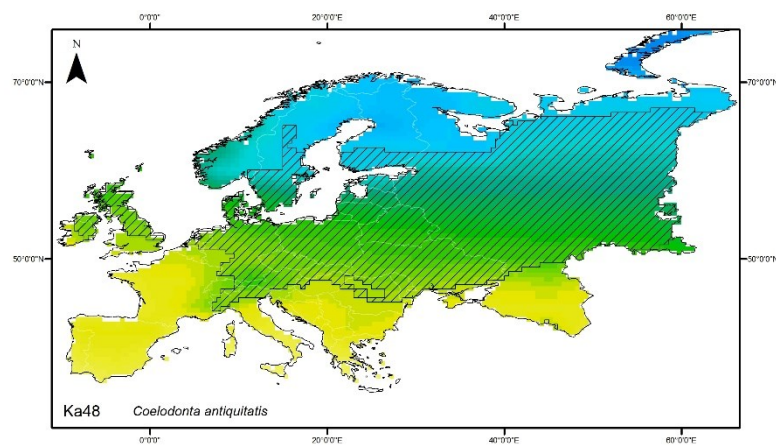
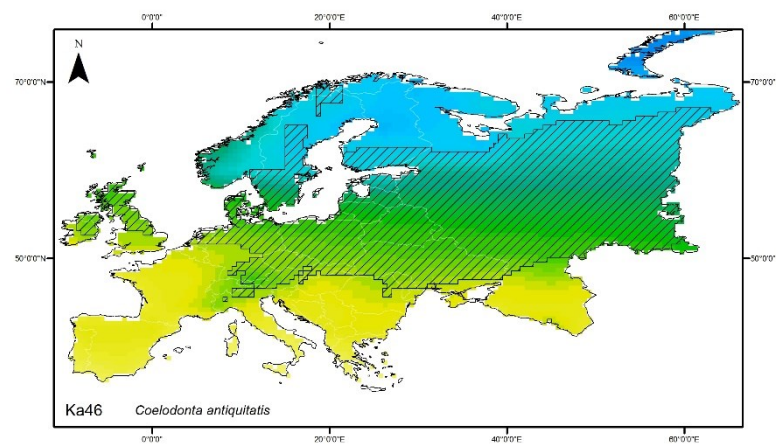
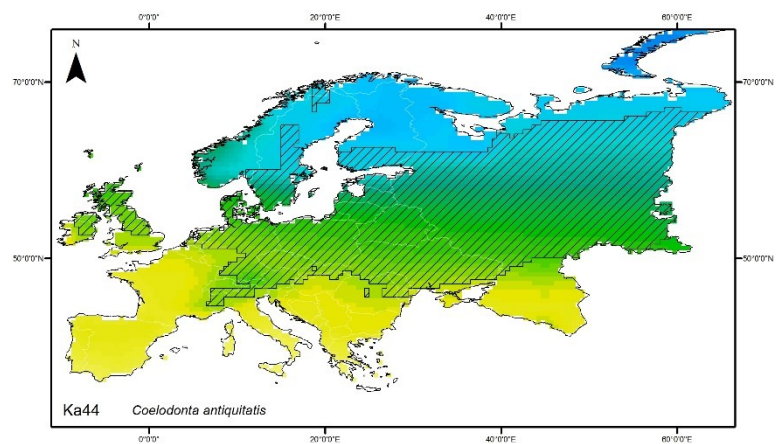


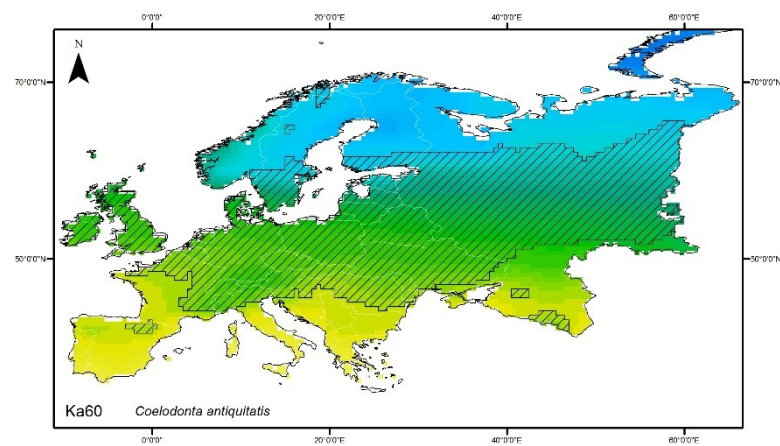
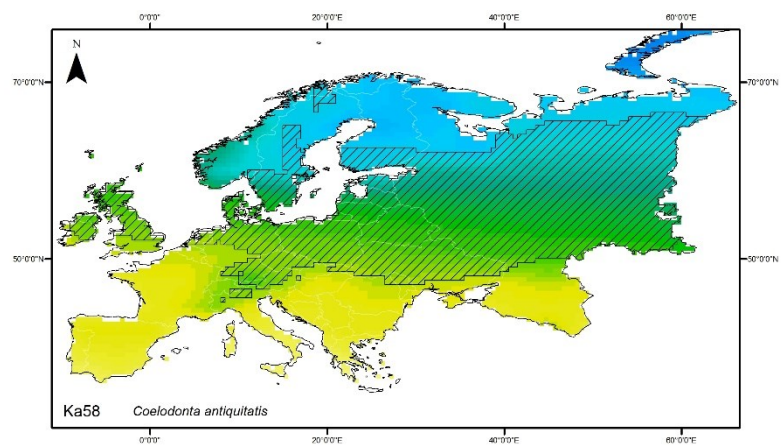
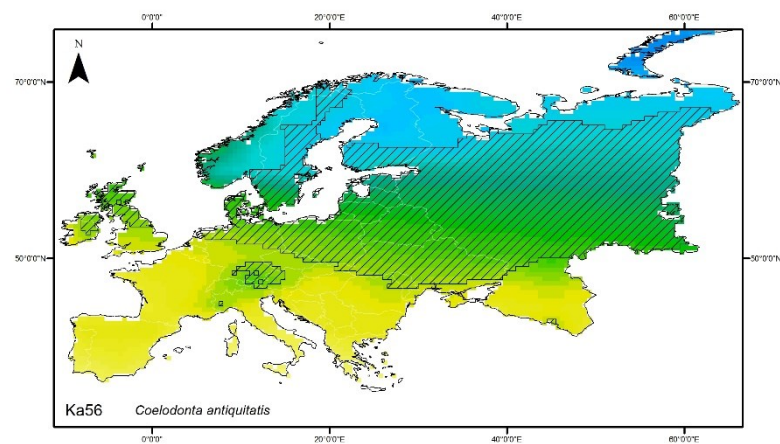
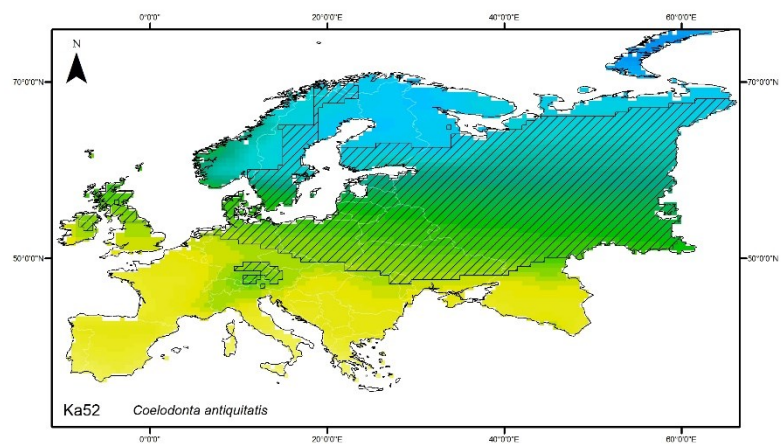


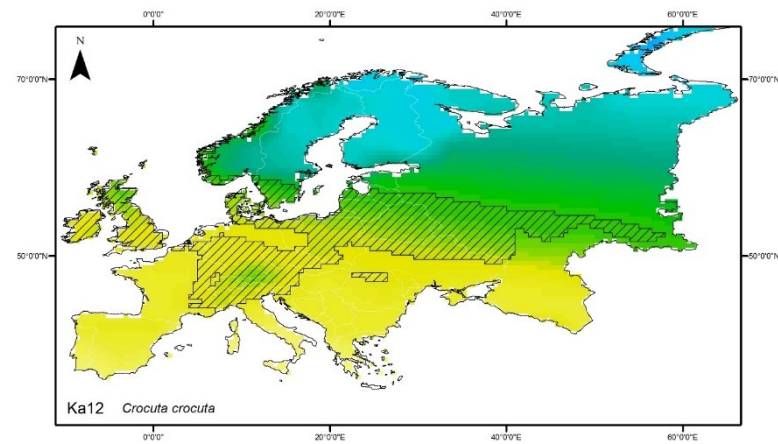
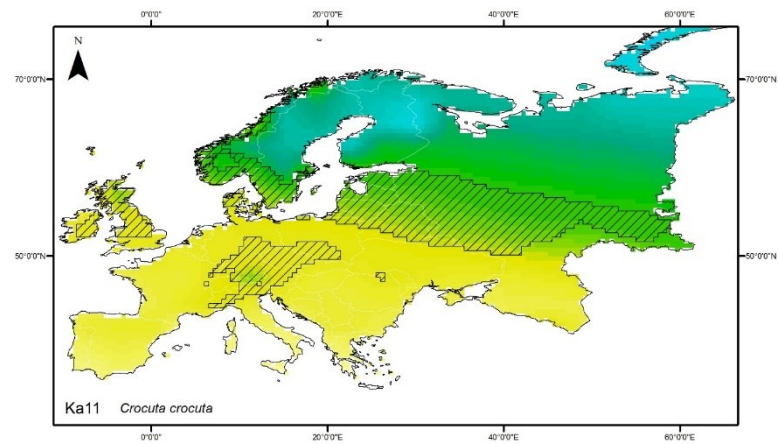
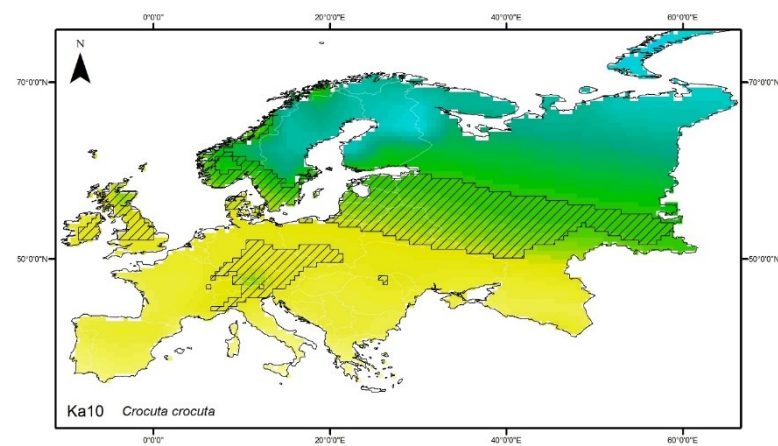
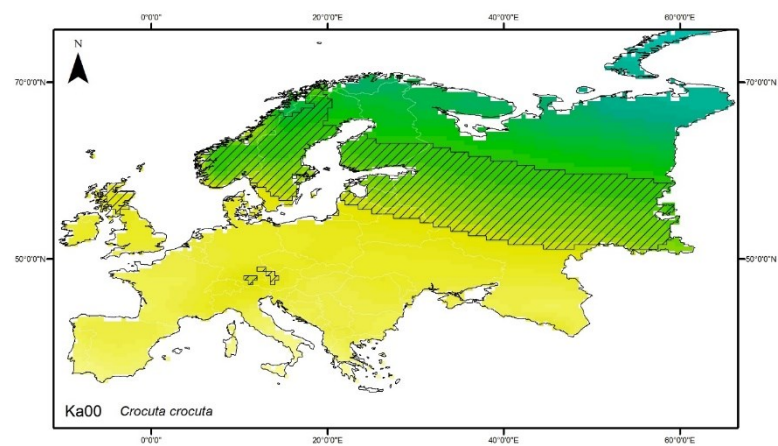


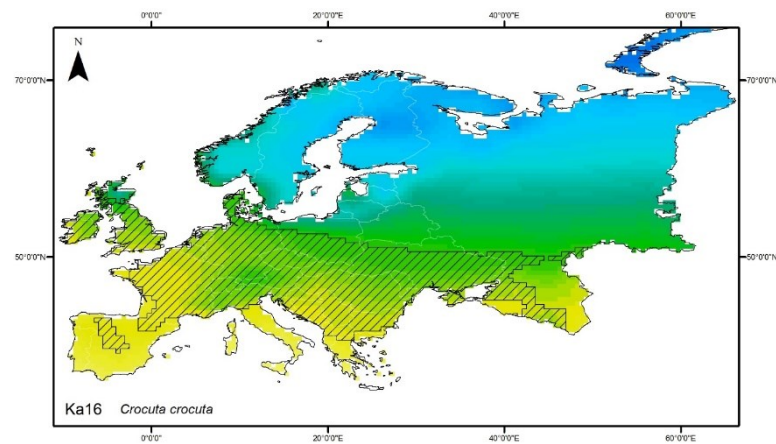
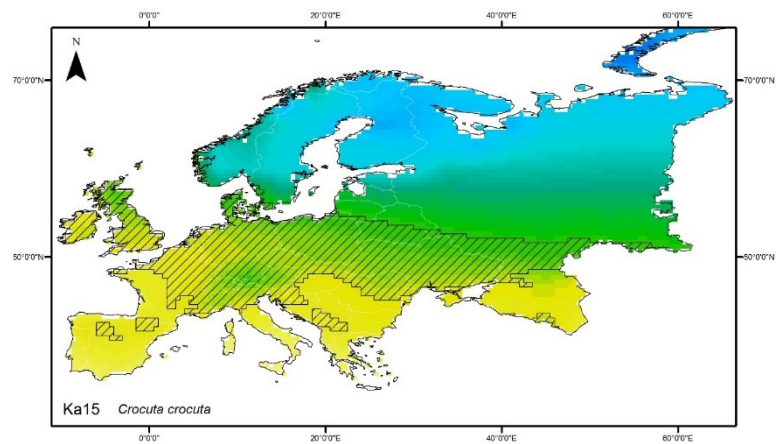
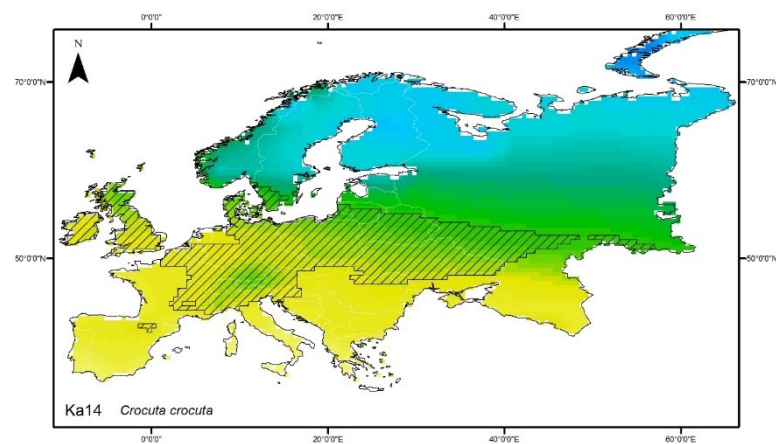
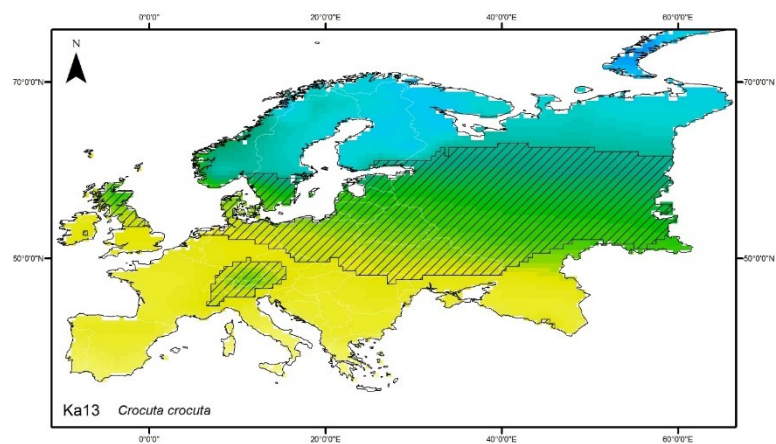


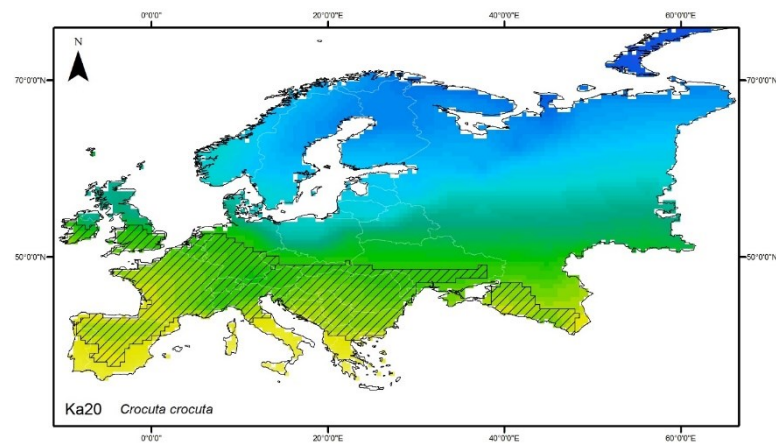
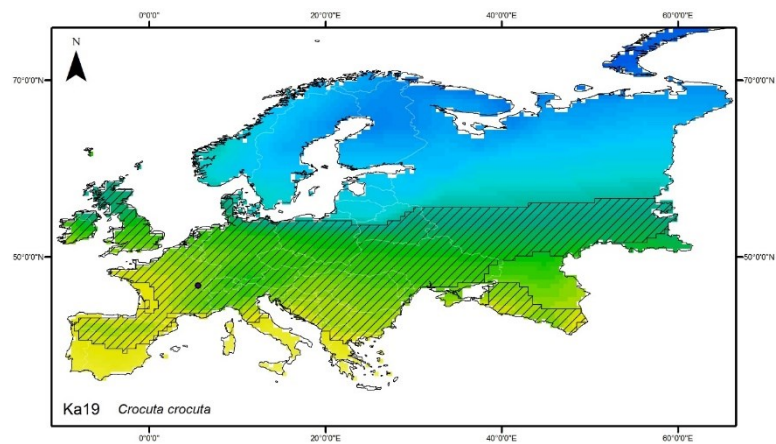
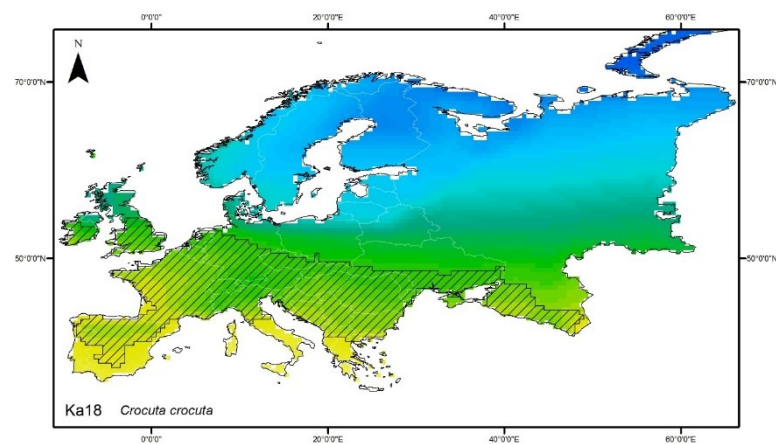
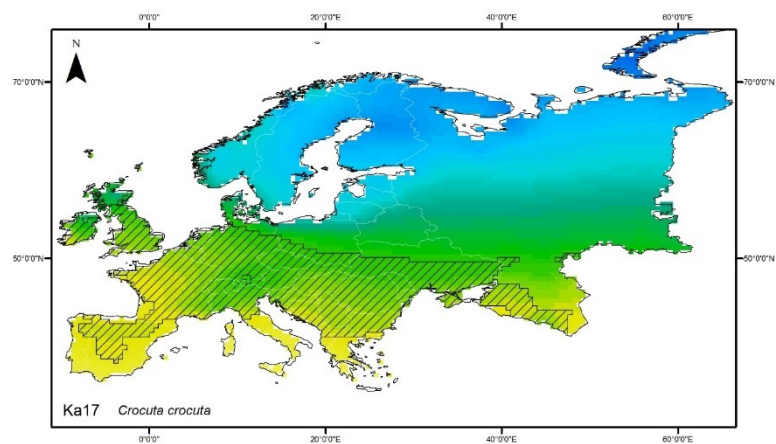


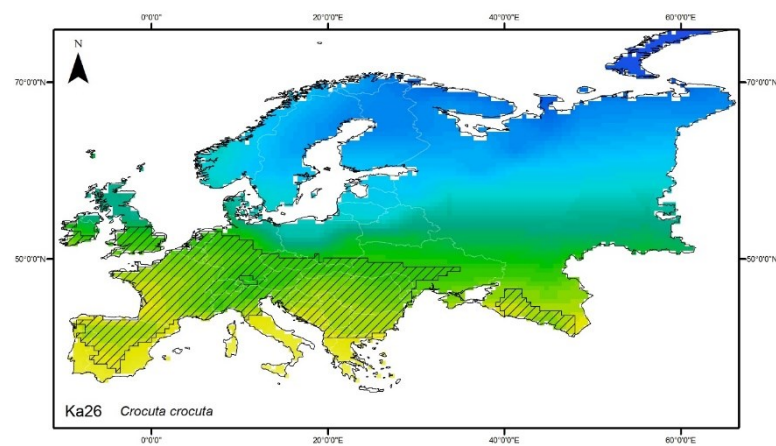
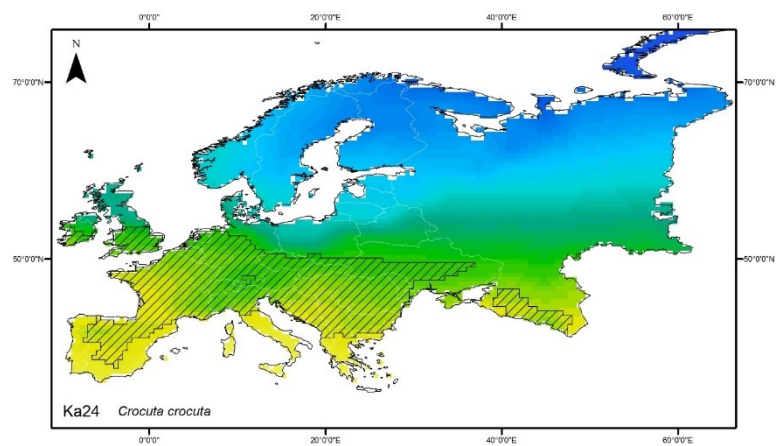
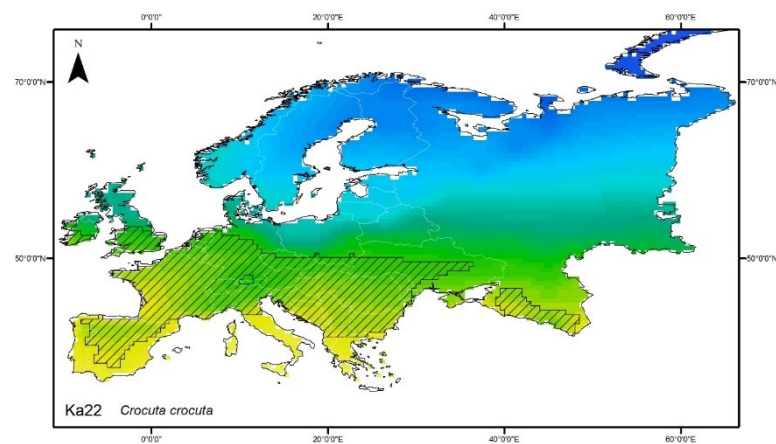
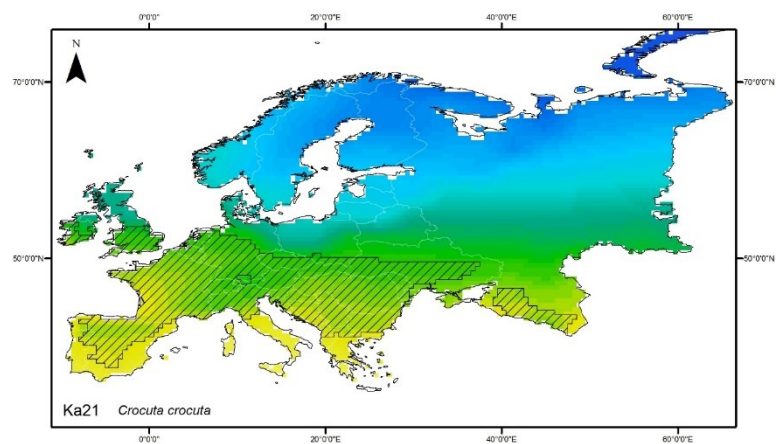


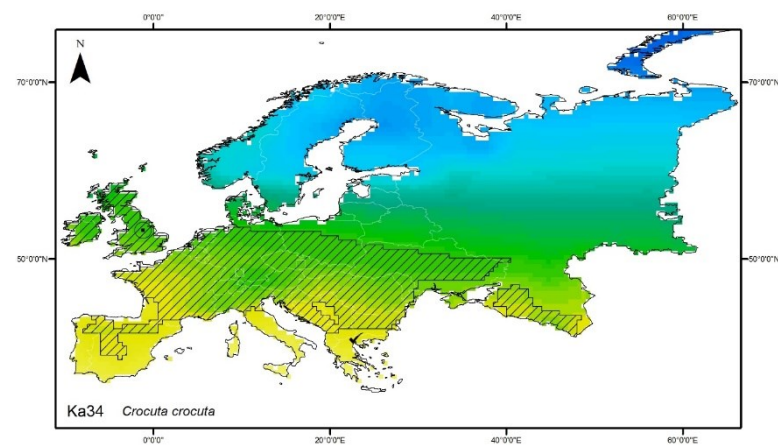
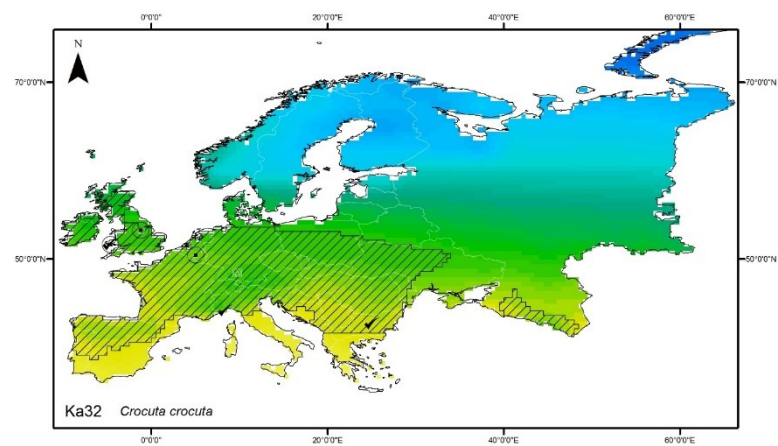
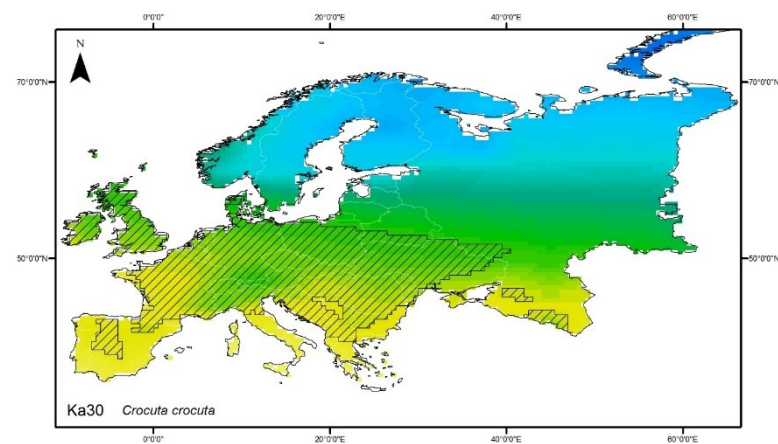
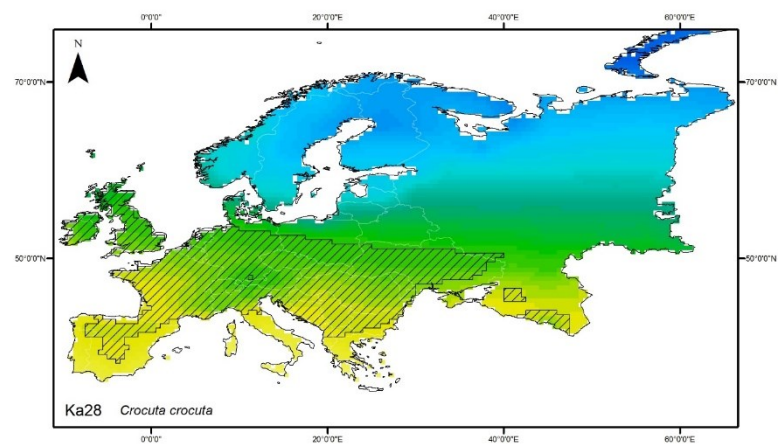


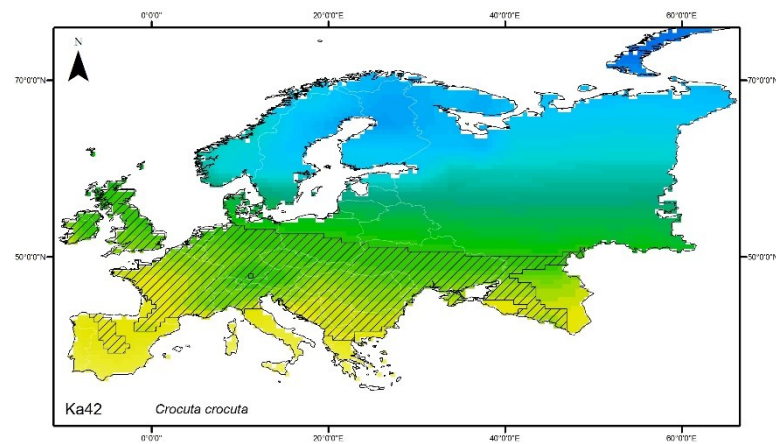
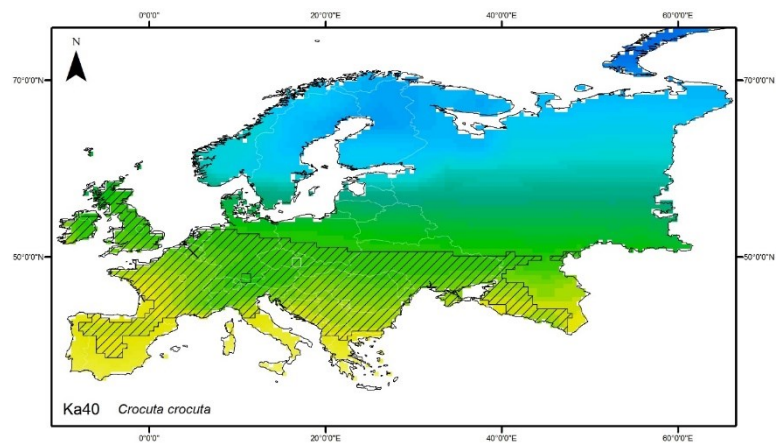
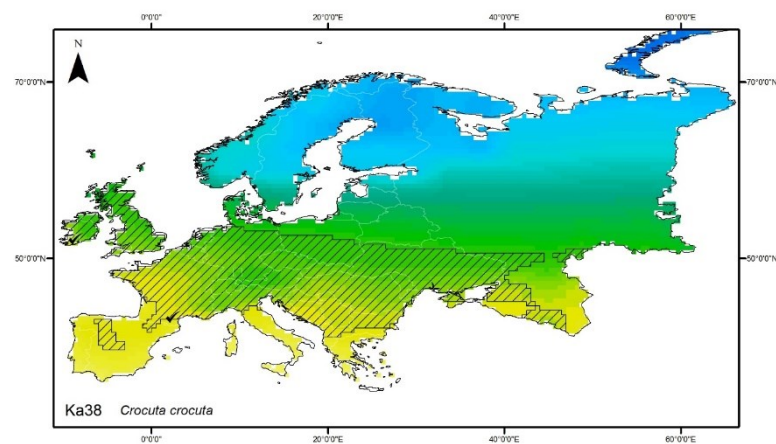
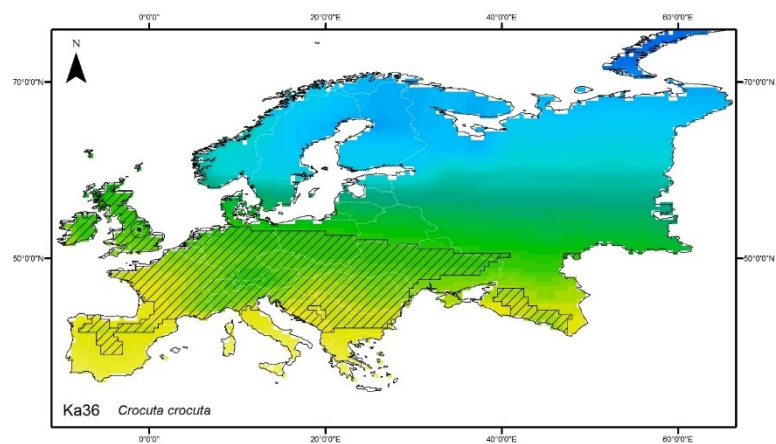
3.5 *Crocute crocuta*

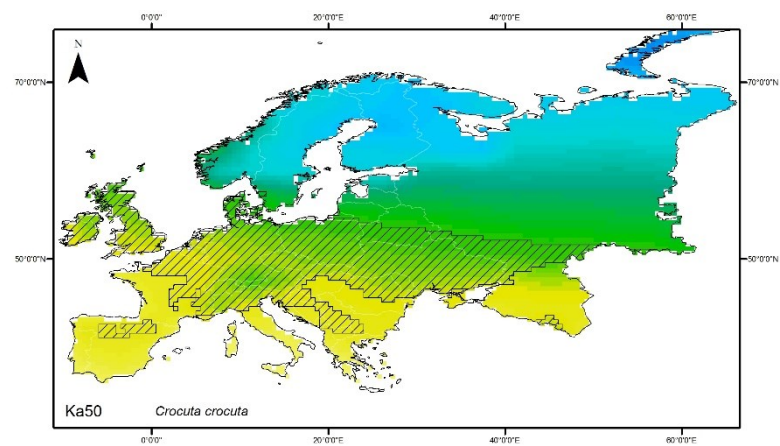
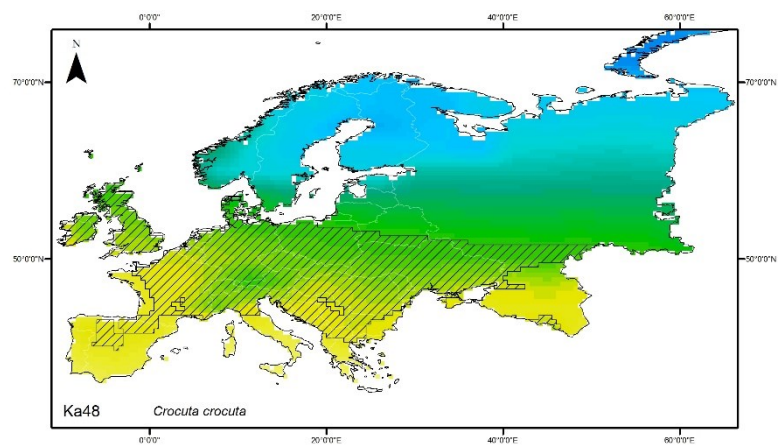
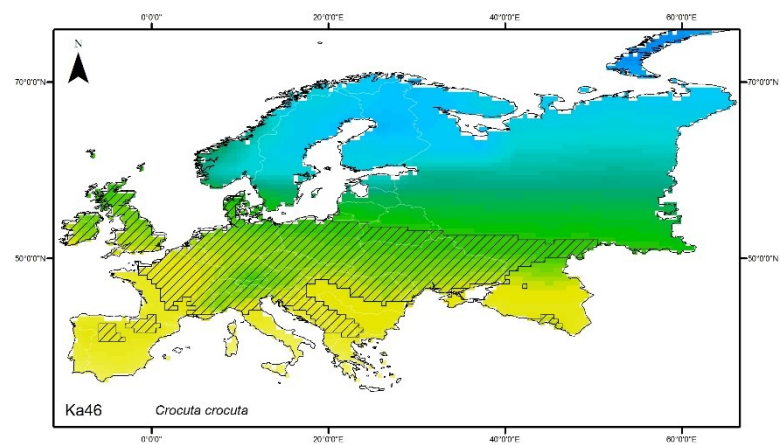
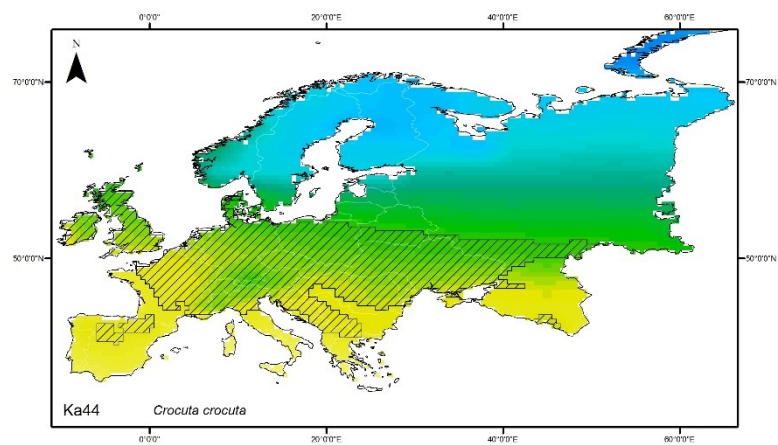


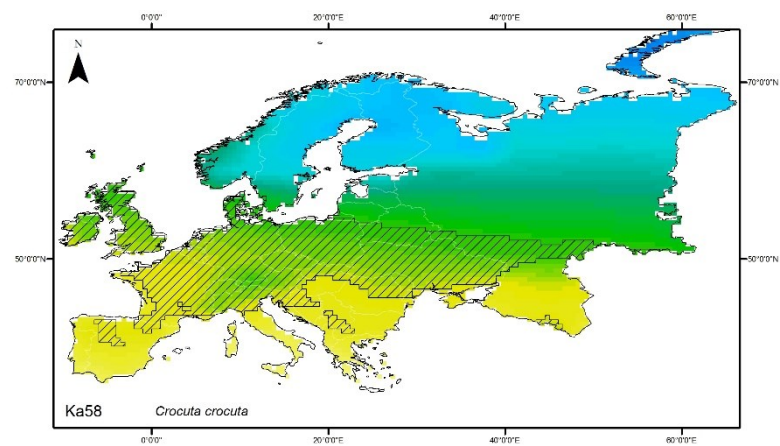
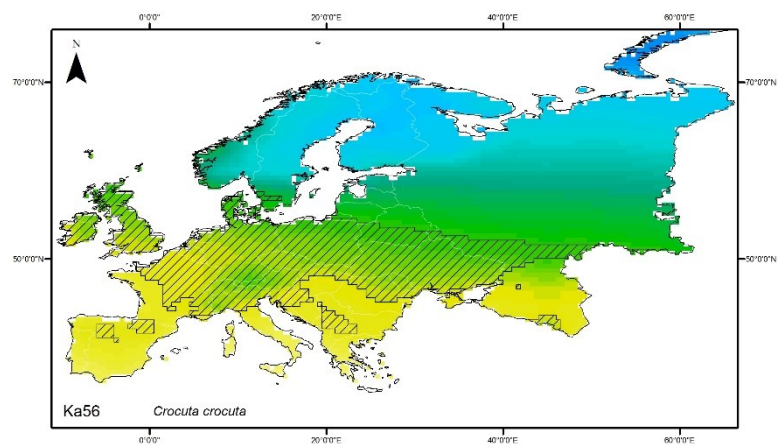
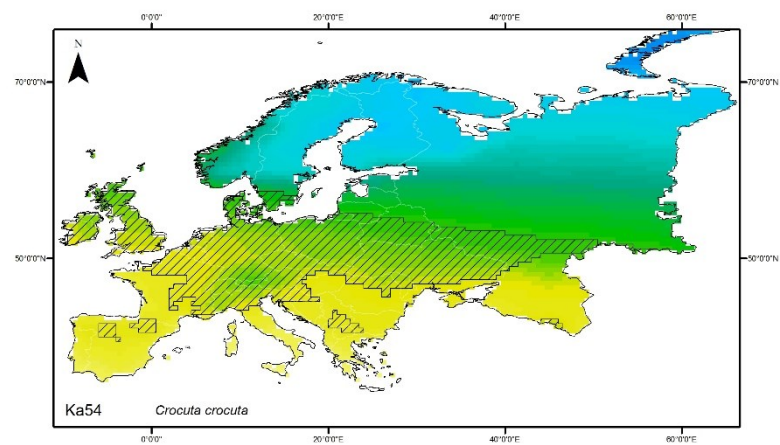
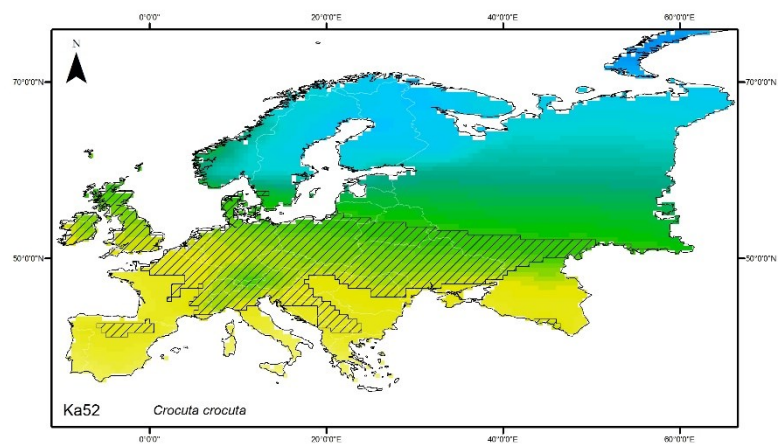


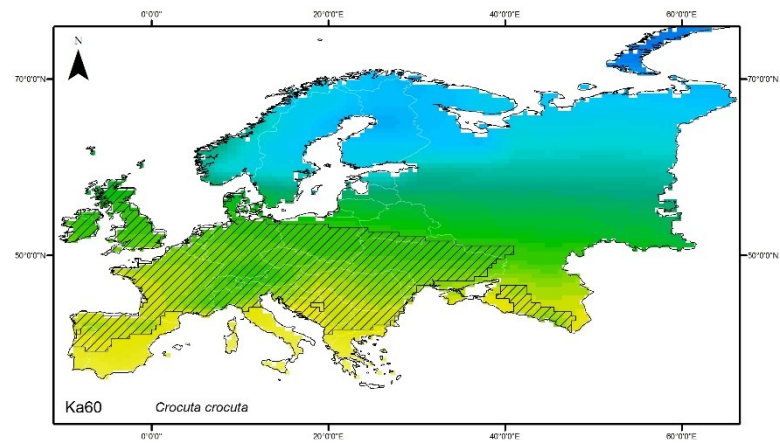


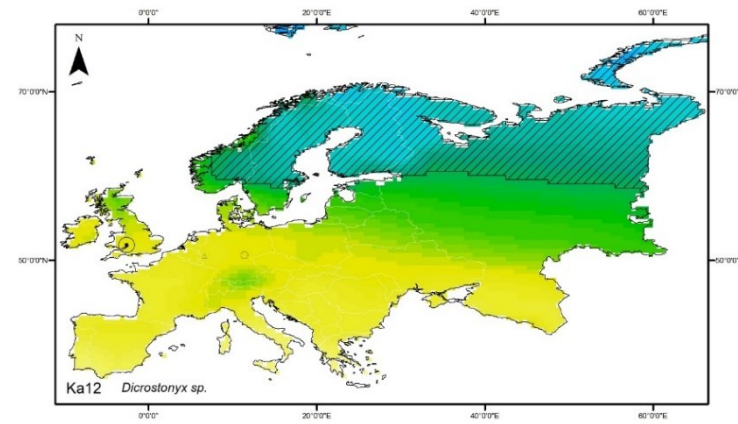
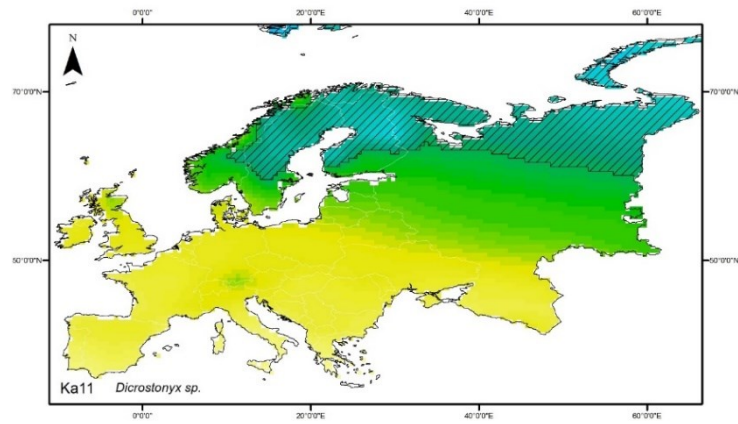
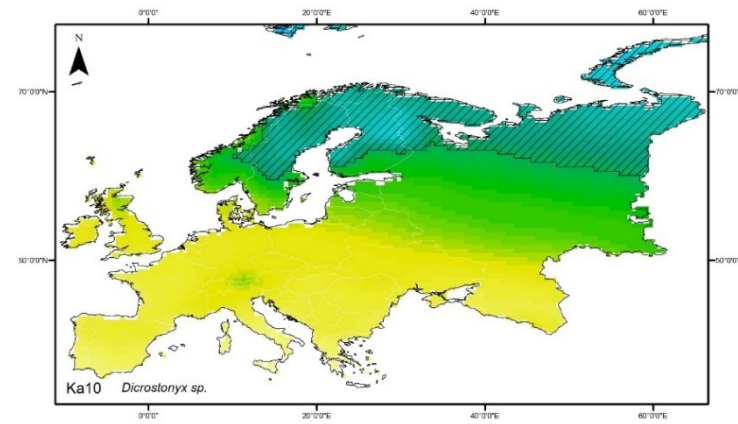
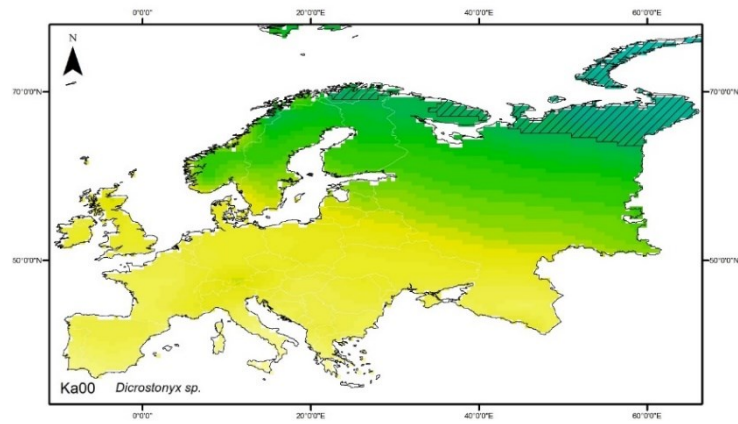


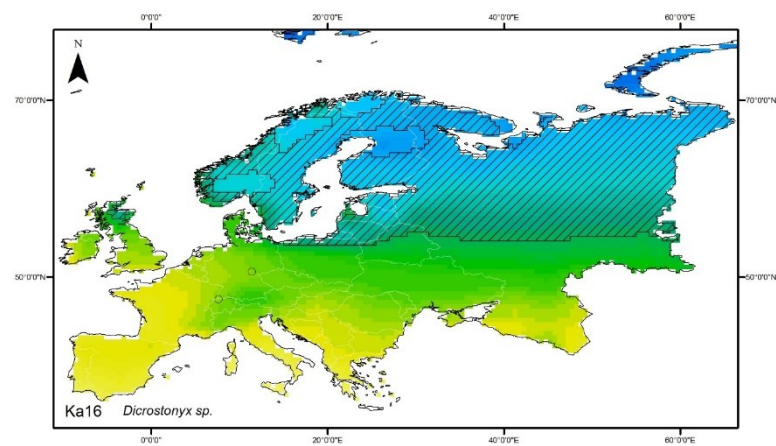
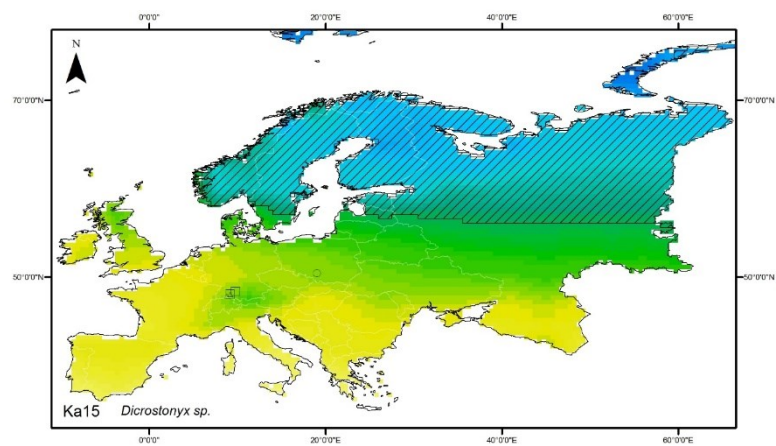
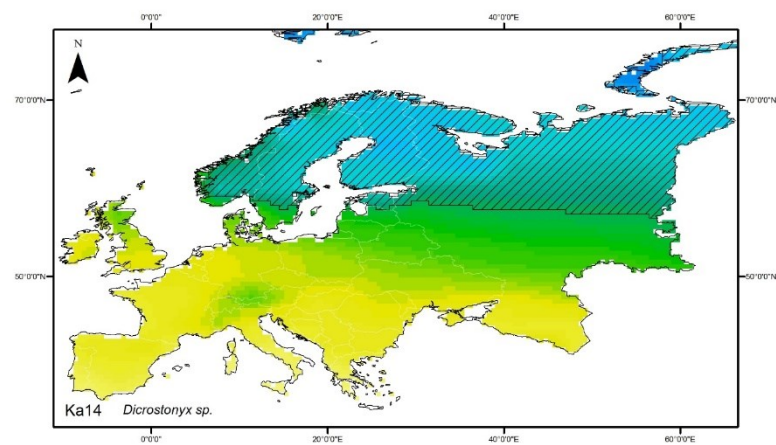
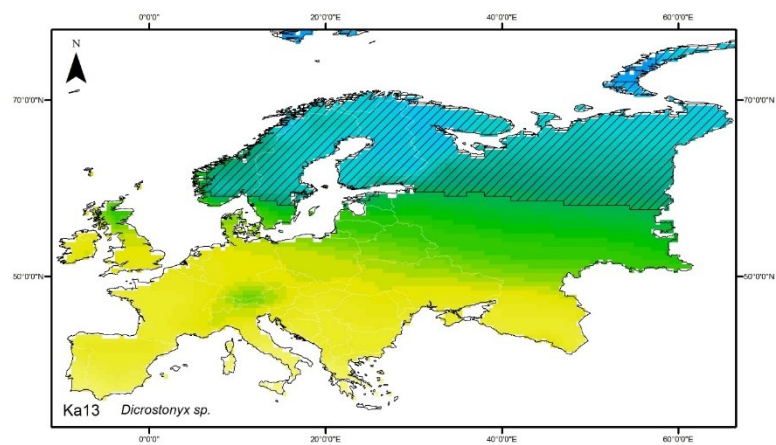


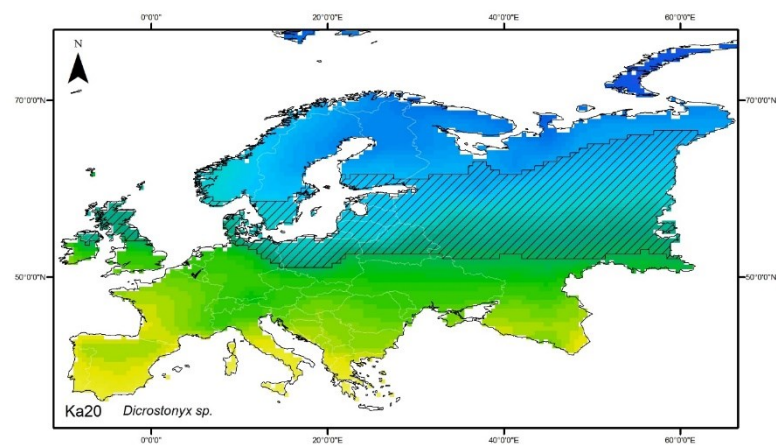
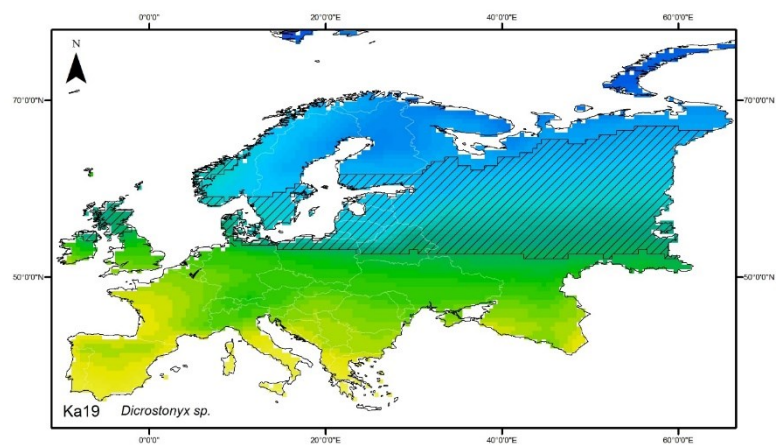
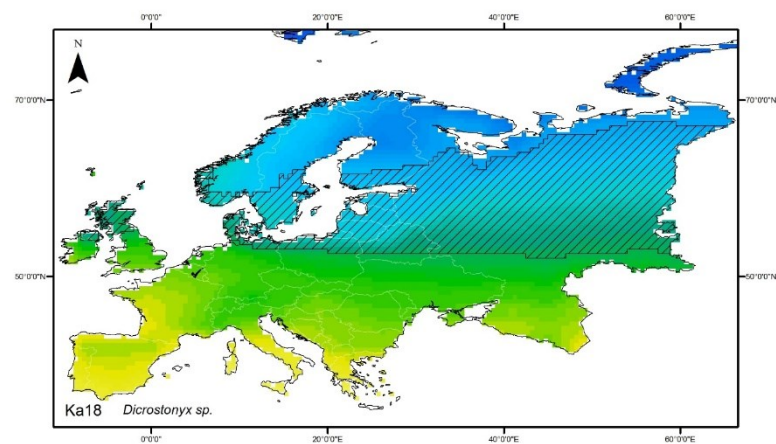
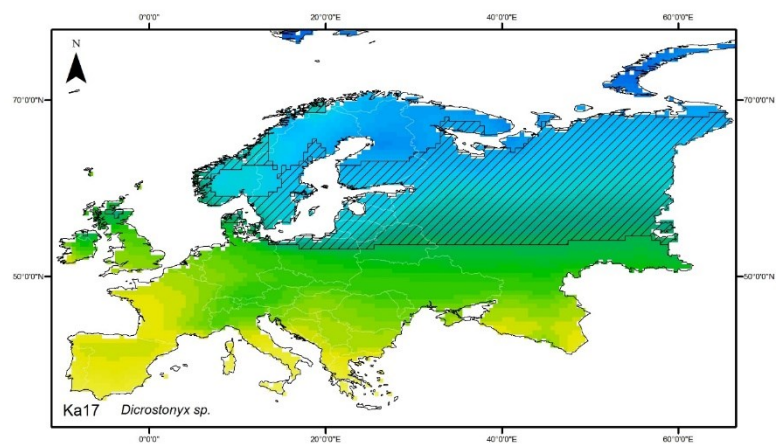


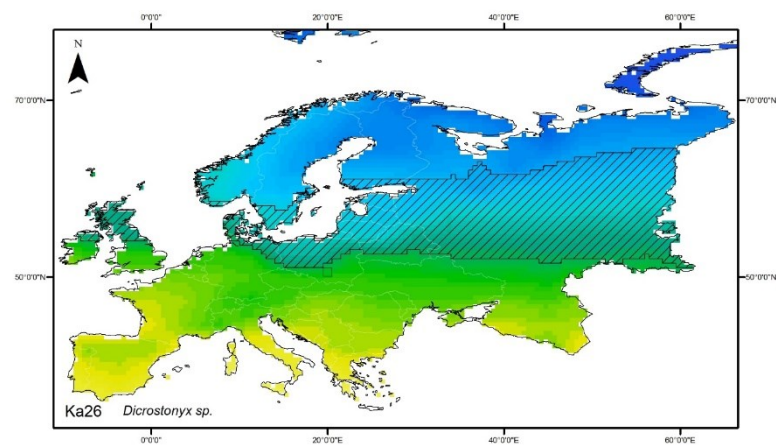
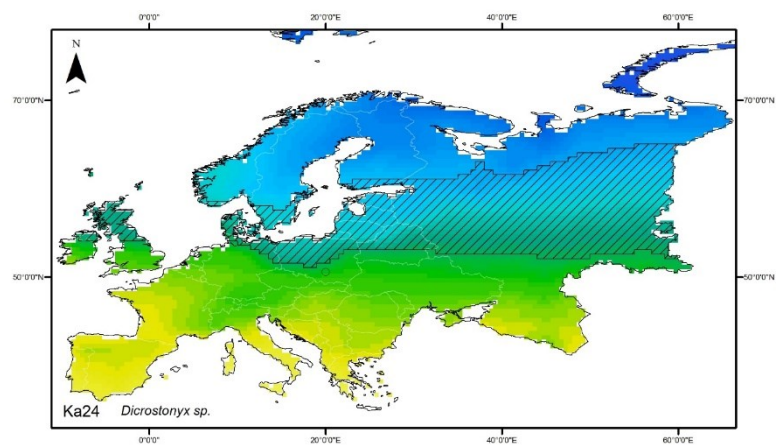
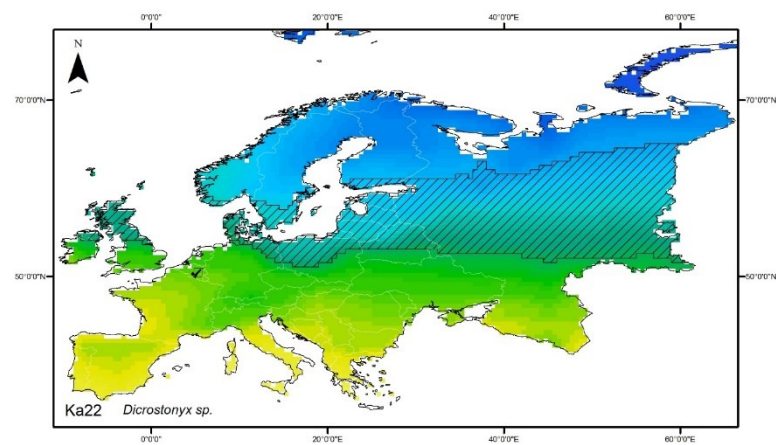
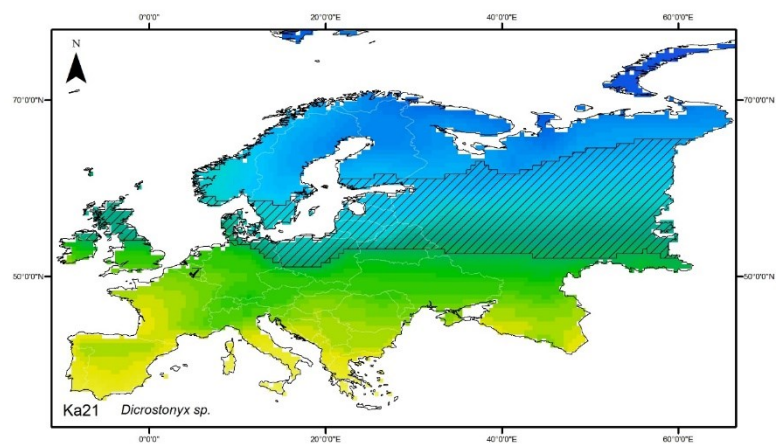


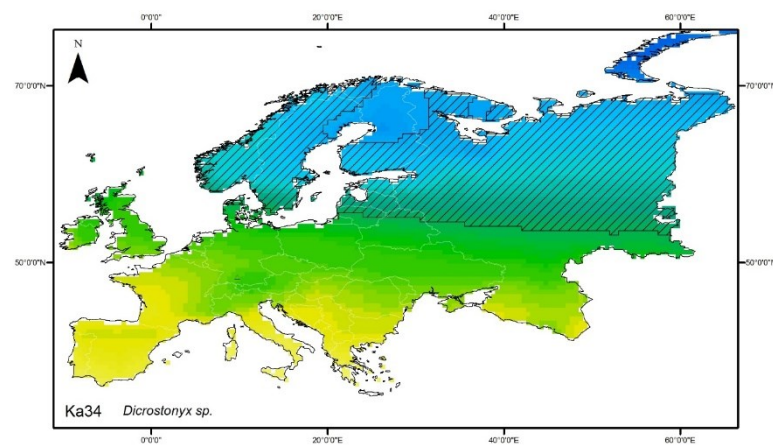
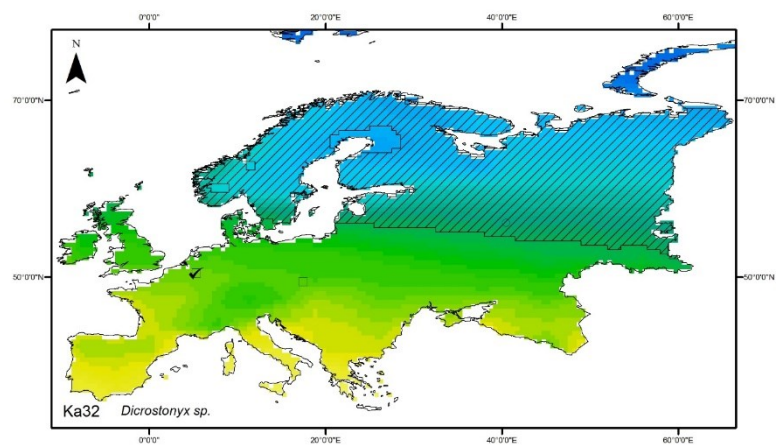
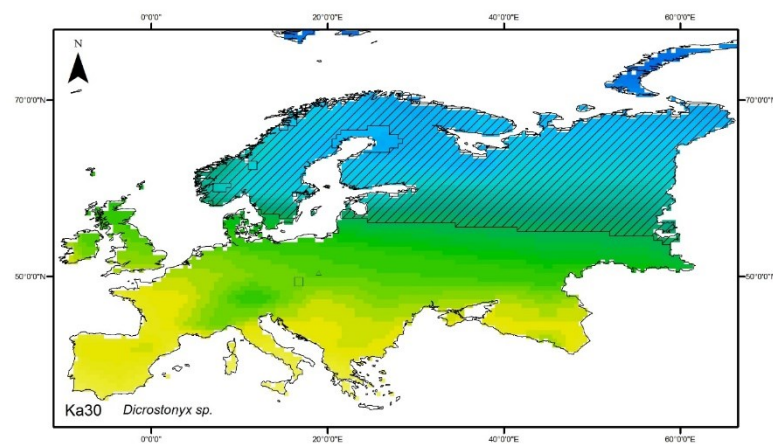
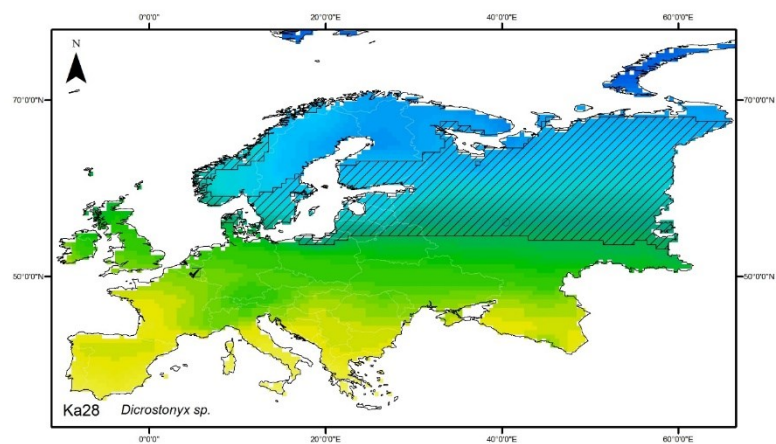


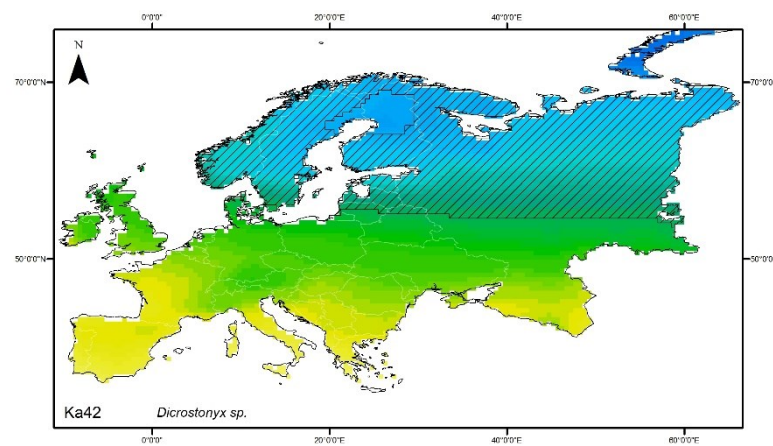
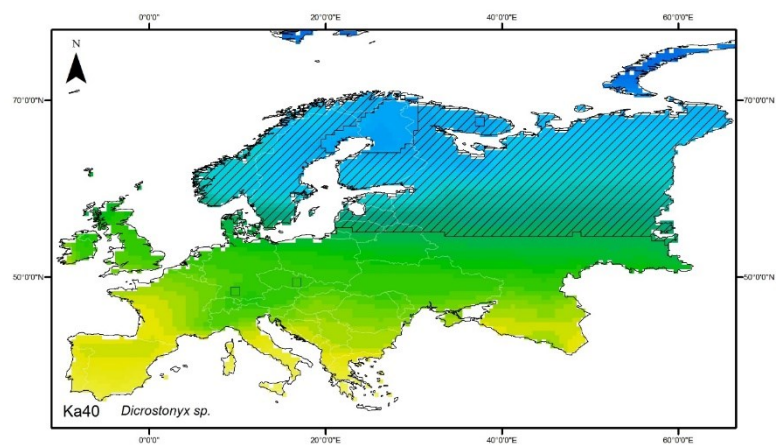
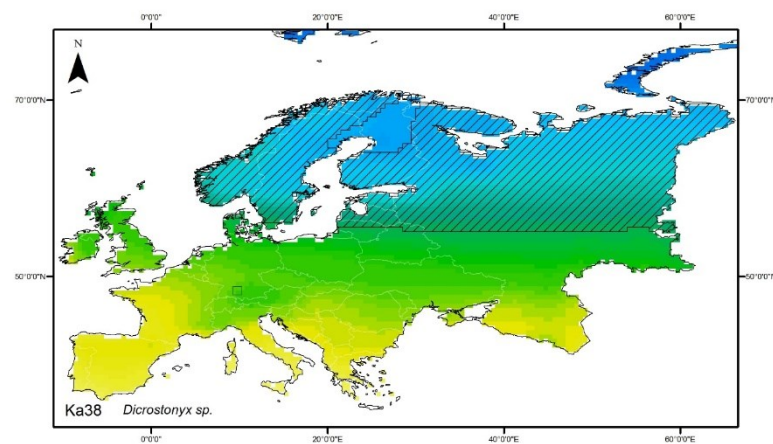
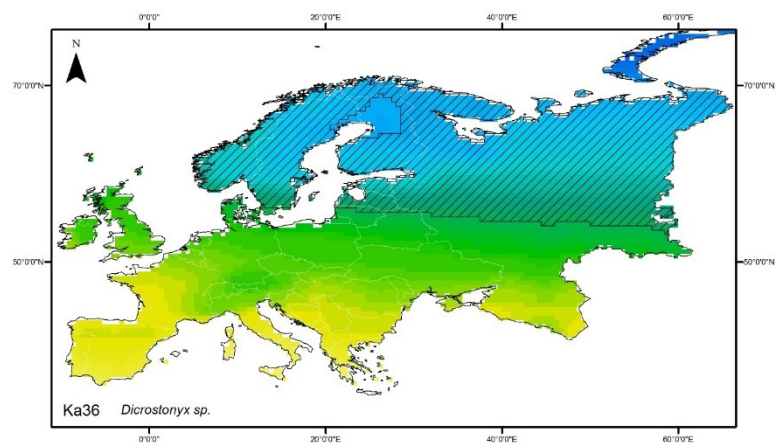
3.6 *Dicrostonyx* sp.

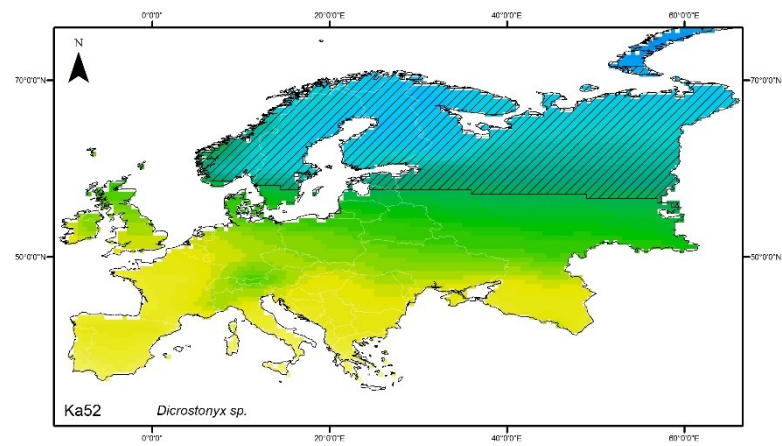
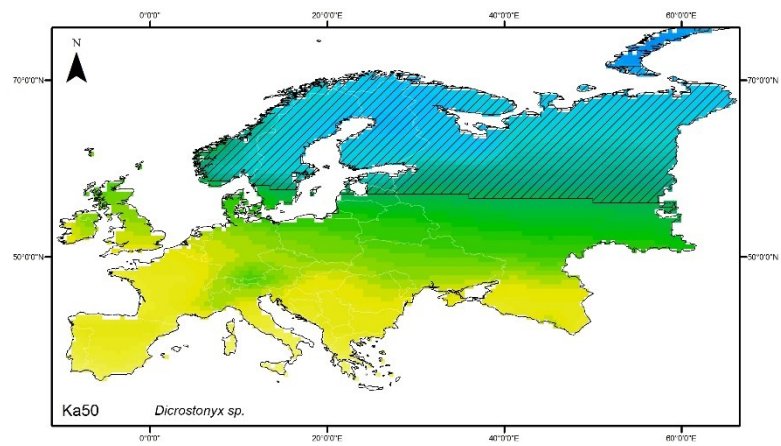
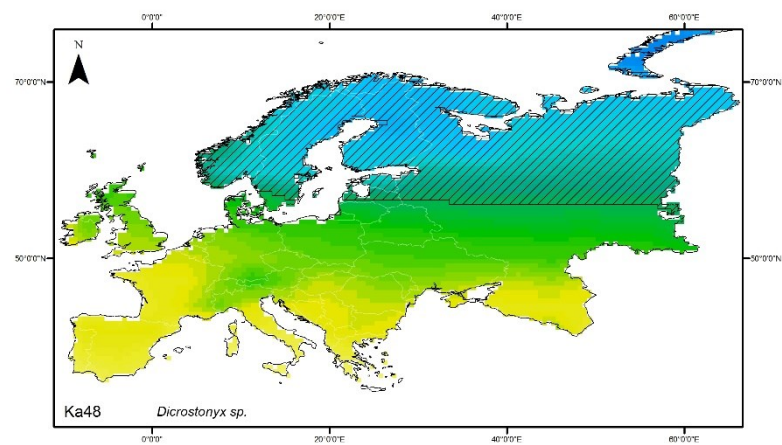
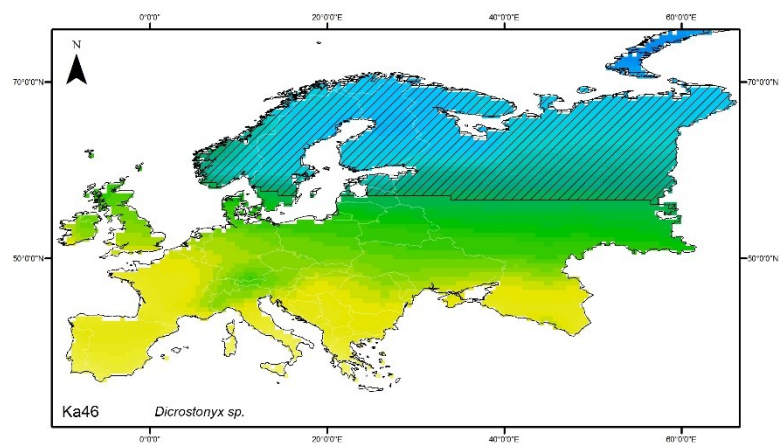


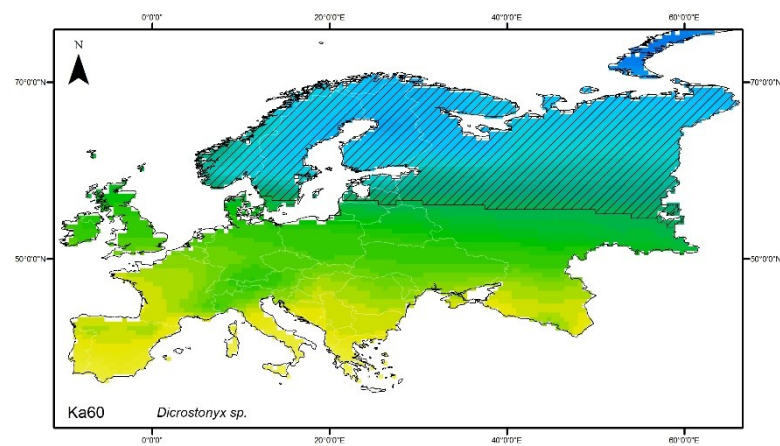
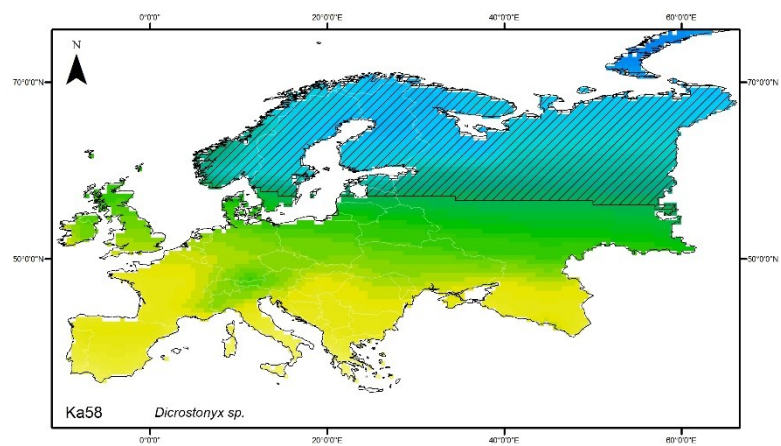
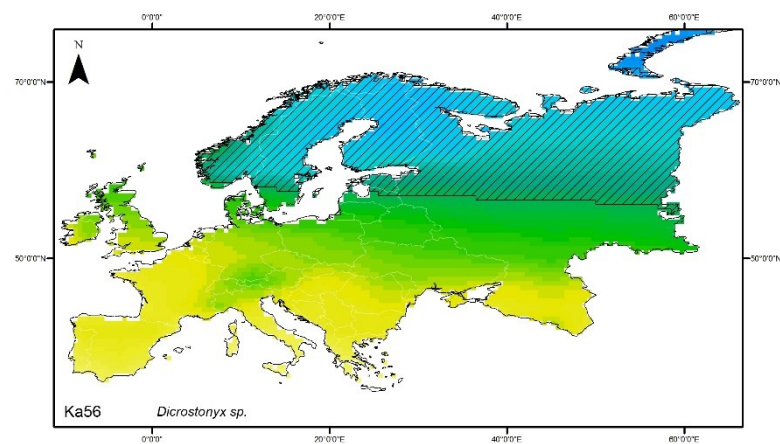
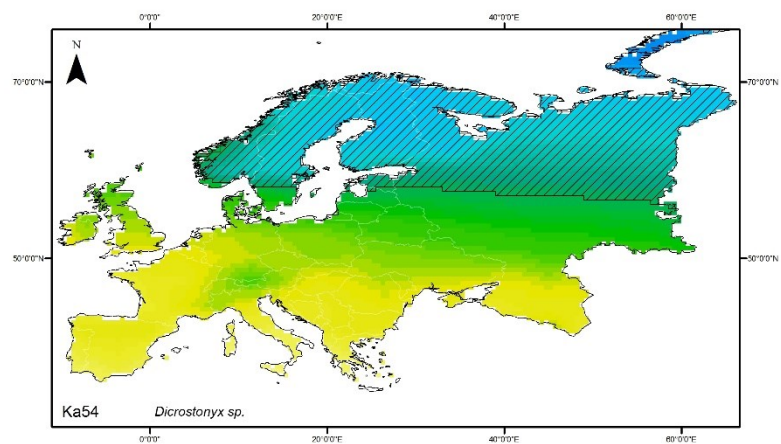


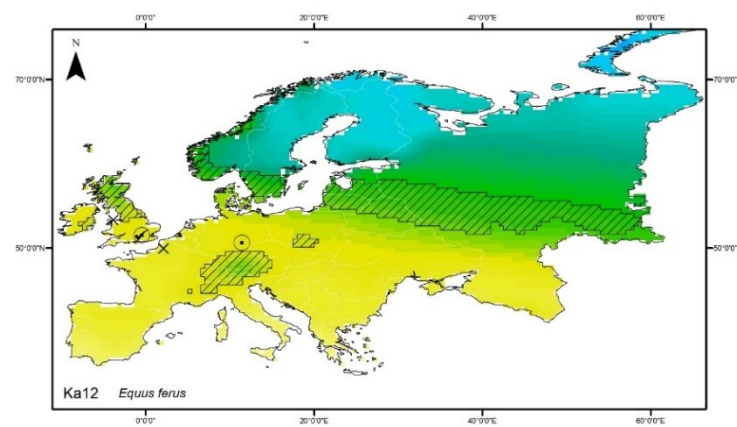
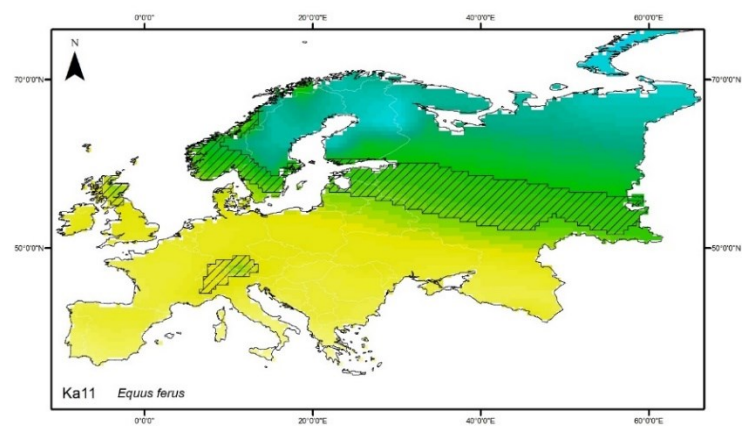
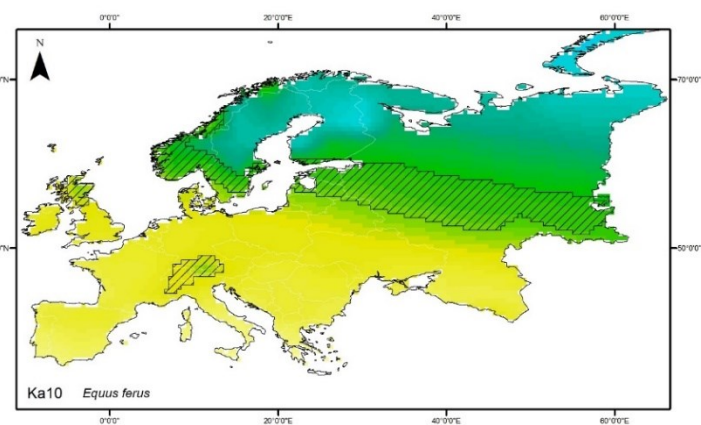
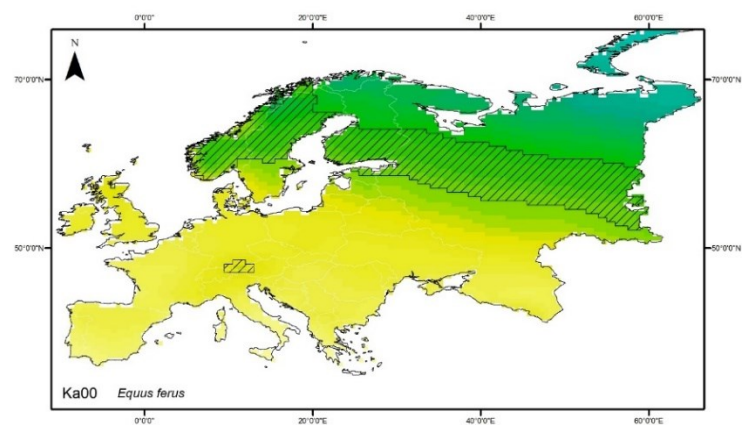


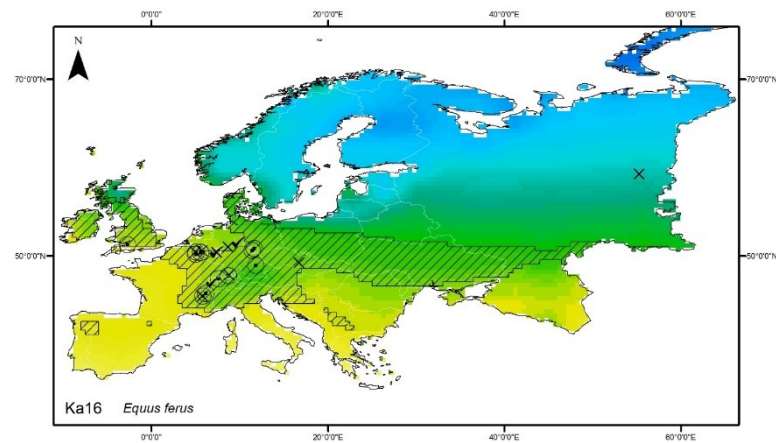
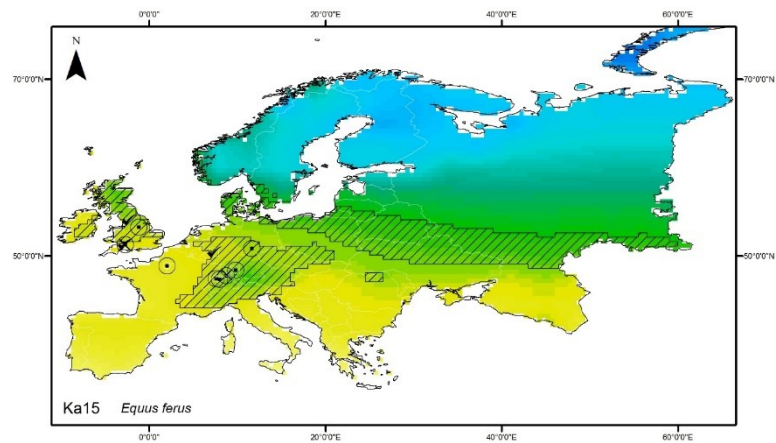
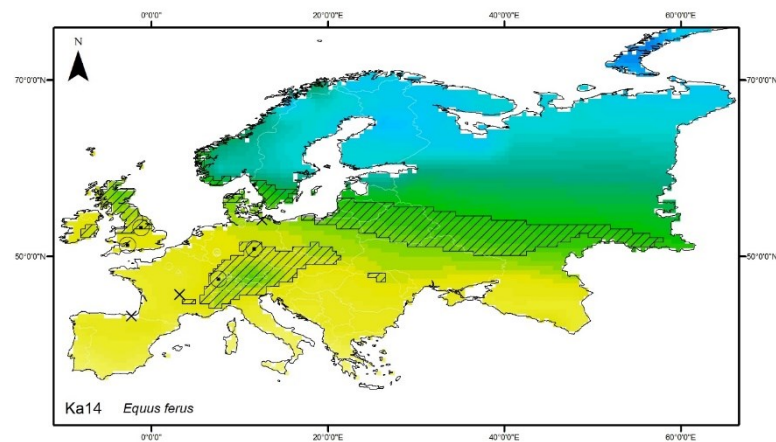
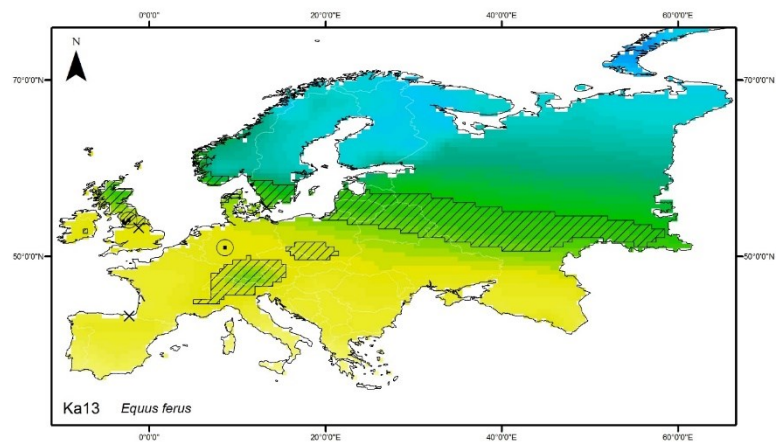


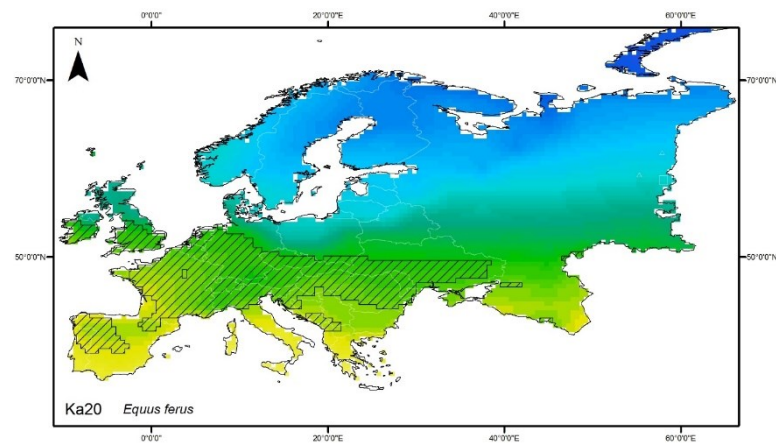
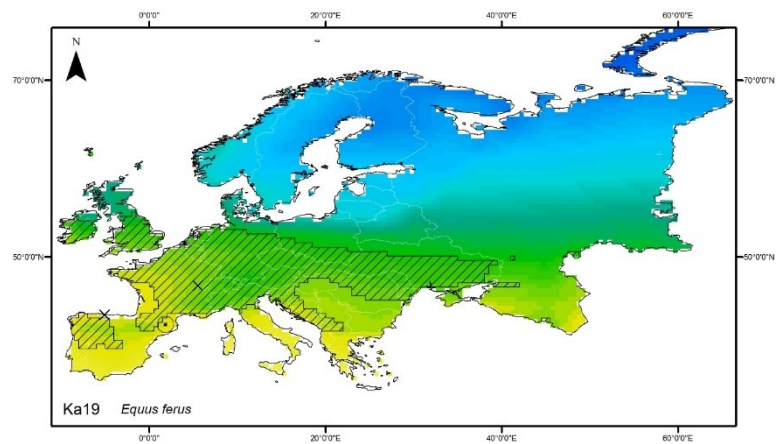
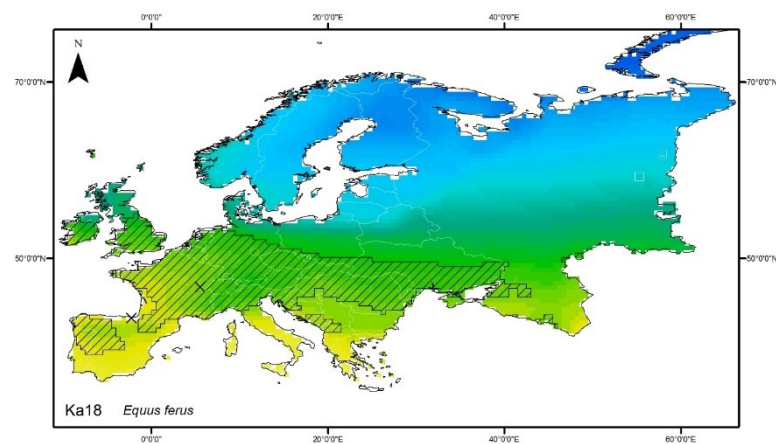
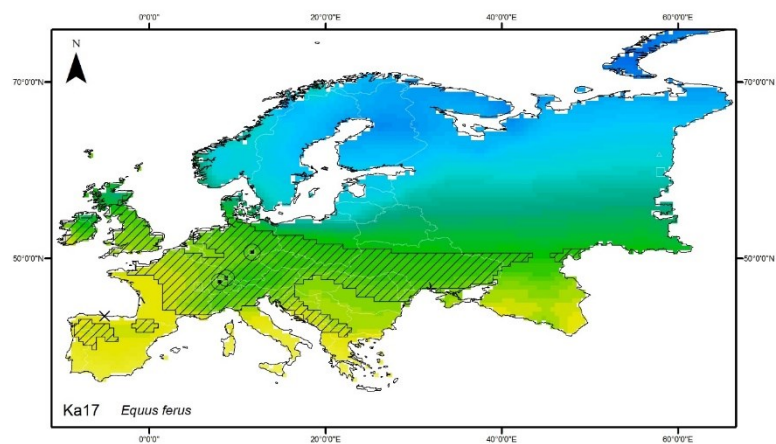


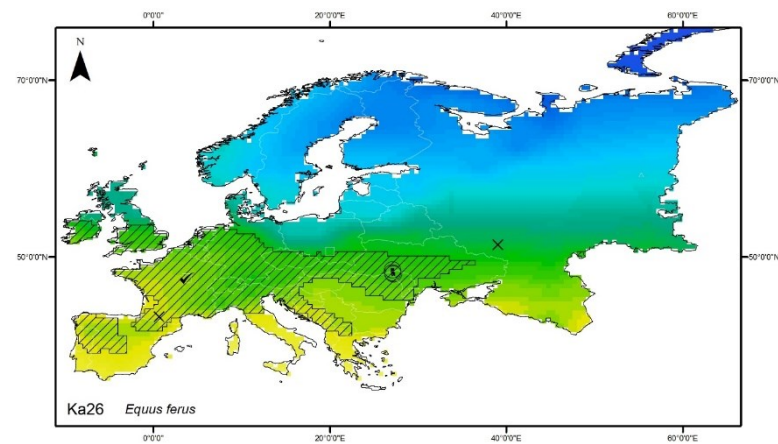
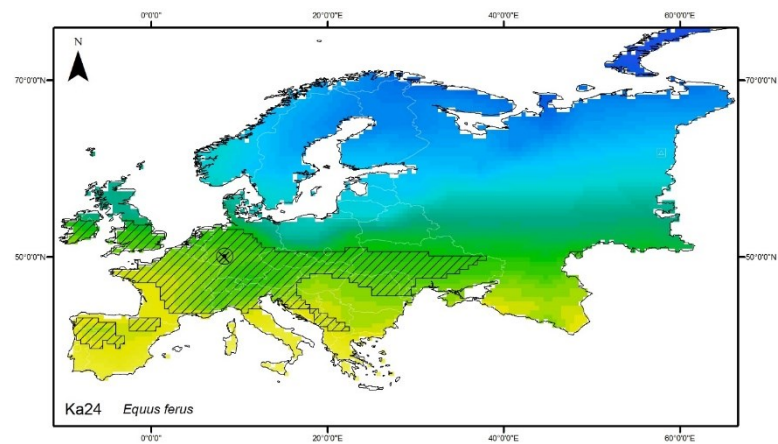
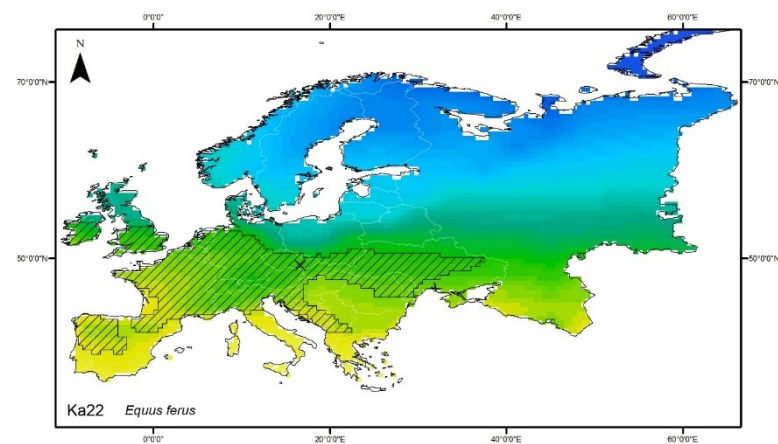
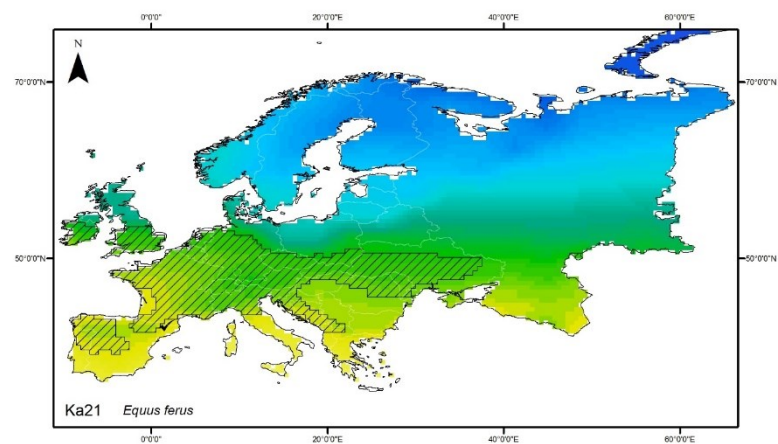


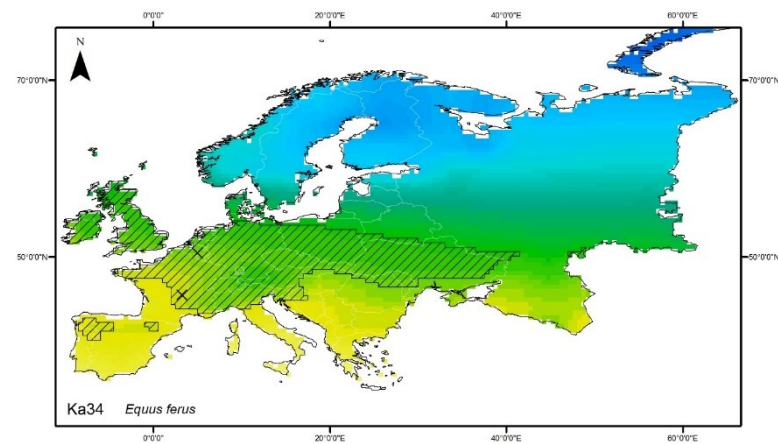
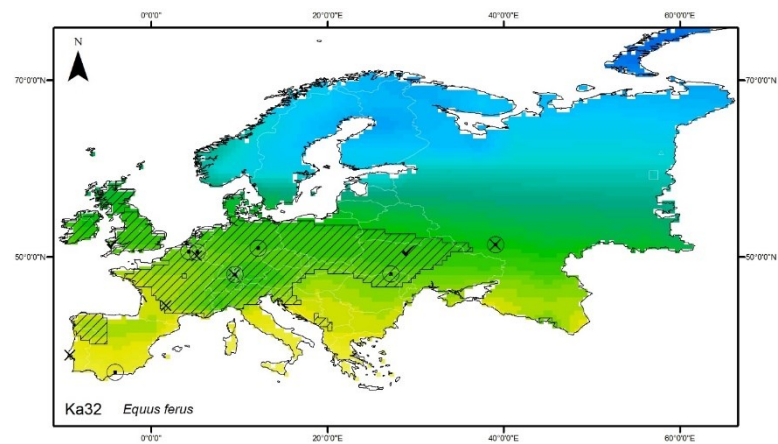
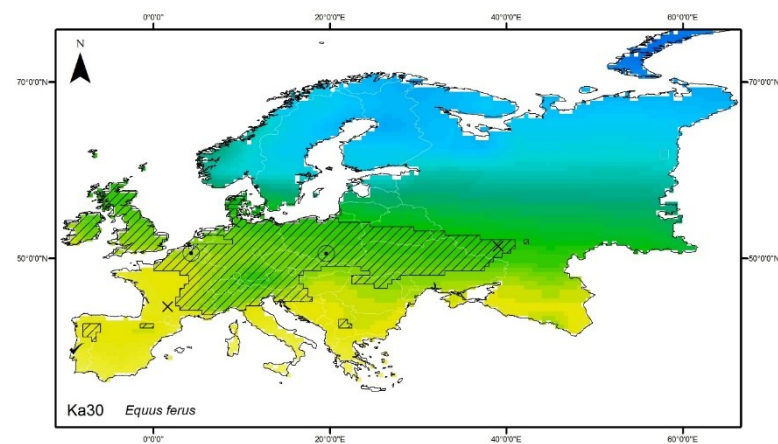
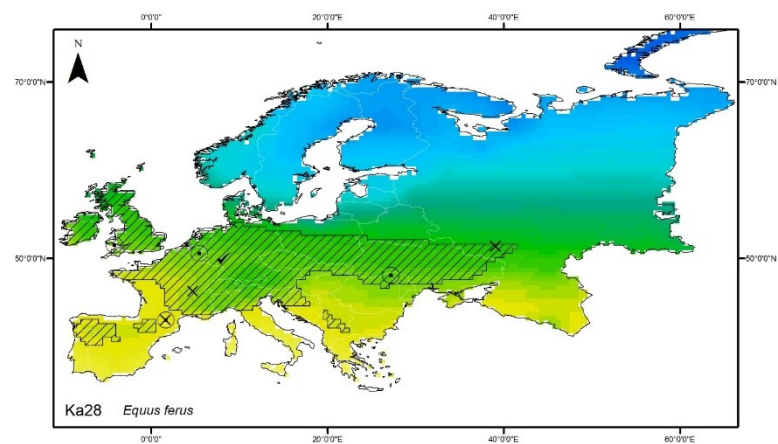


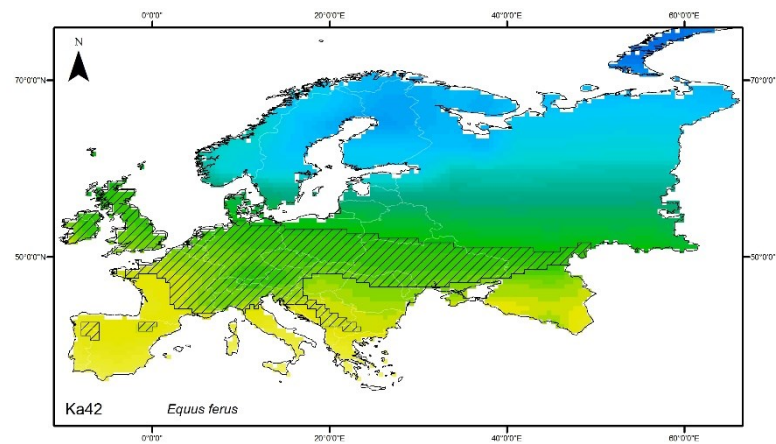
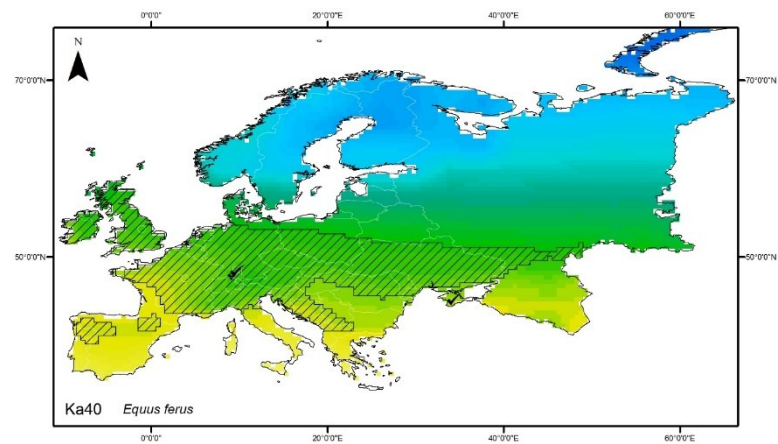
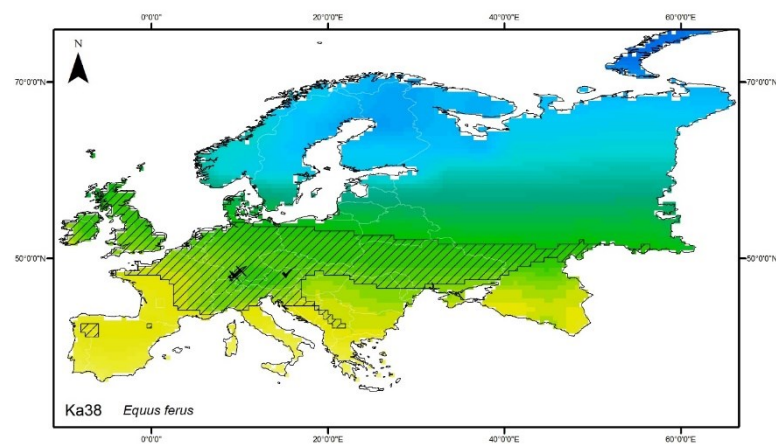
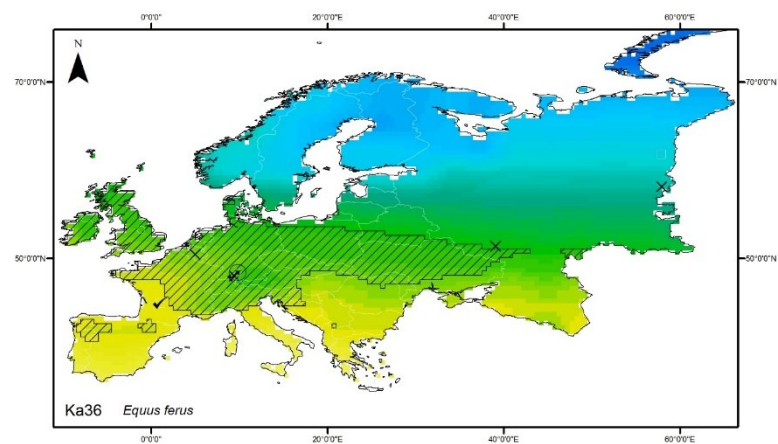
3.7 *Equus ferus*

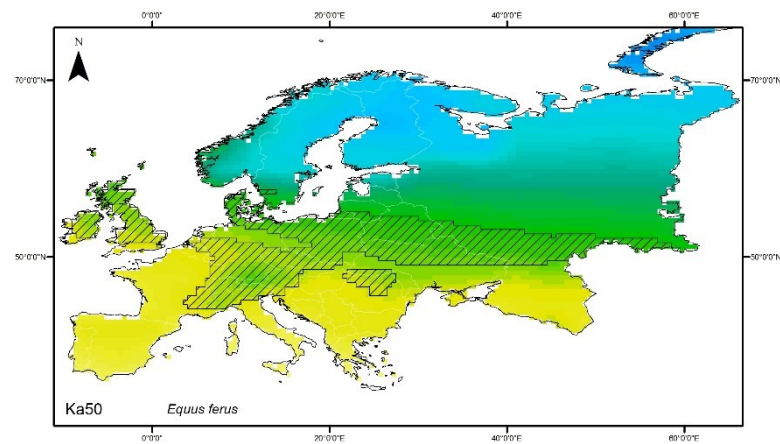
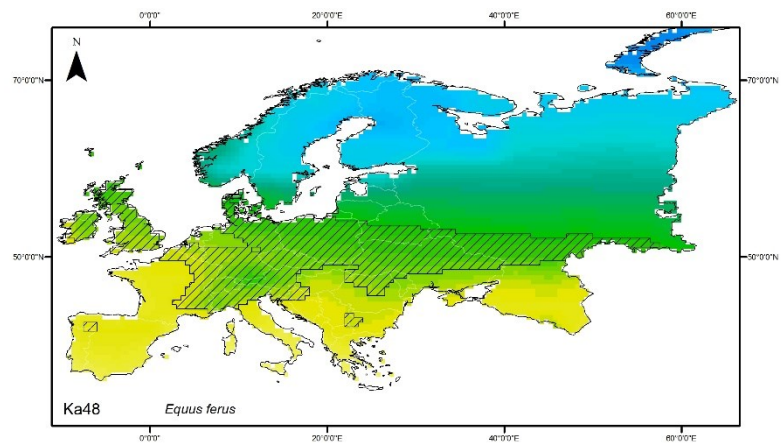
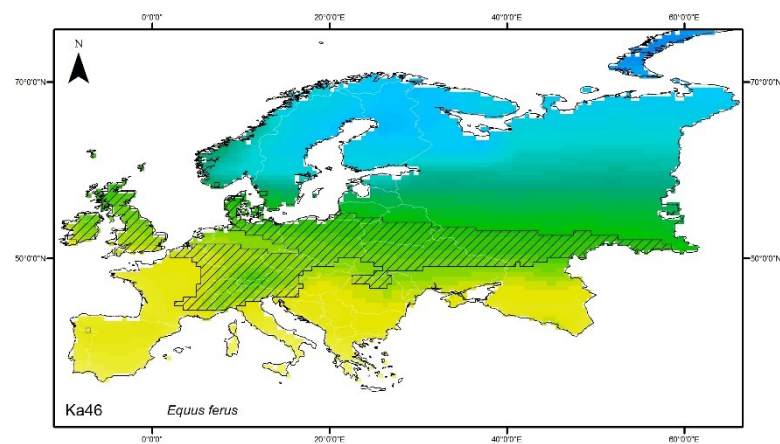
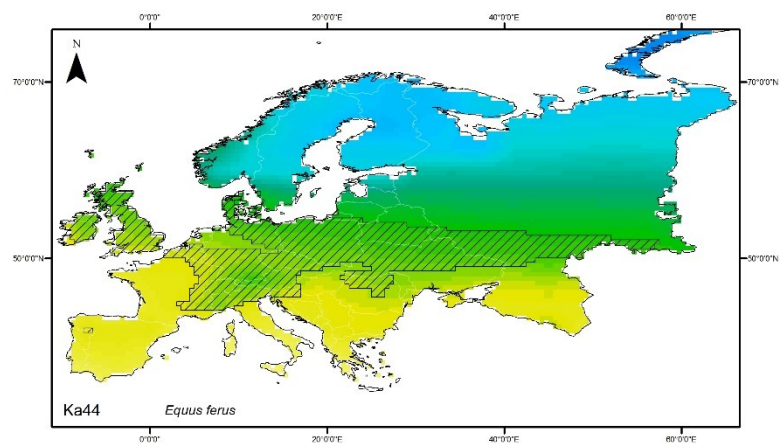


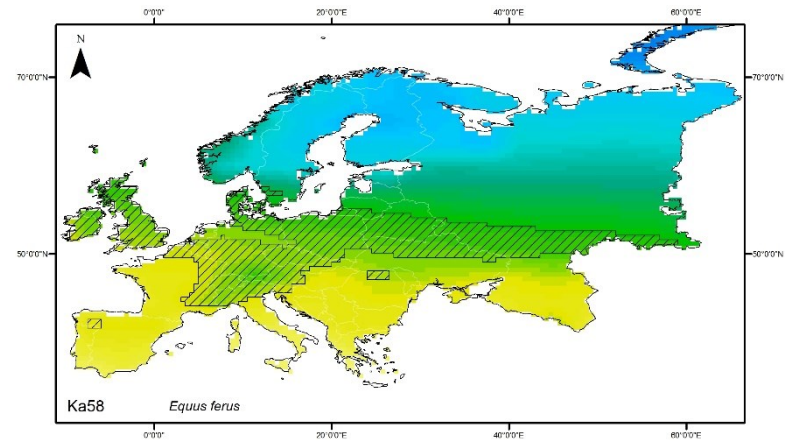
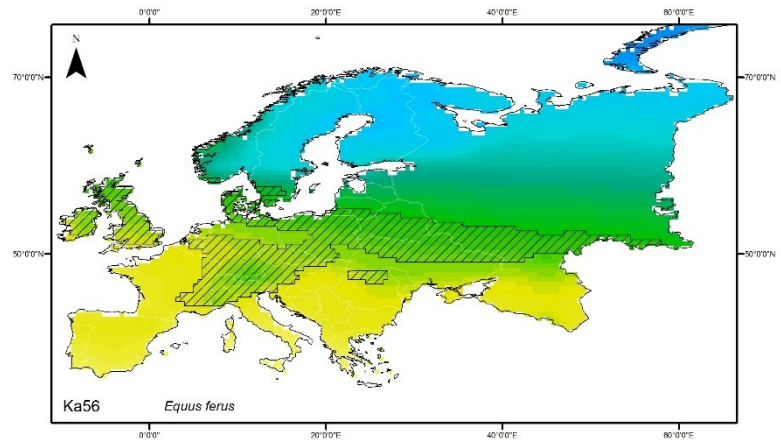
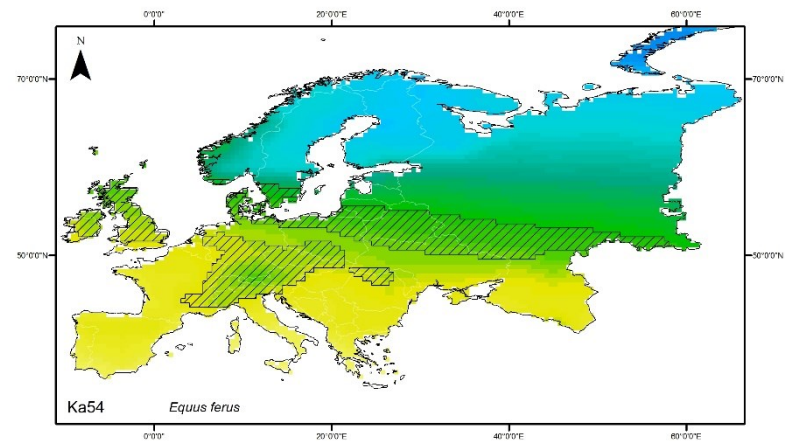
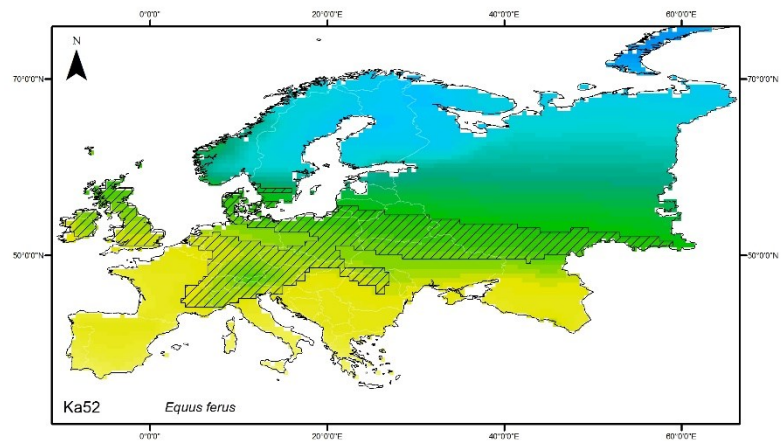


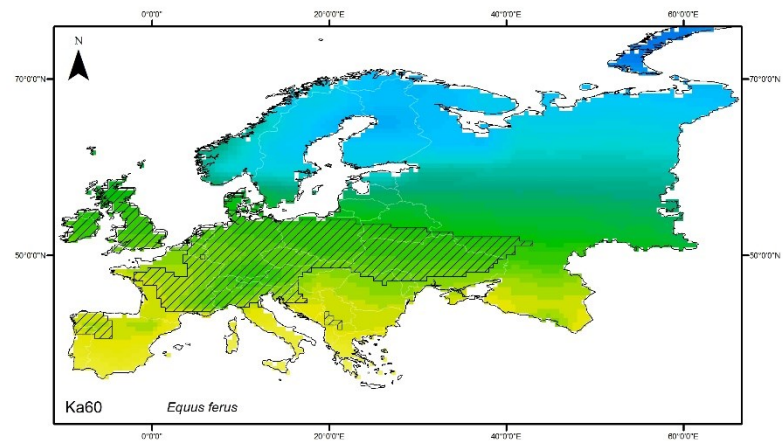


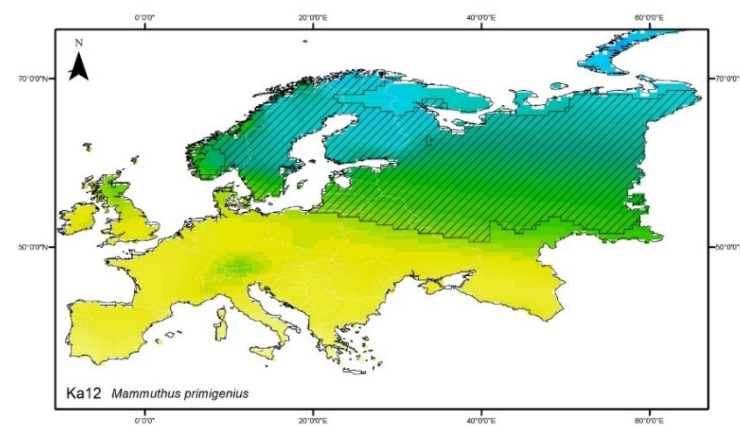
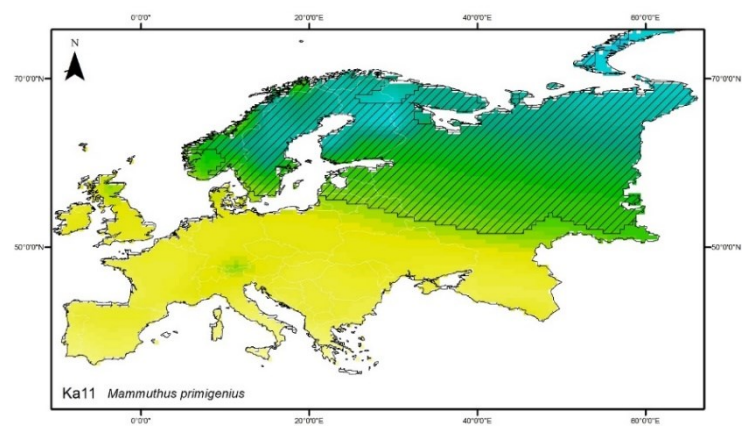
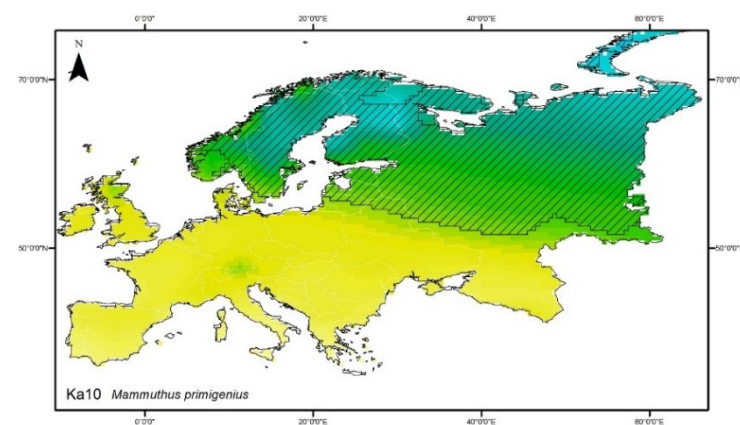
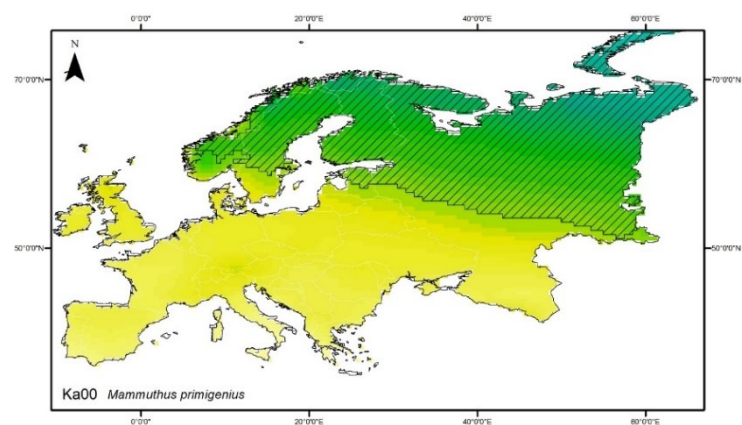


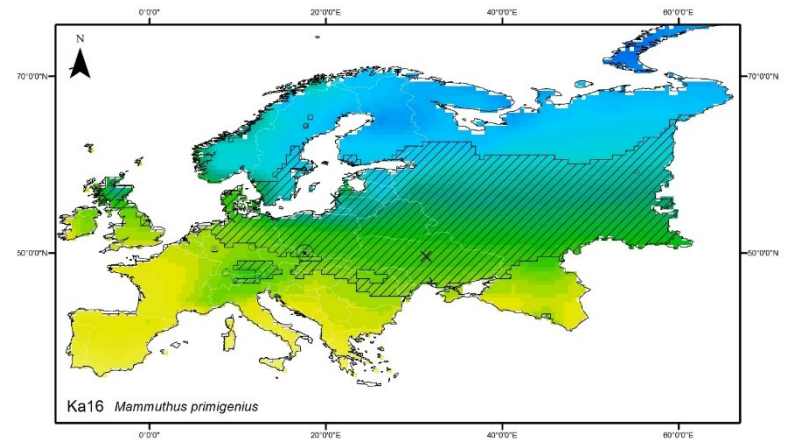
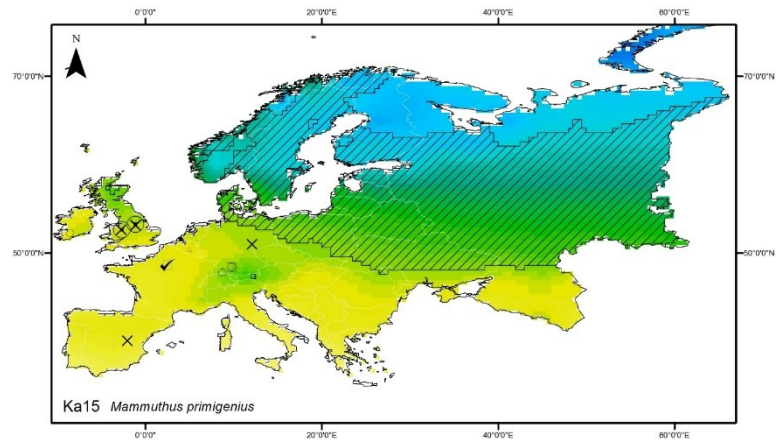
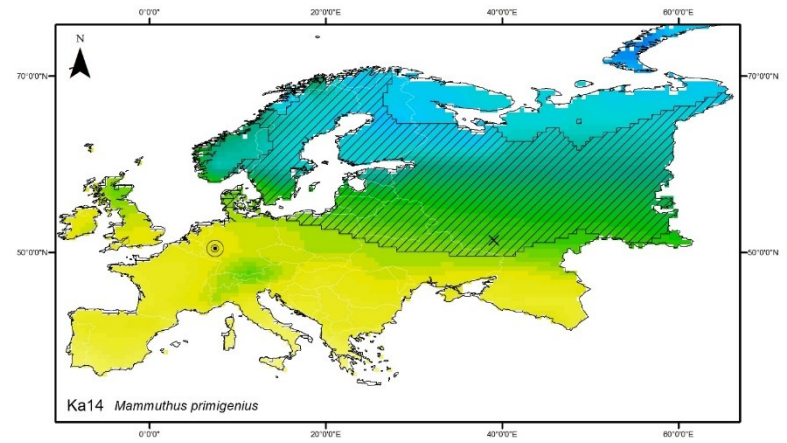
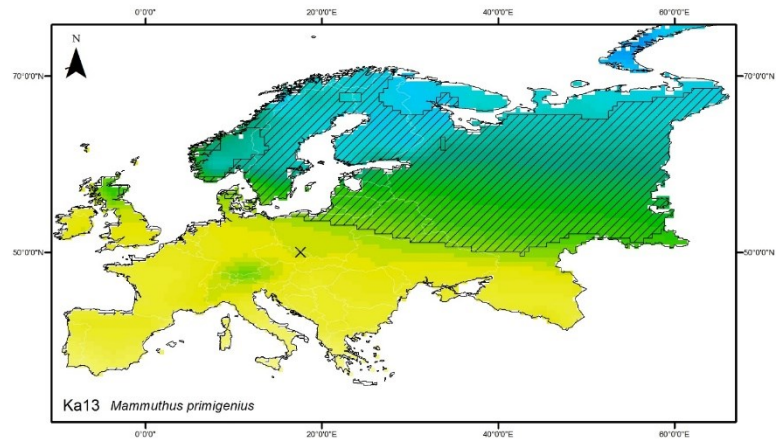


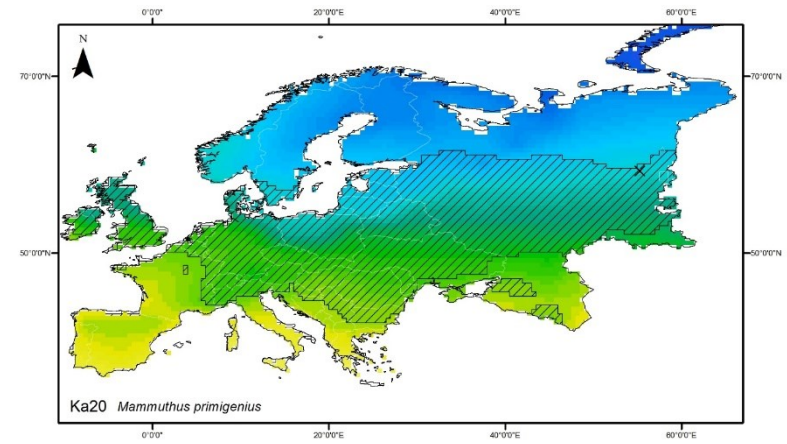
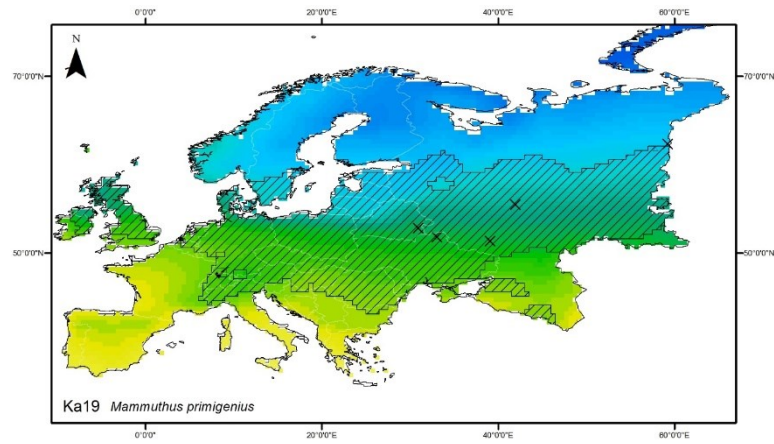
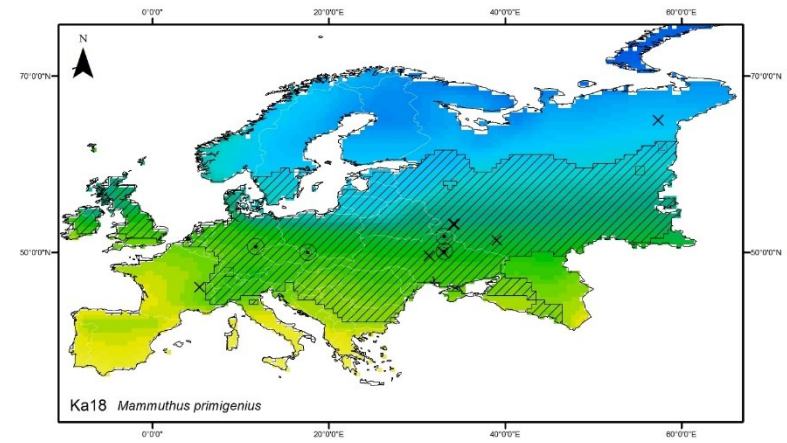
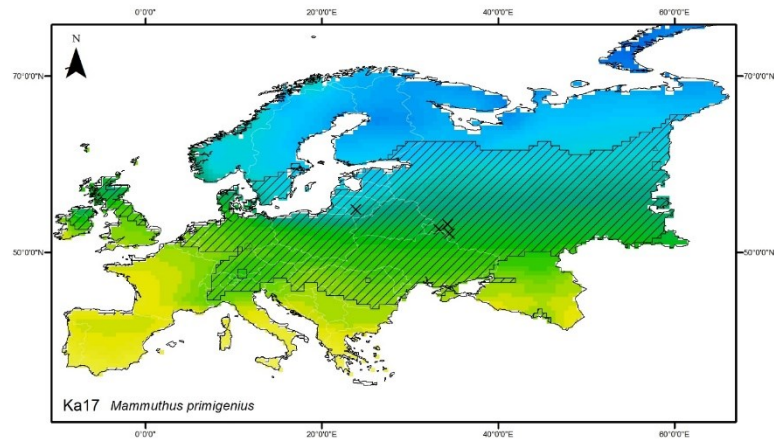


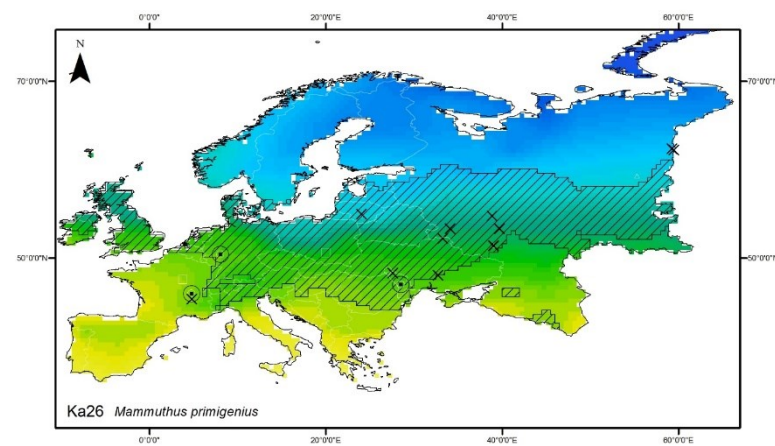
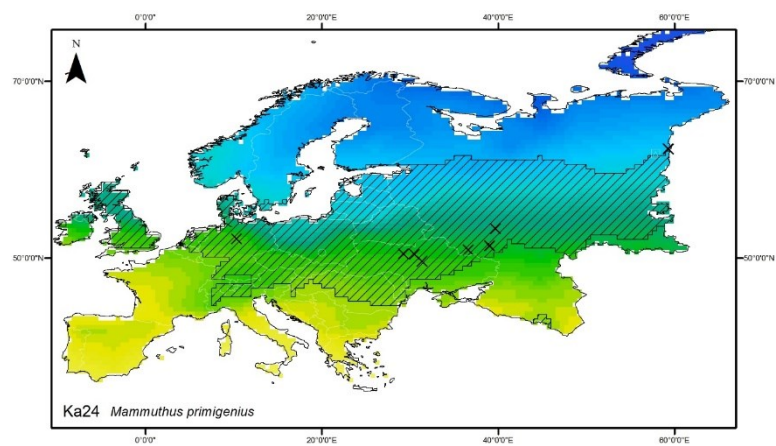
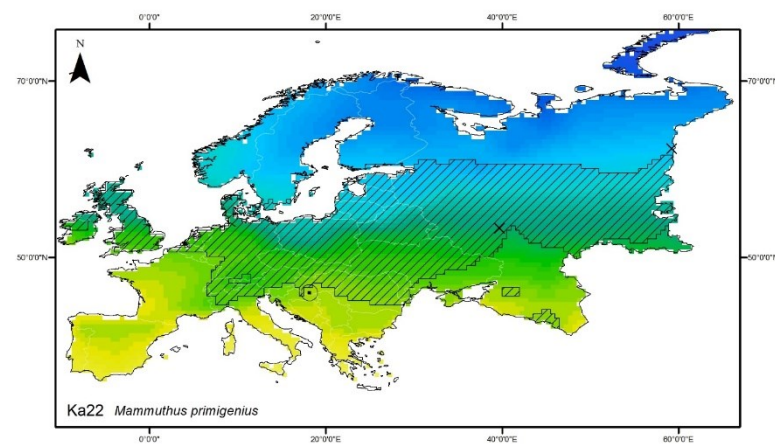
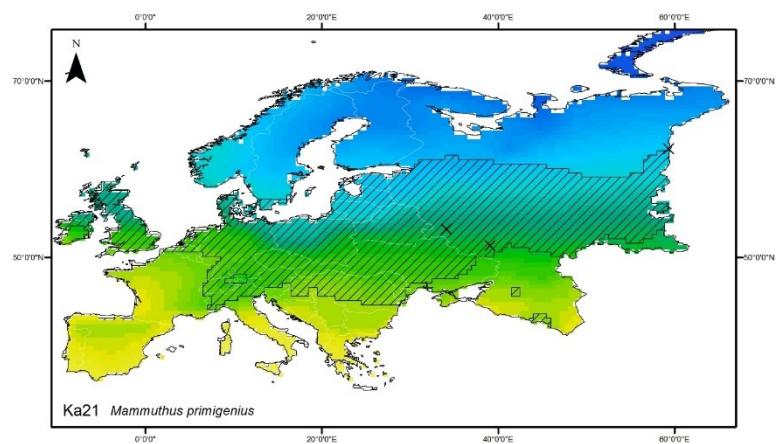


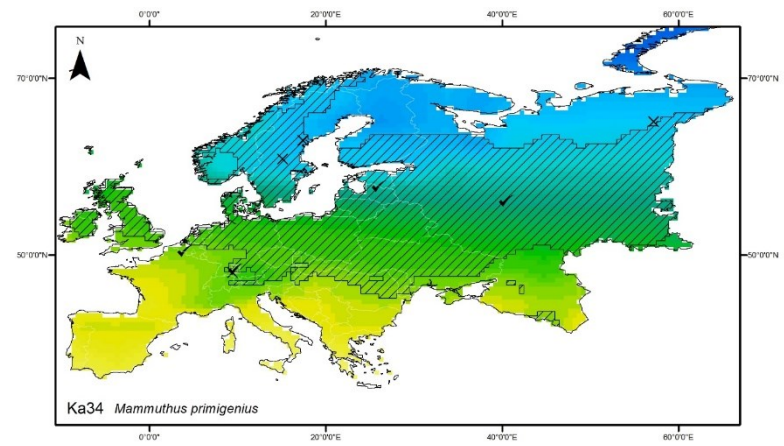
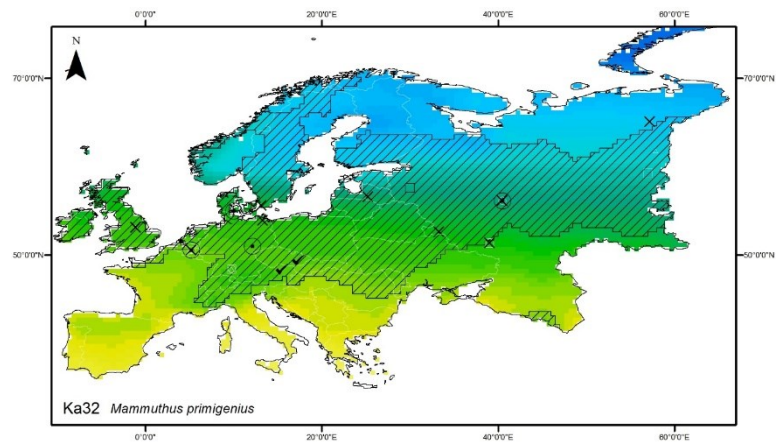
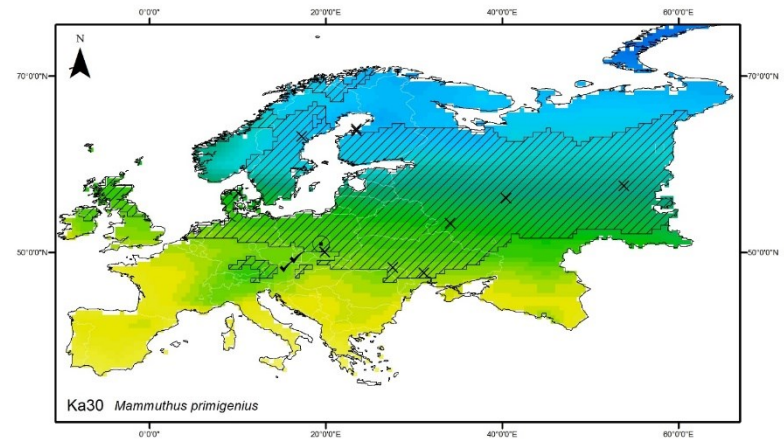
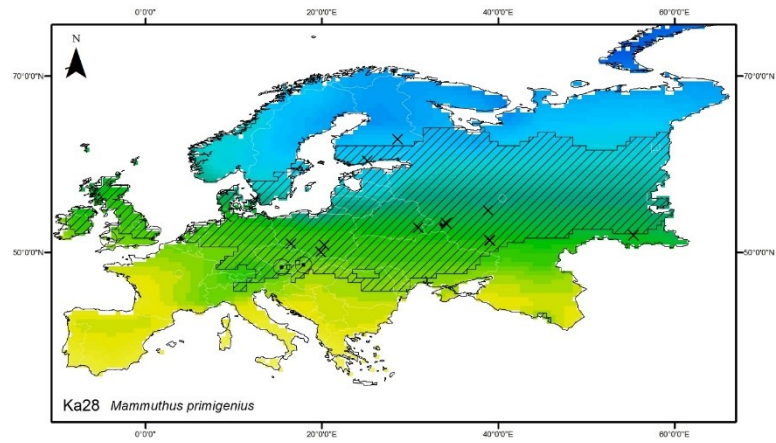


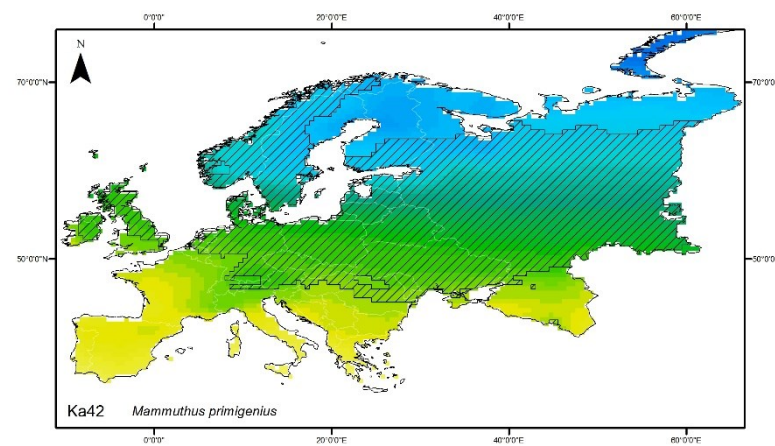
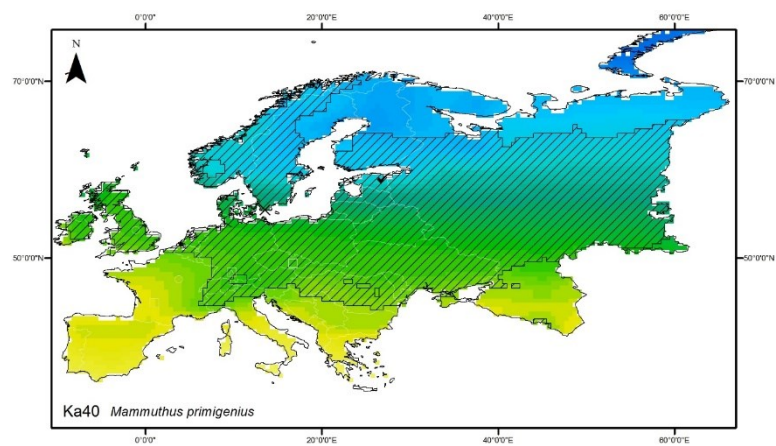
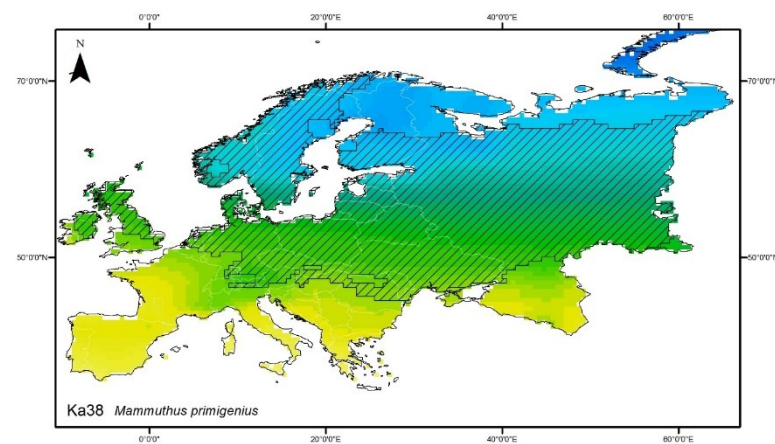
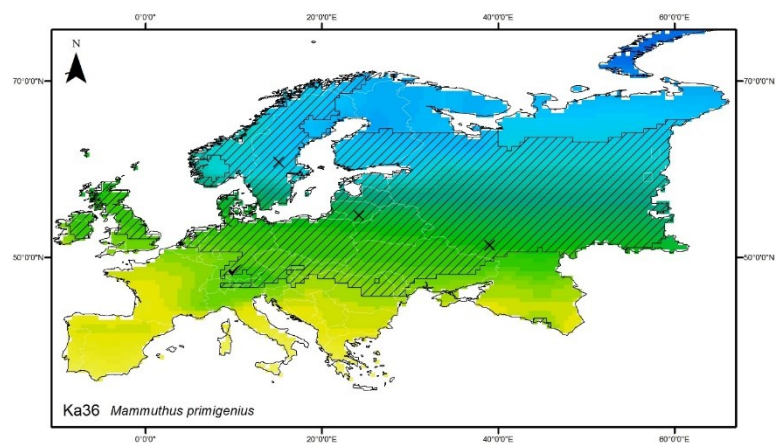
3.8 *Mammuthus primigenius*

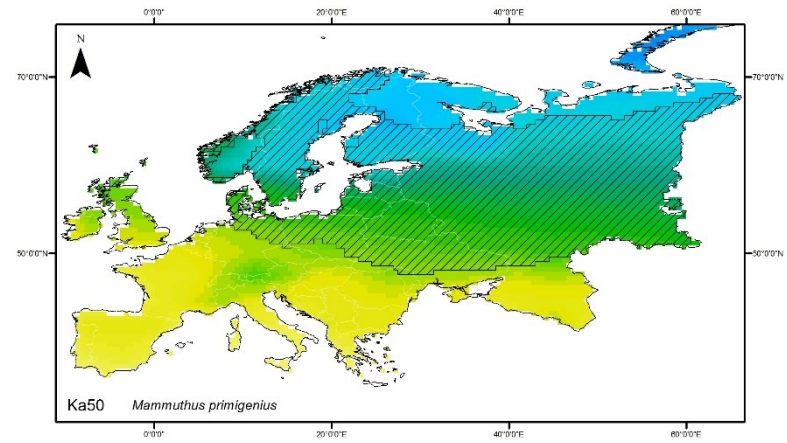
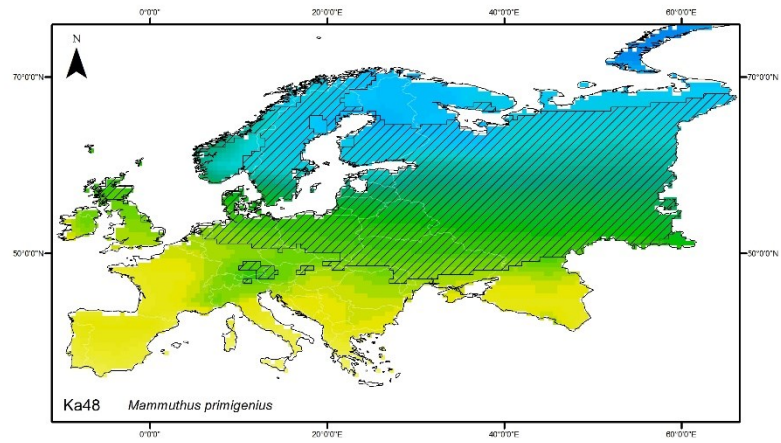
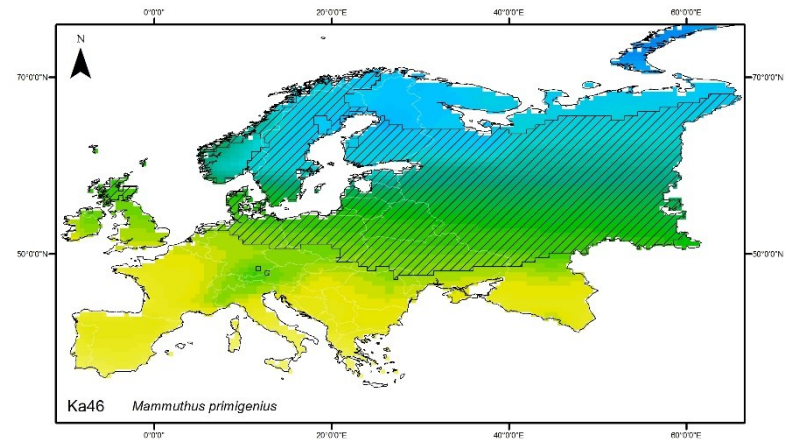
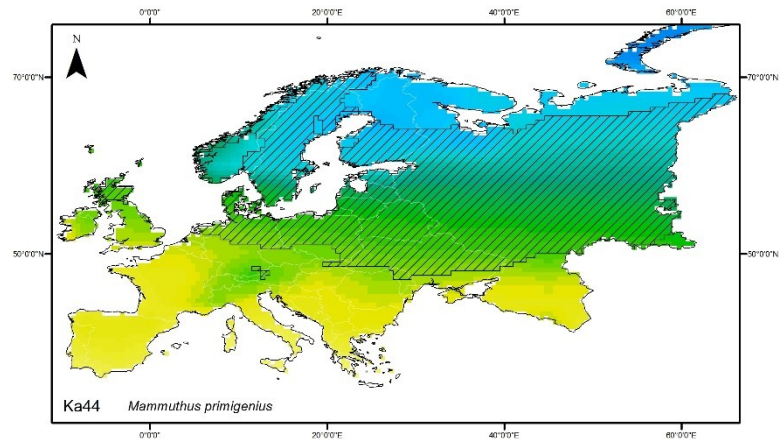


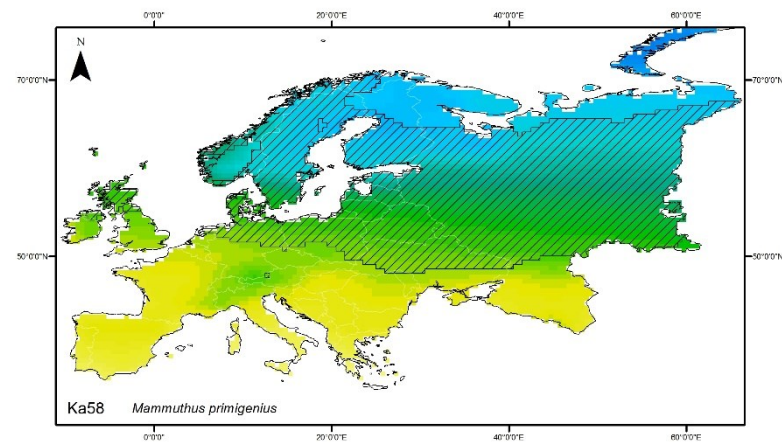
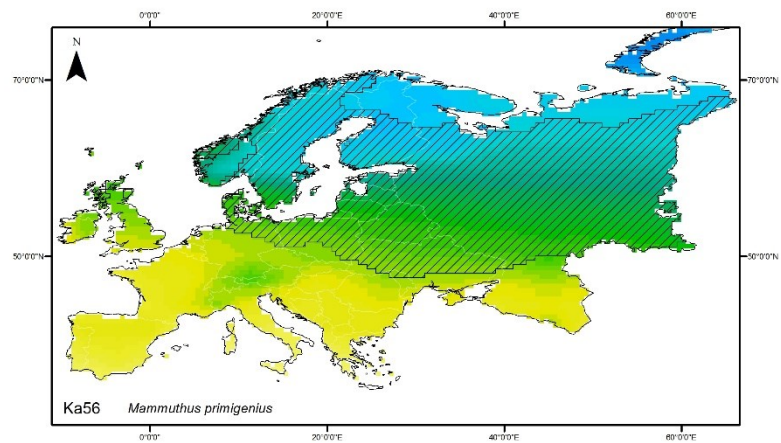
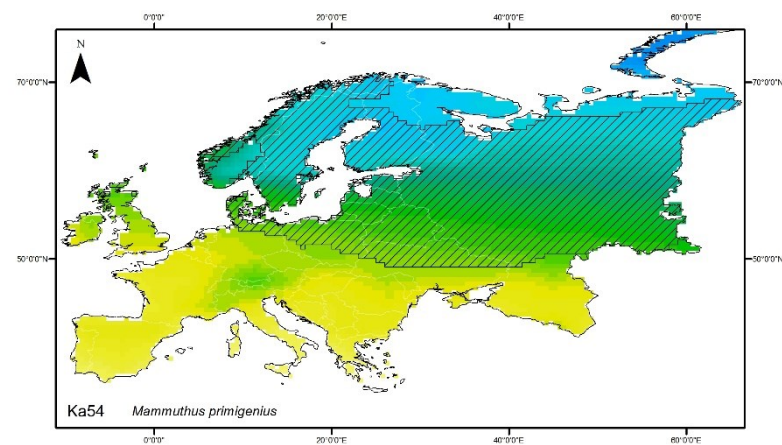
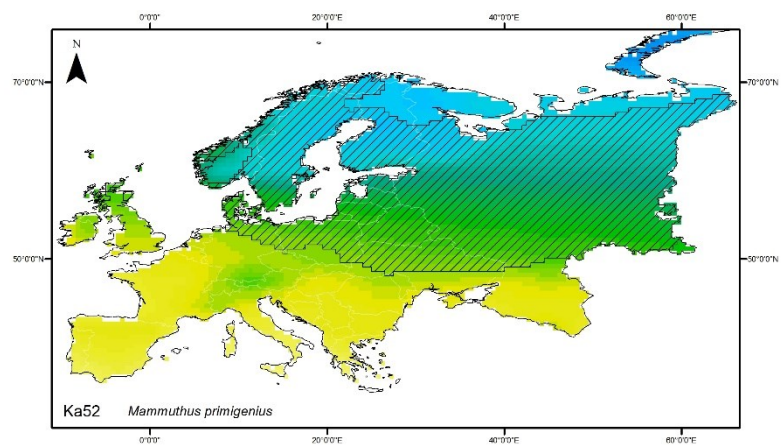


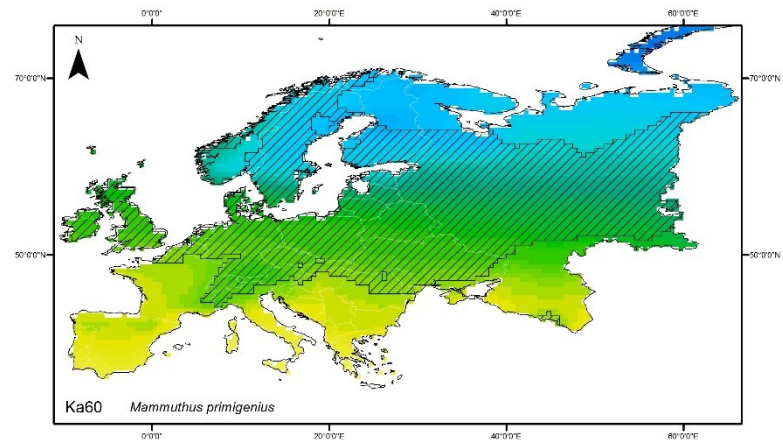






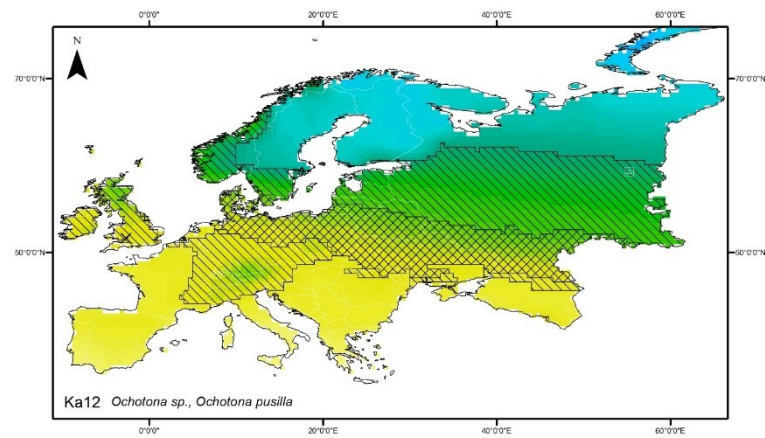
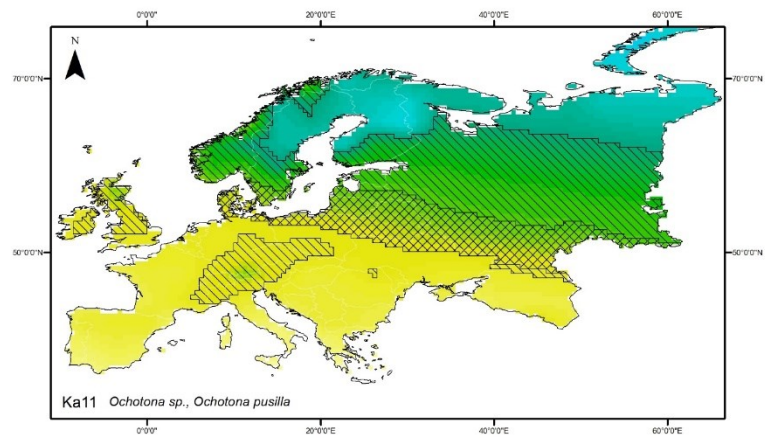
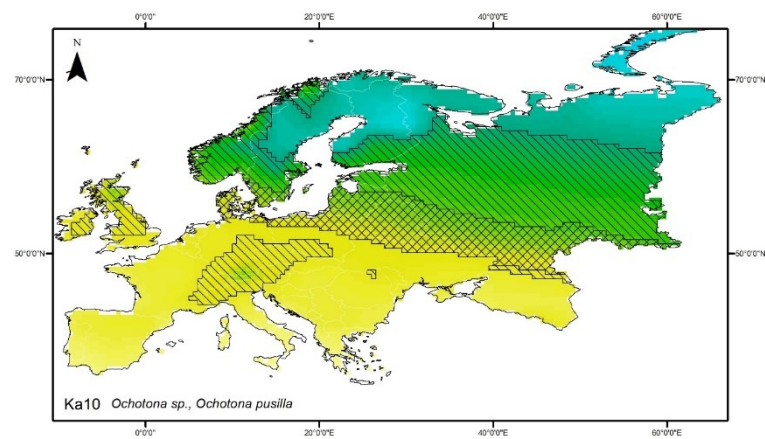
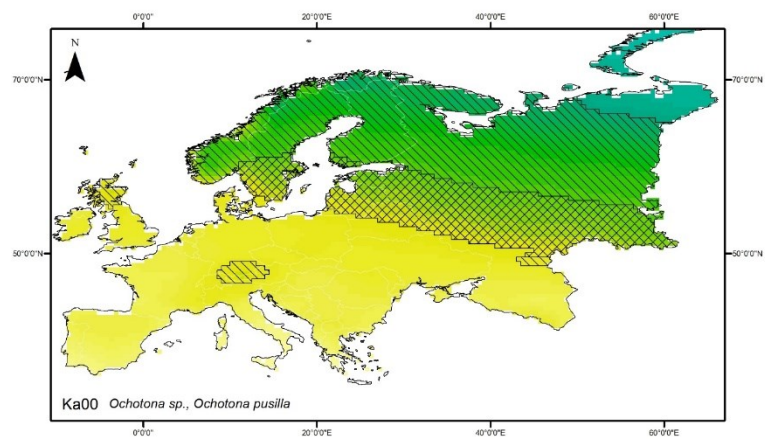


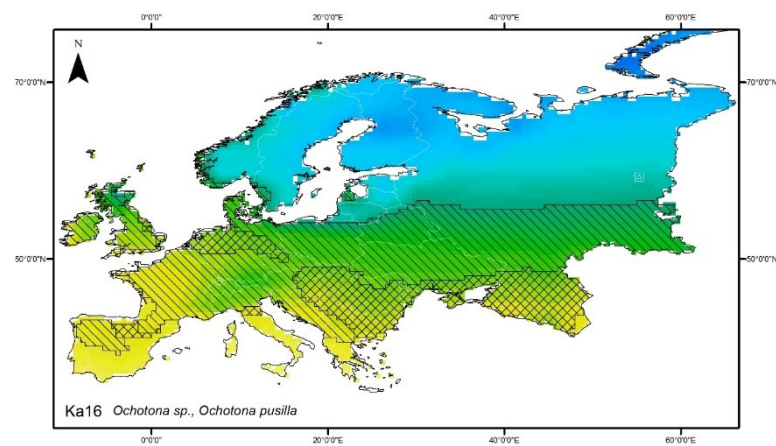
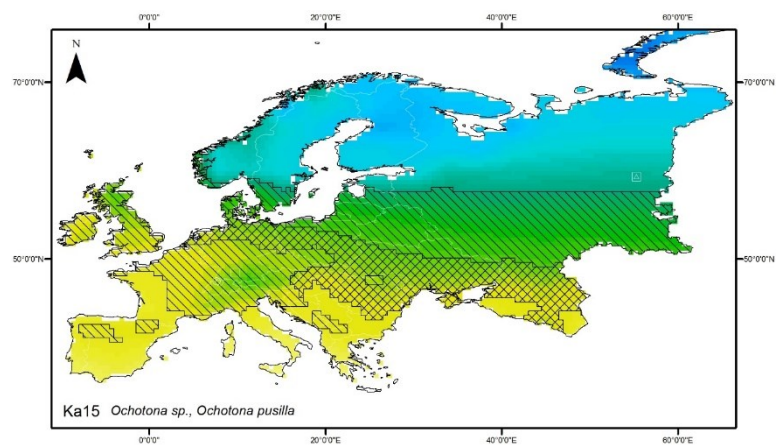
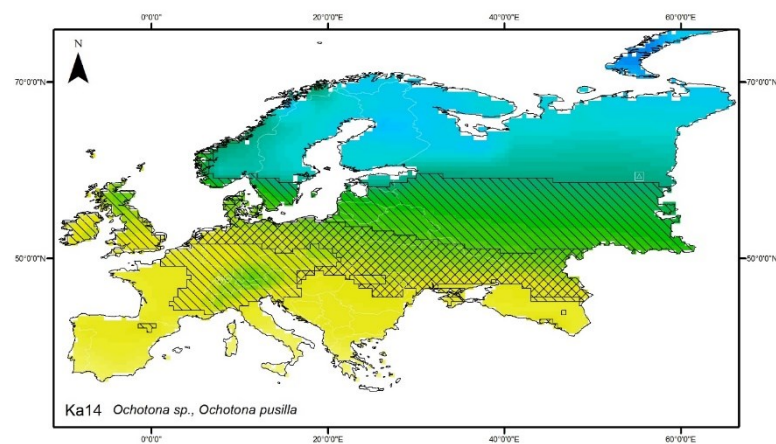
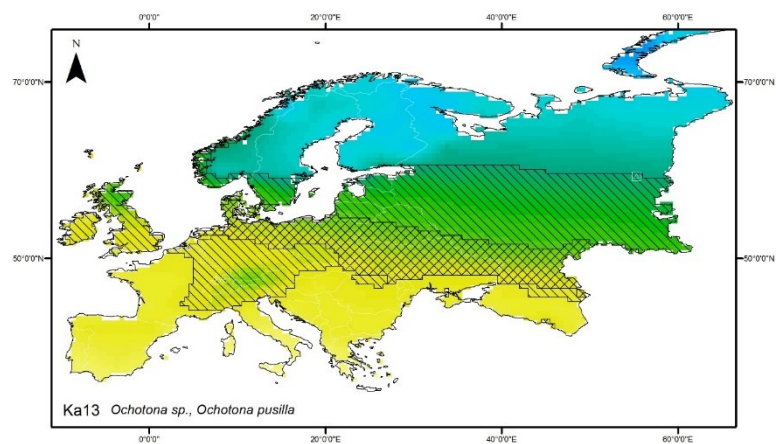


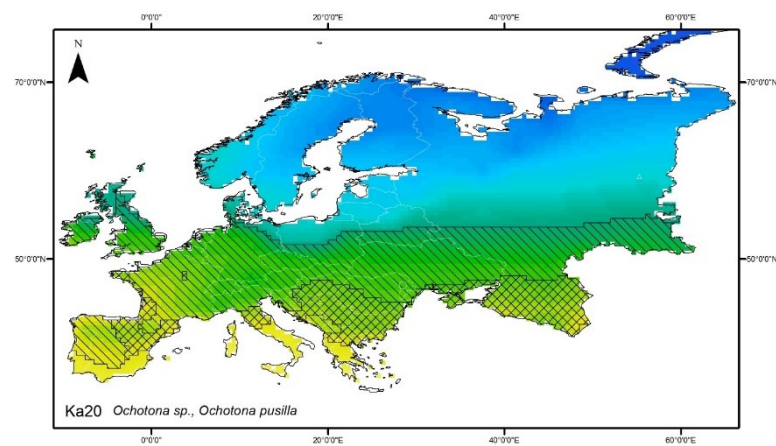
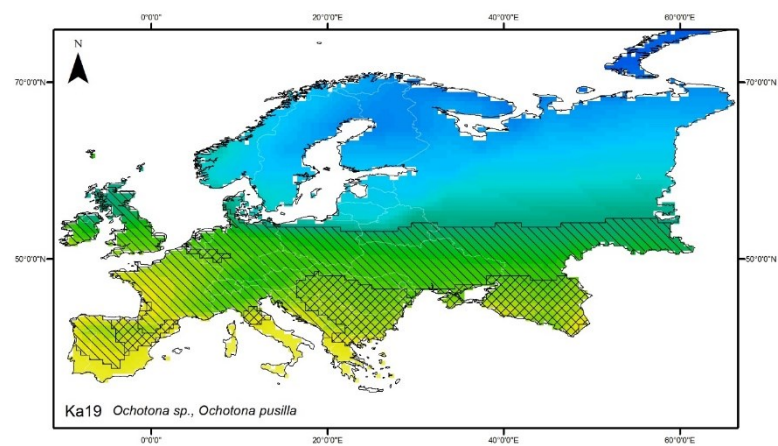
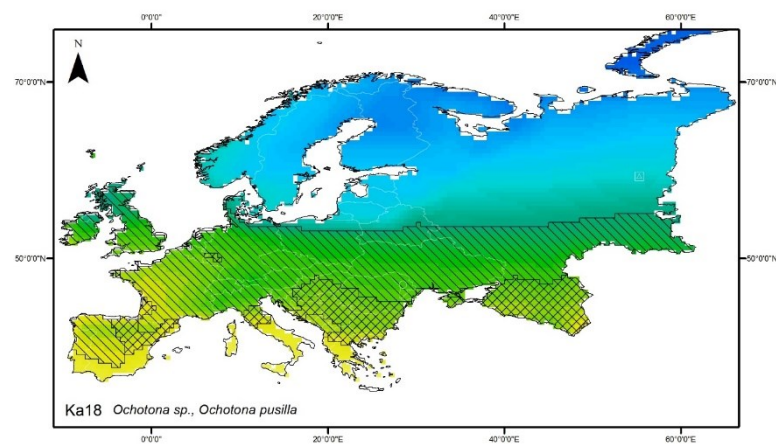
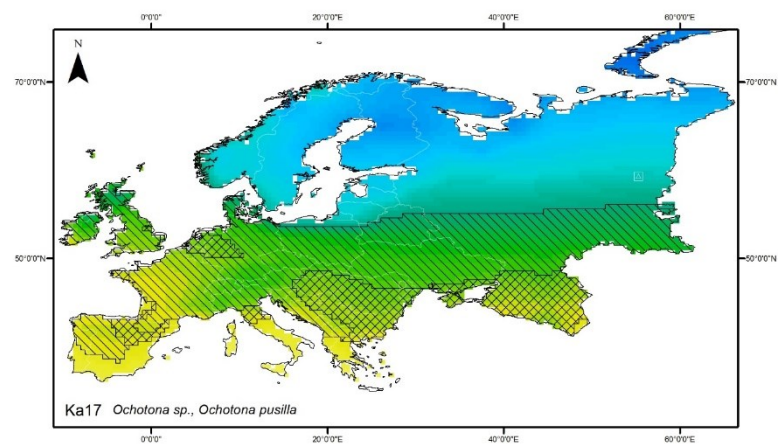


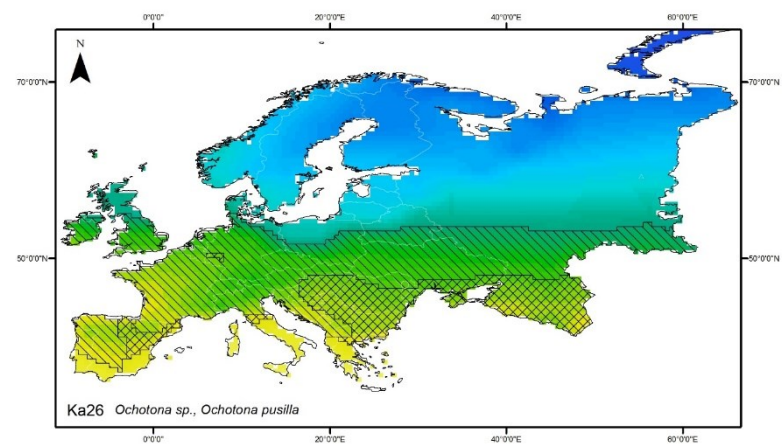
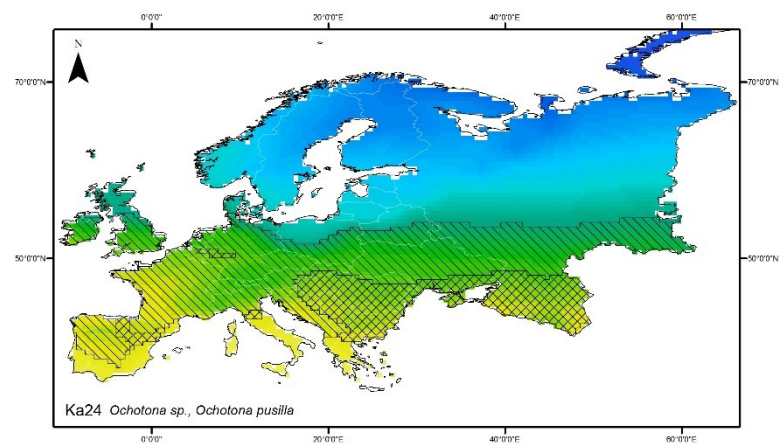
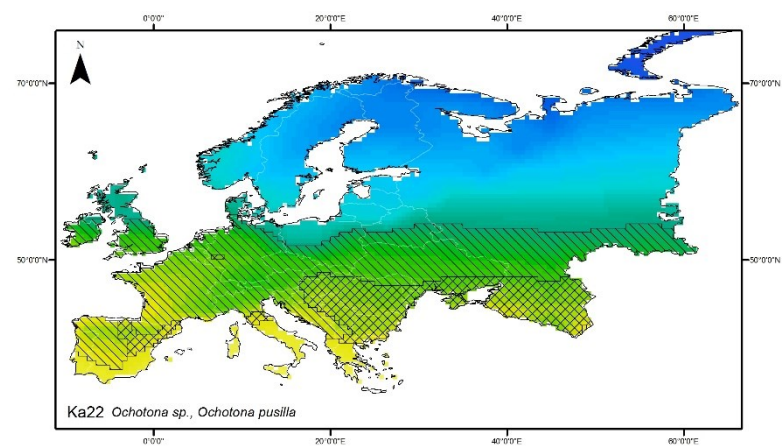
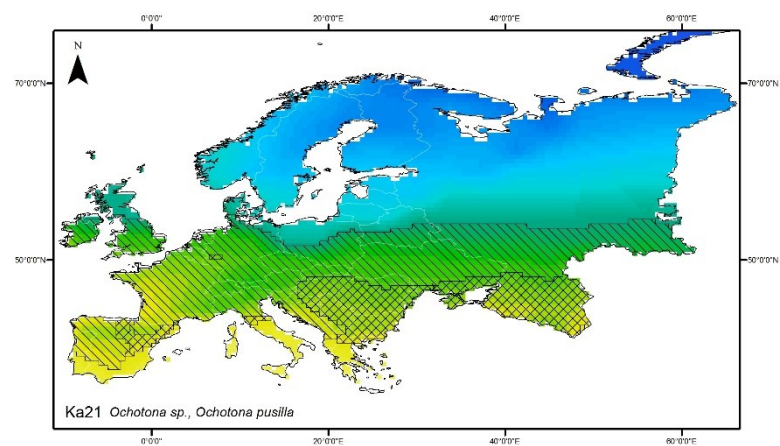
3.9 Ochotona sp. and Ochotona pusilla

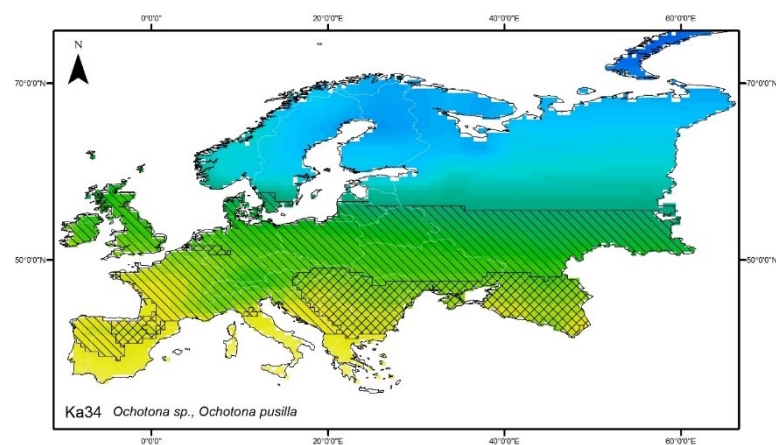
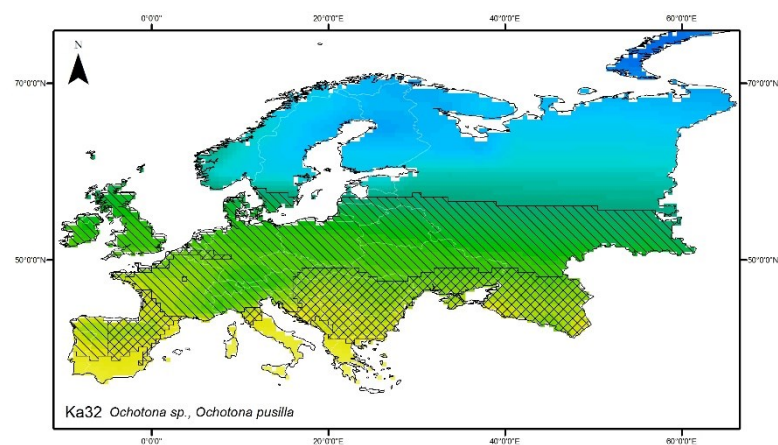
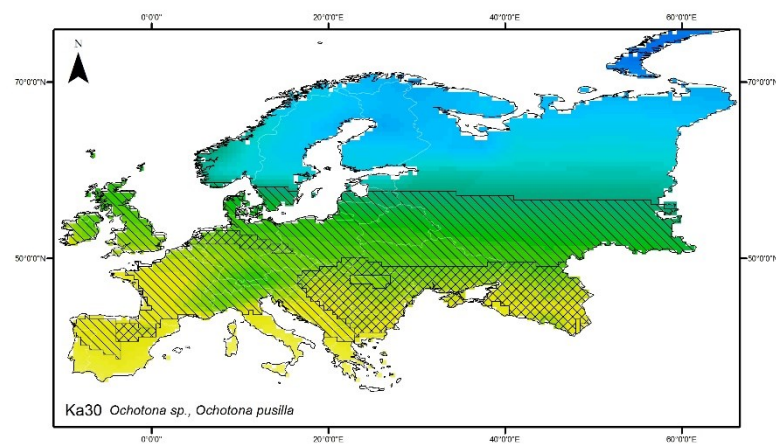
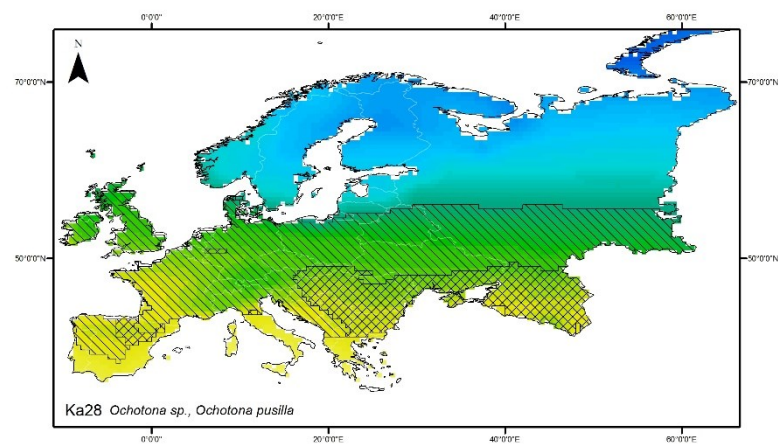
Hatch from upper left to lower right: *Ochotona* sp. Hatch from upper right to lower left: *Ochotona pusilla*

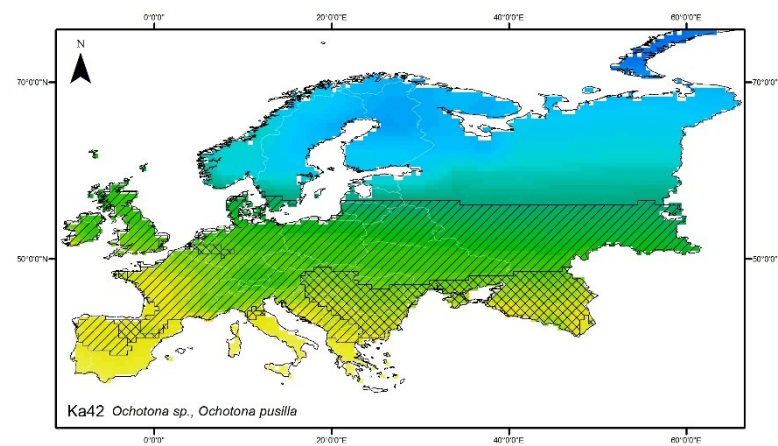
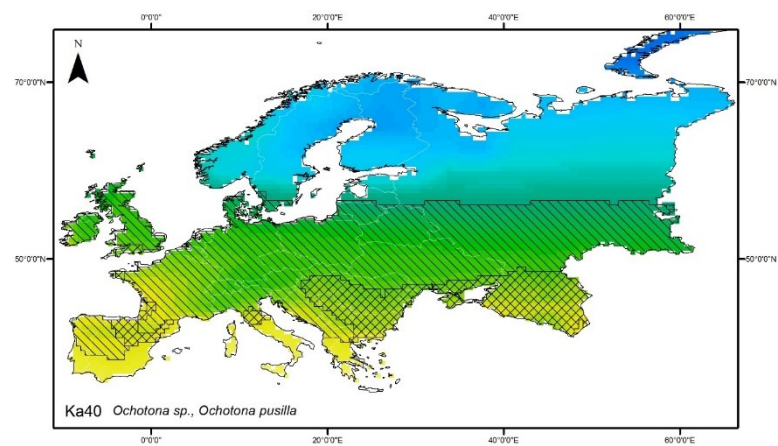
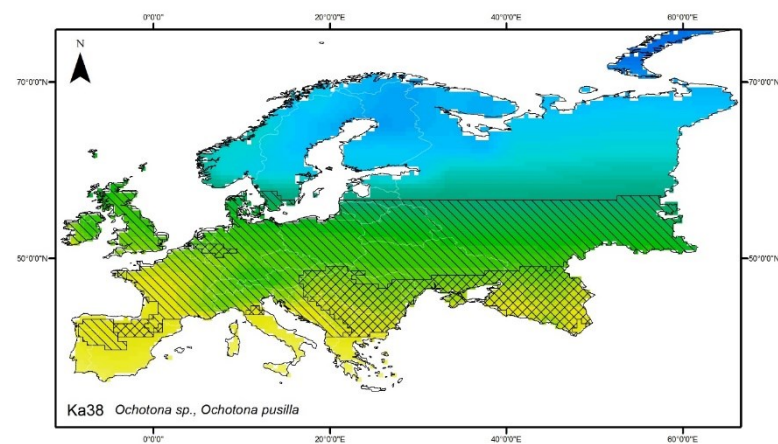
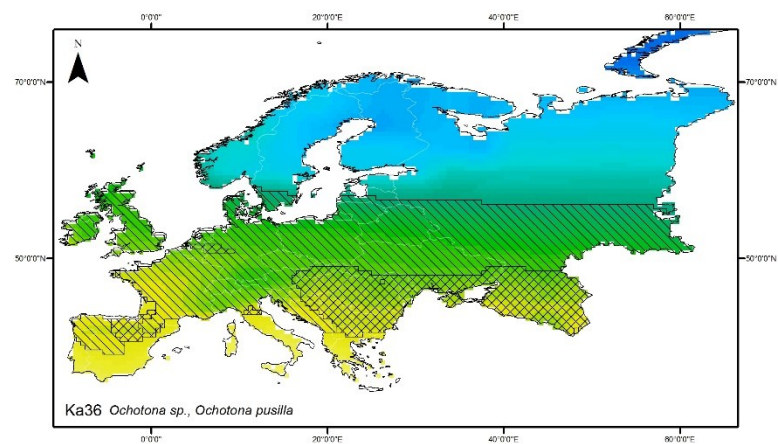


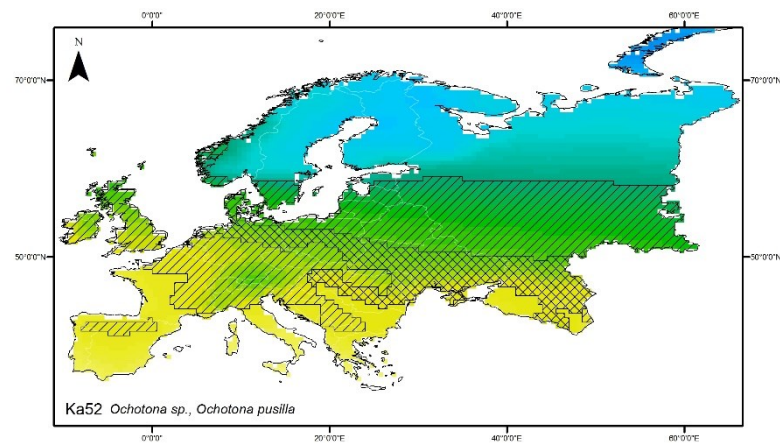
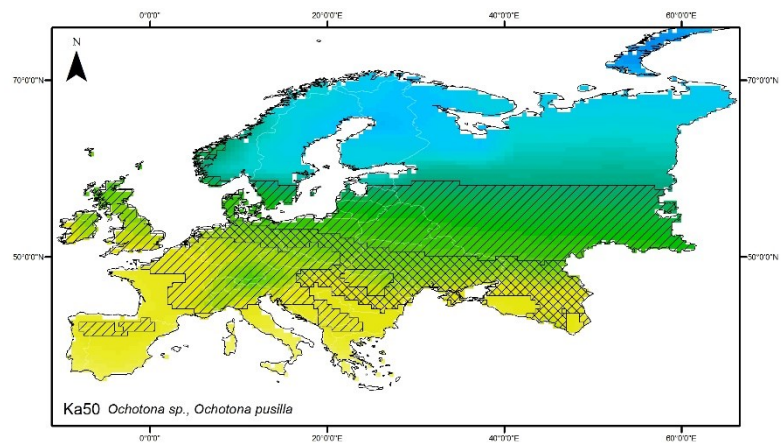
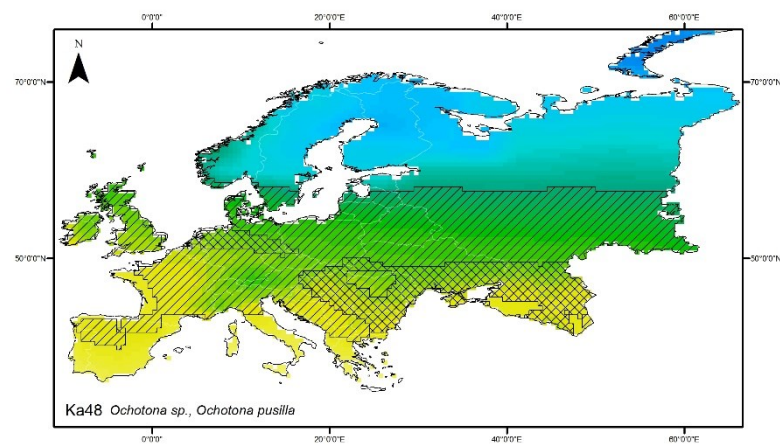
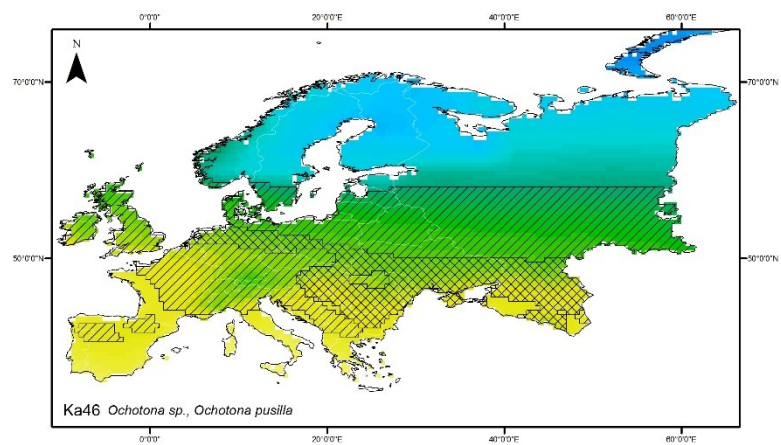


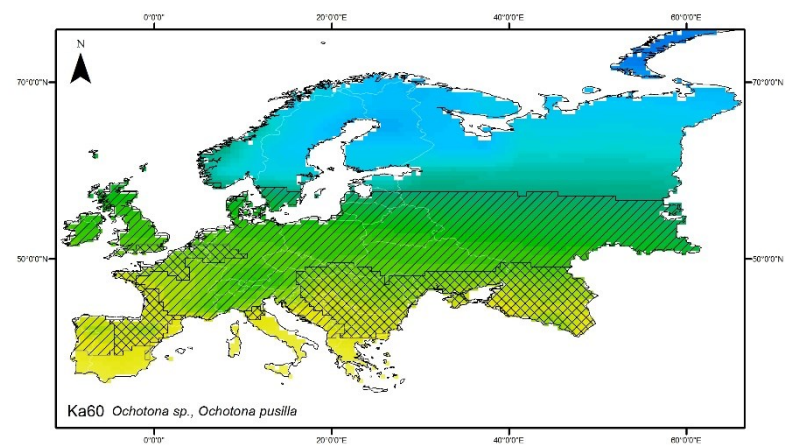
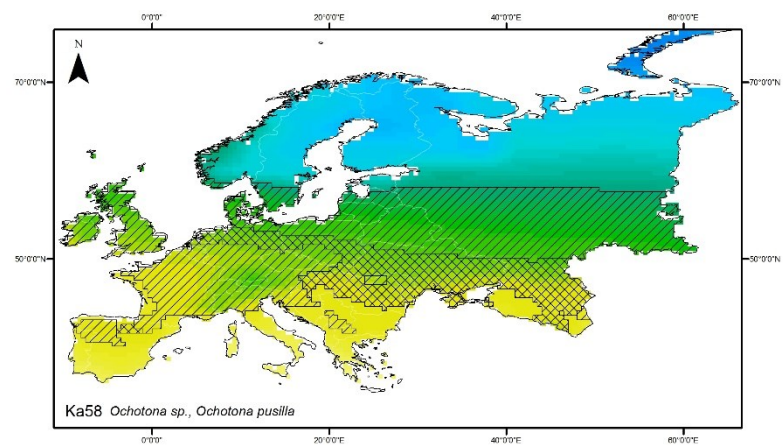
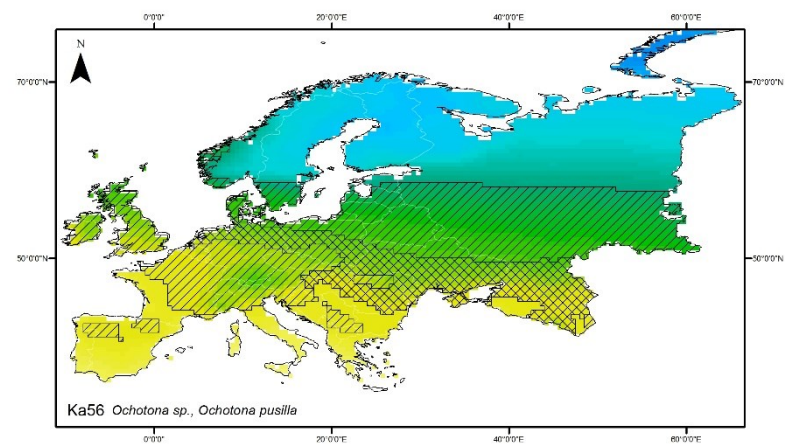
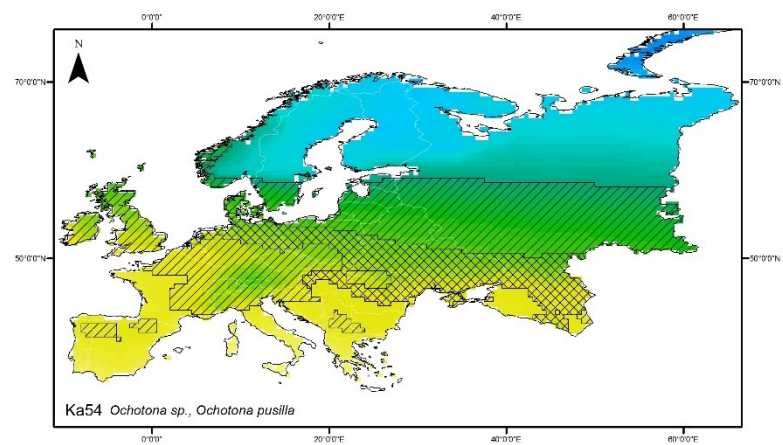


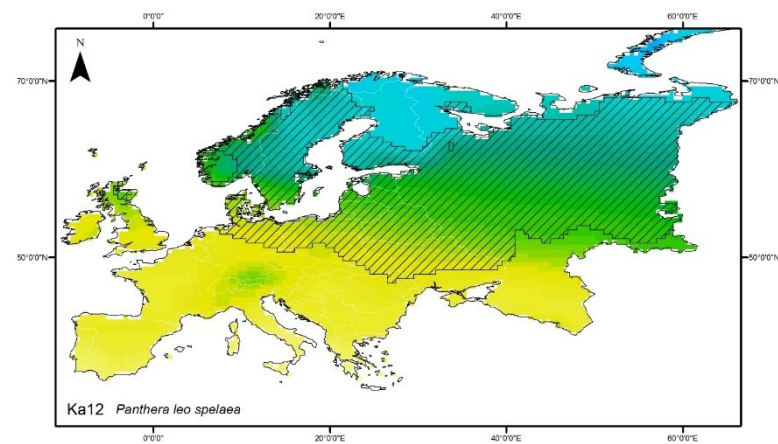
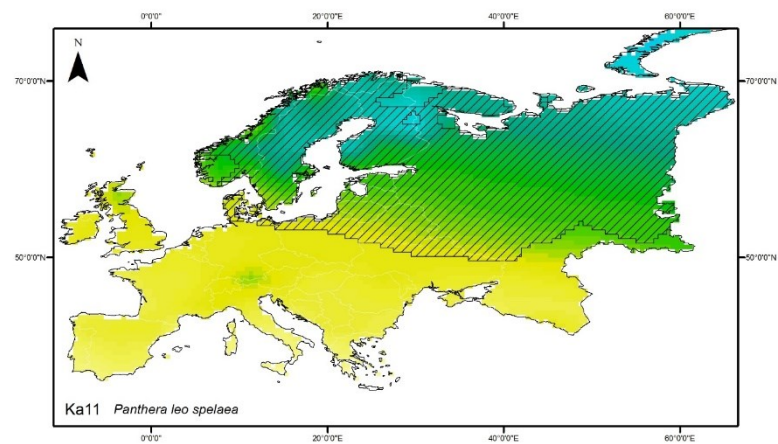
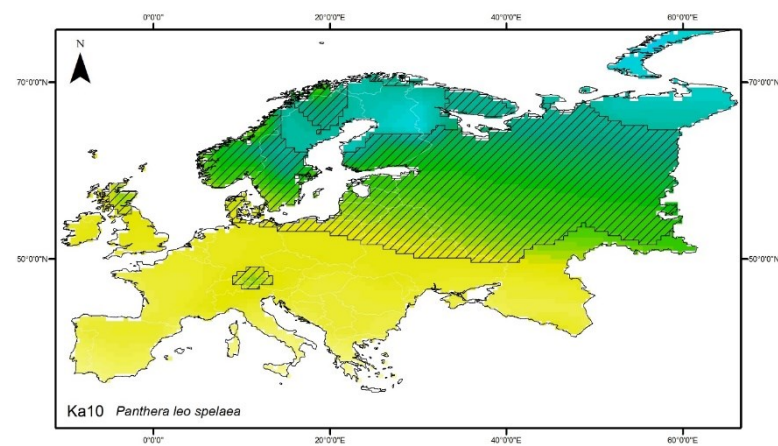
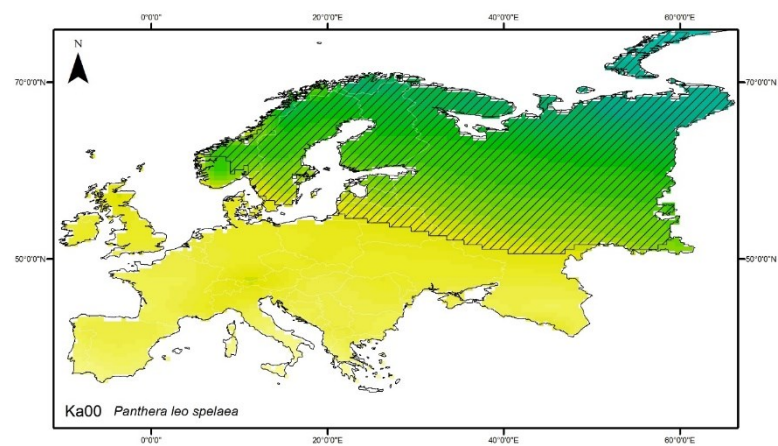


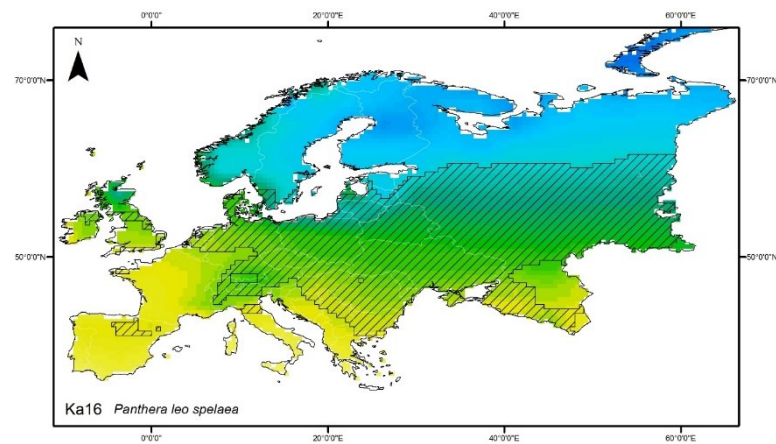
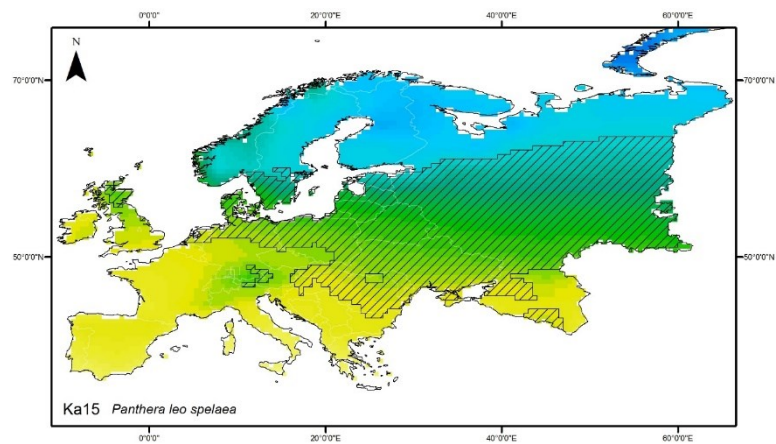
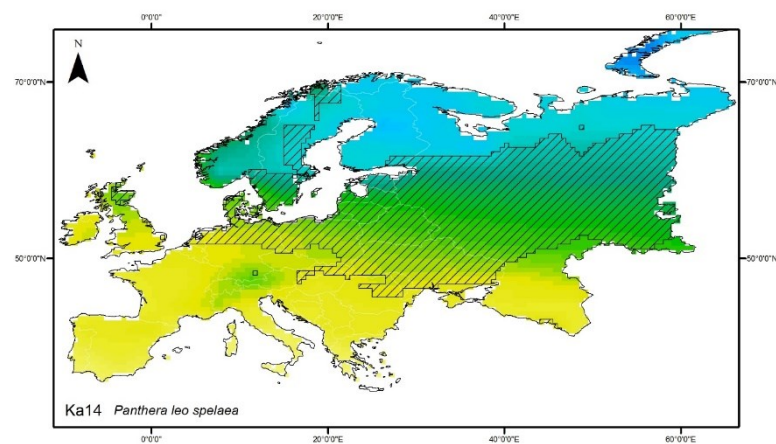
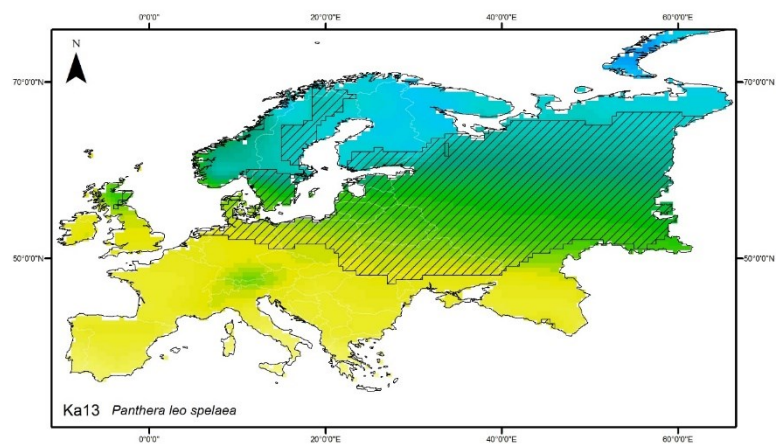


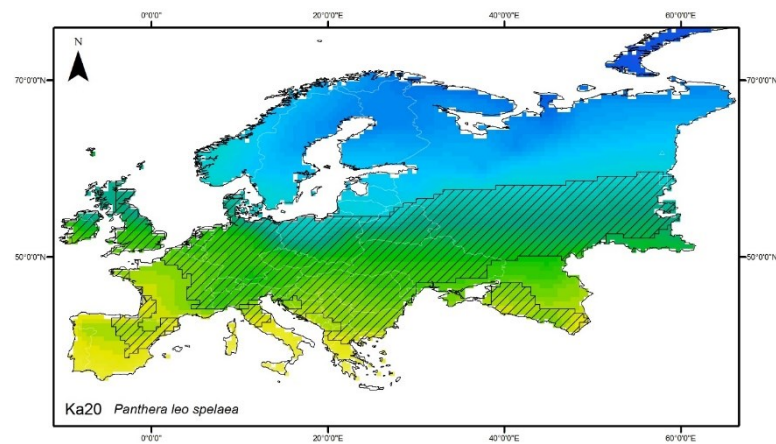
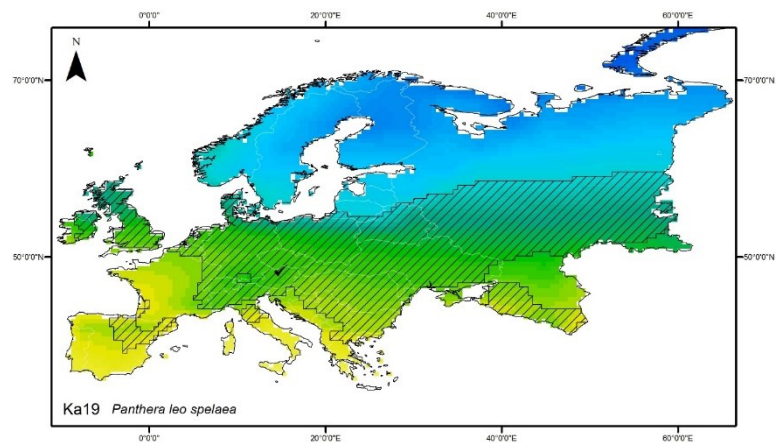
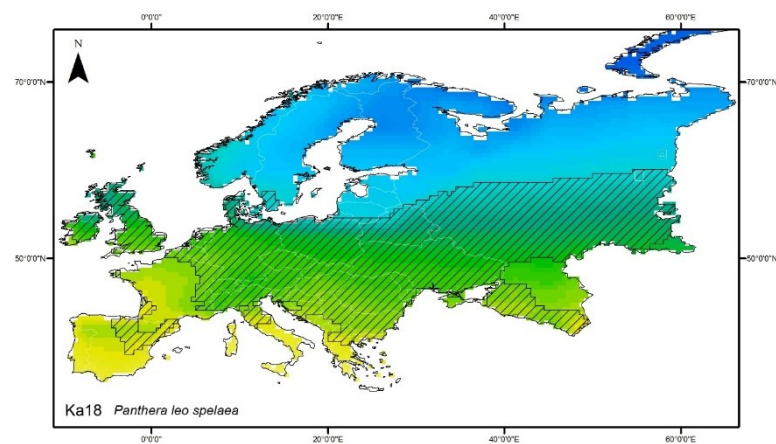
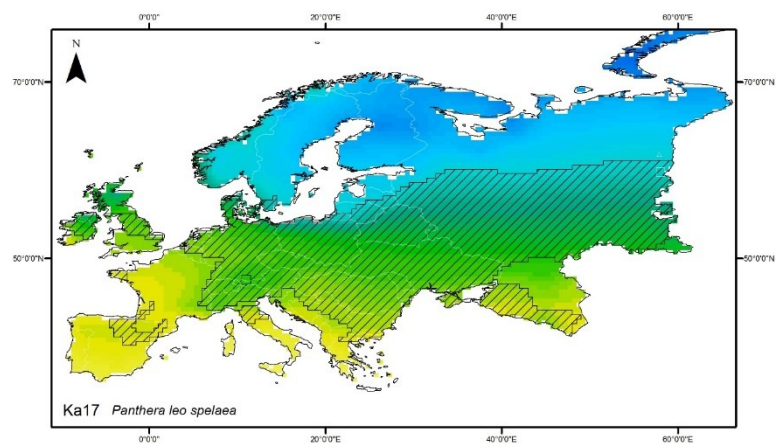


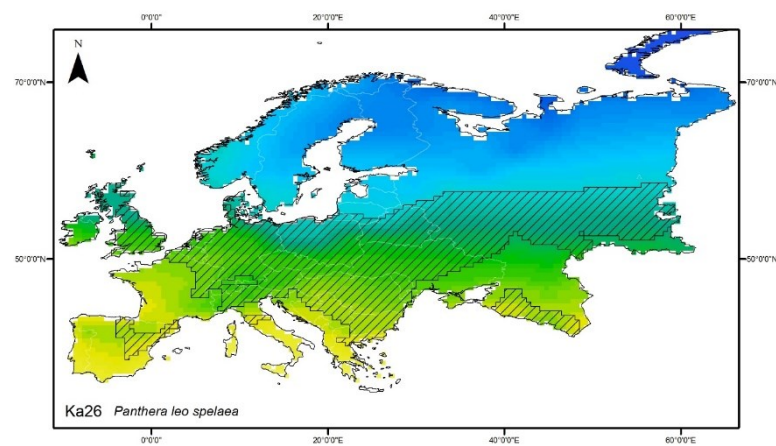
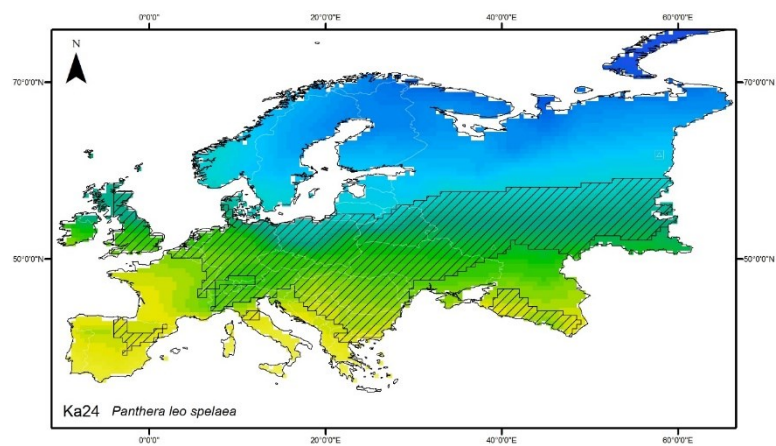
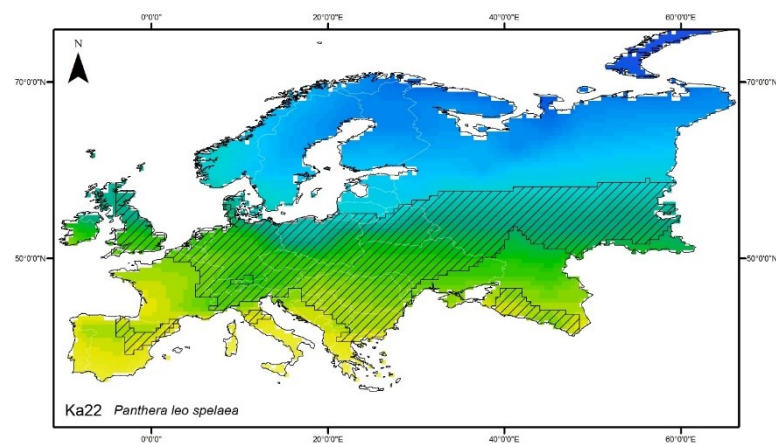
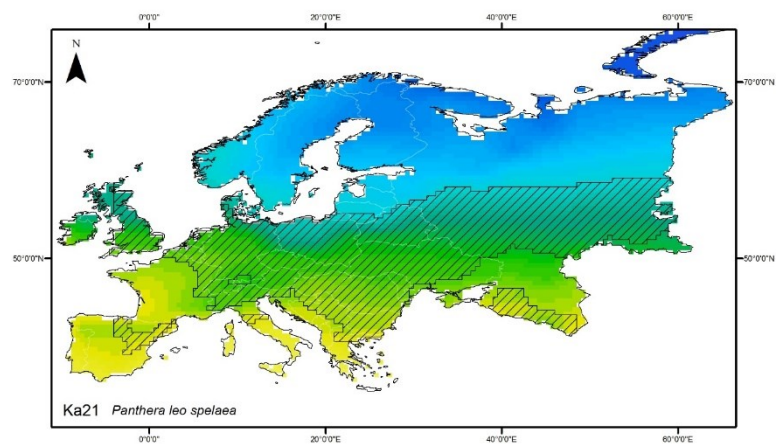


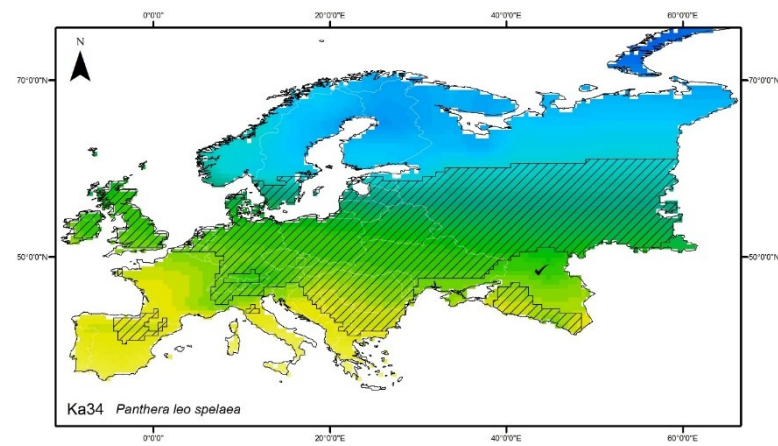
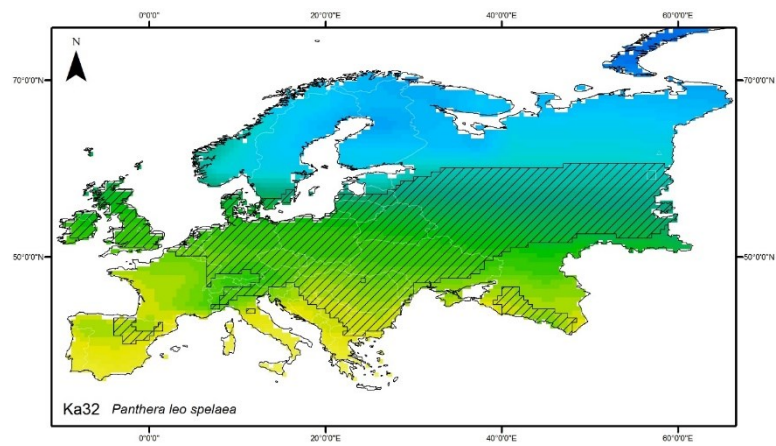
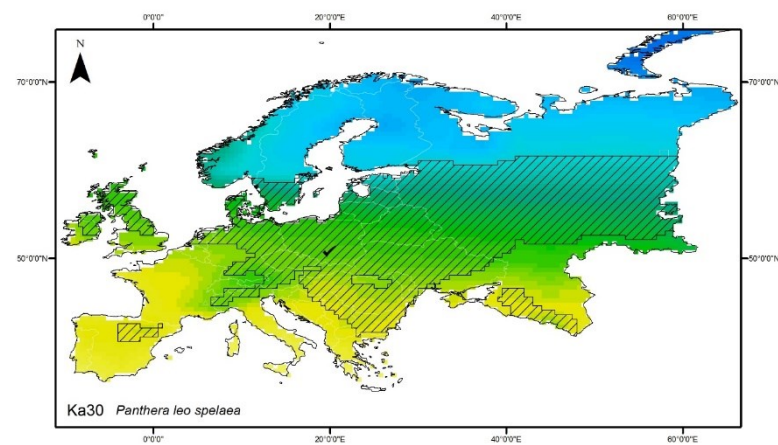
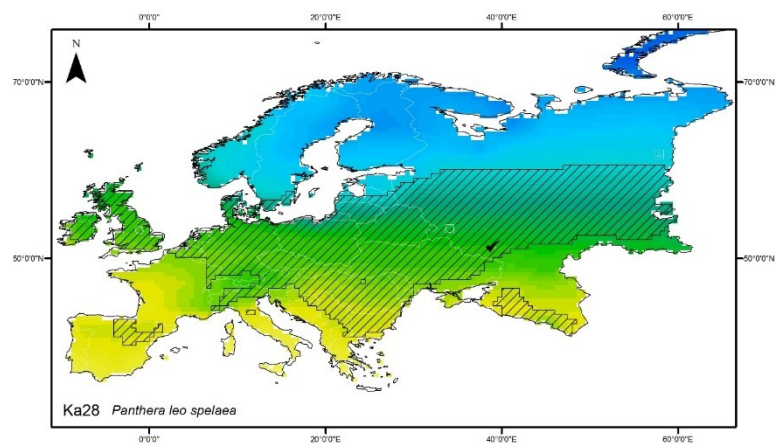


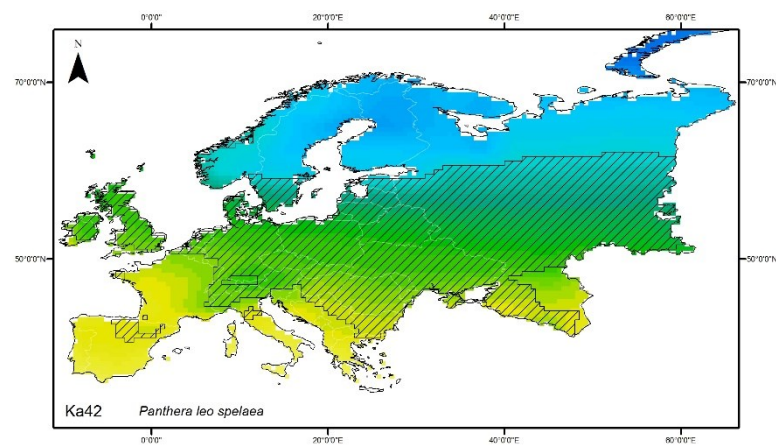
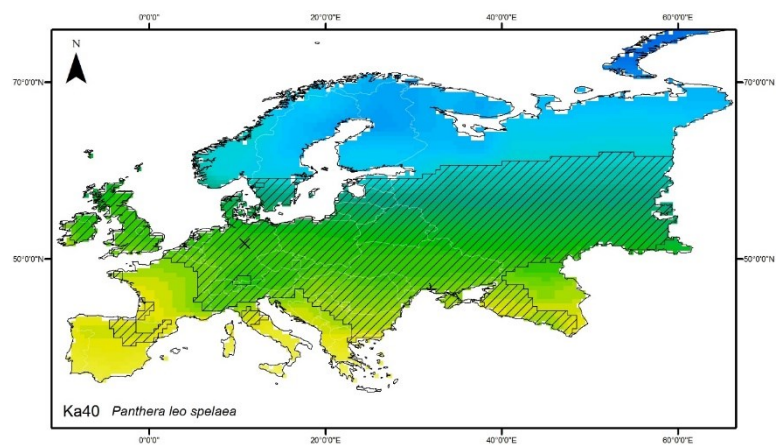
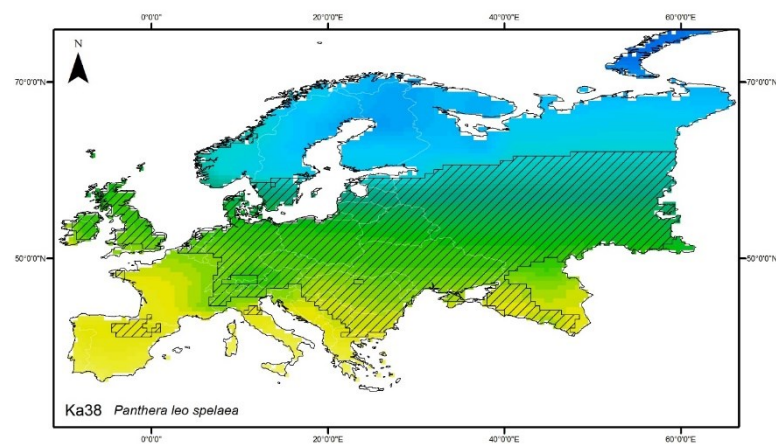
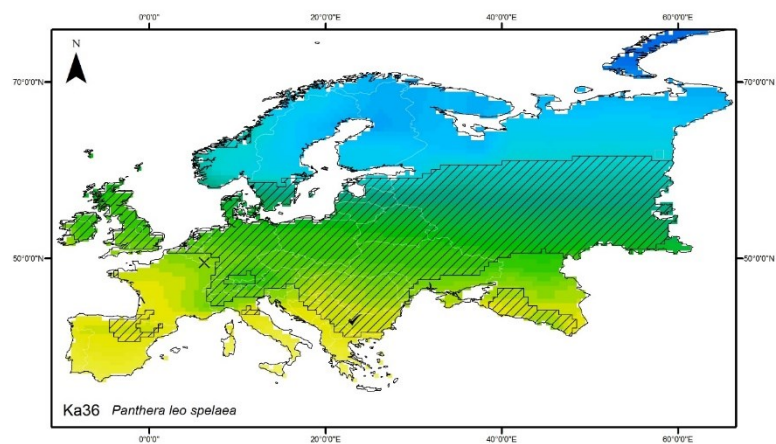
3.10 *Panthera leo spelaeus*

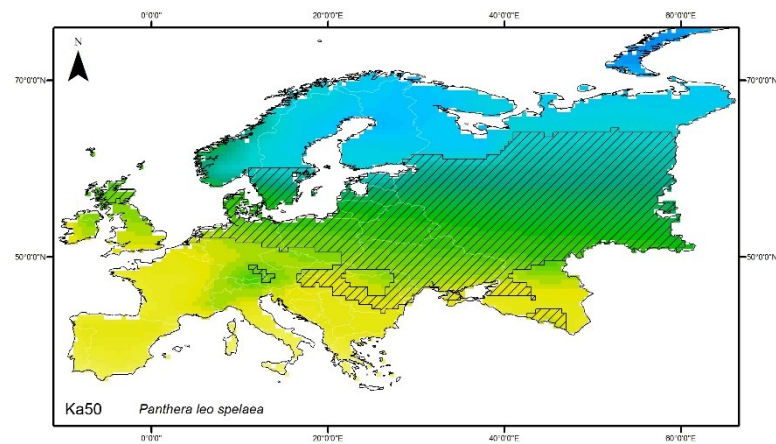
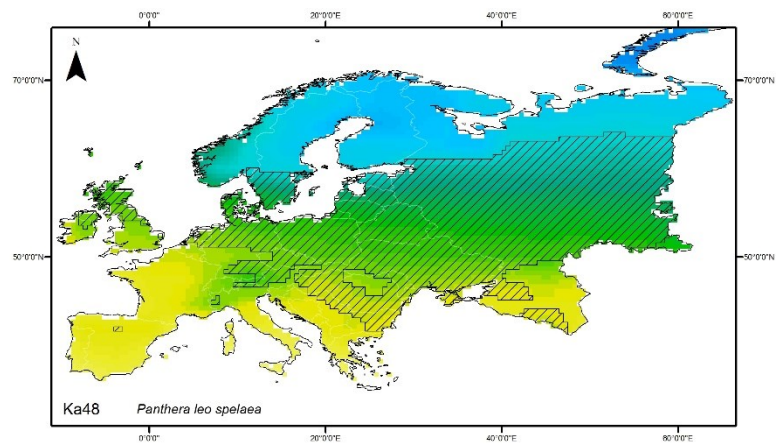
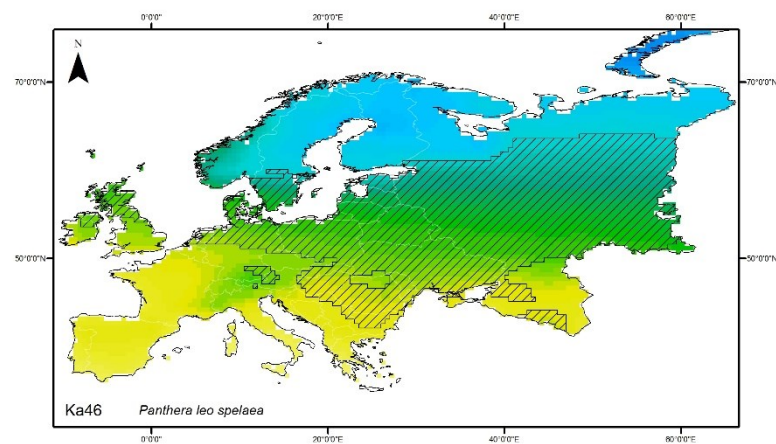
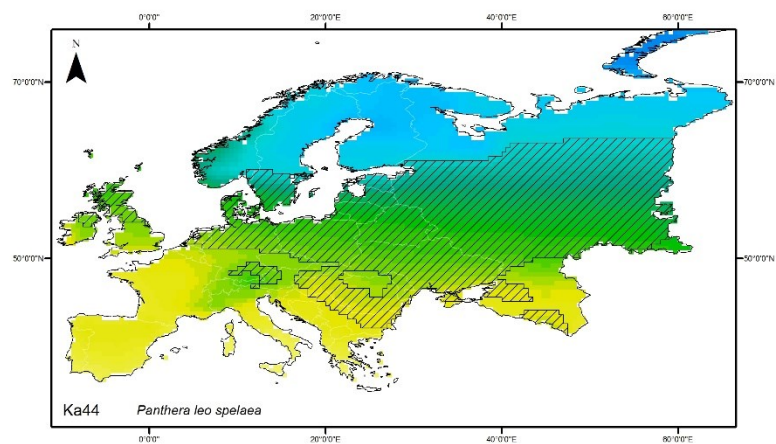


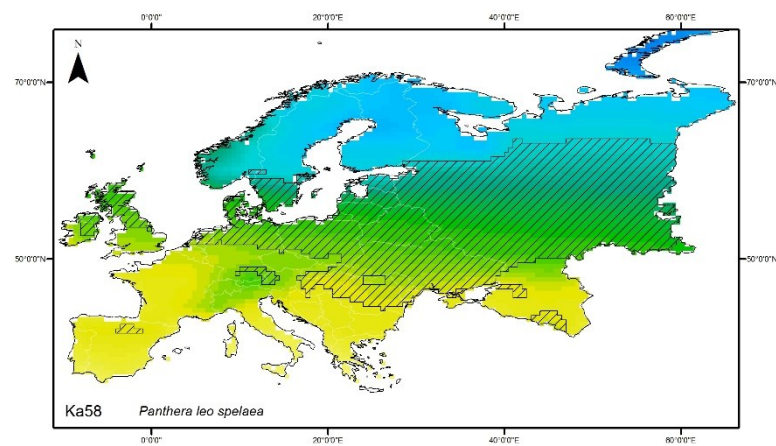
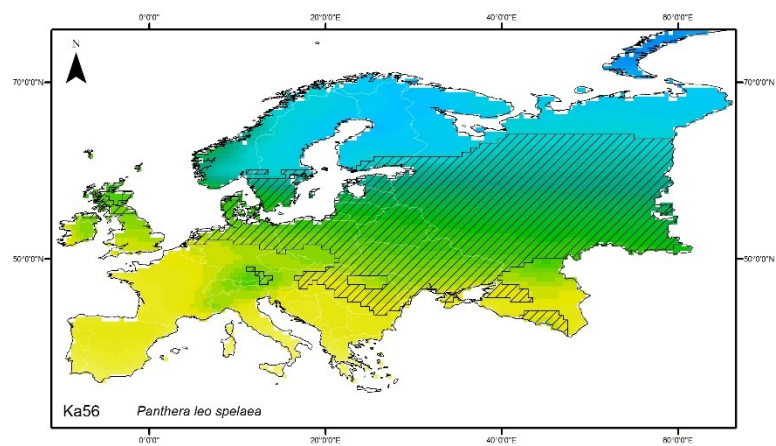
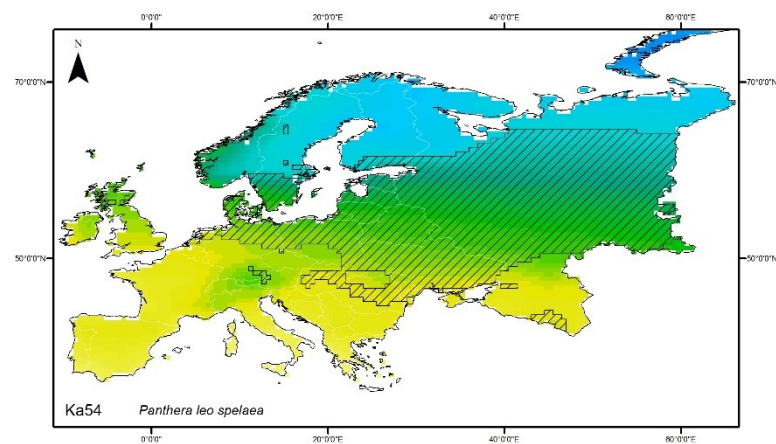
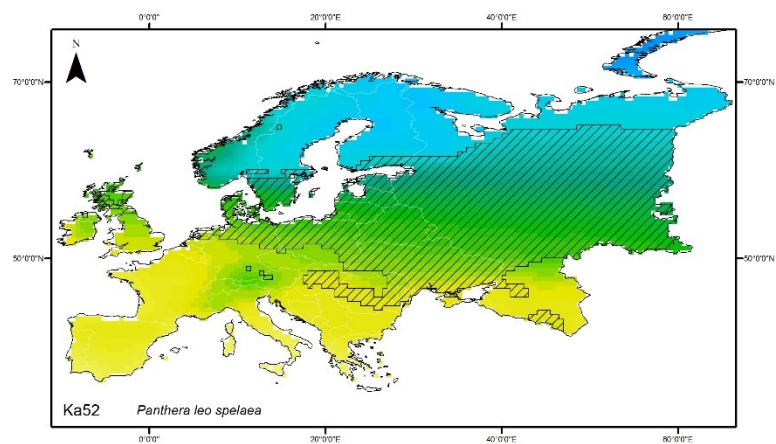


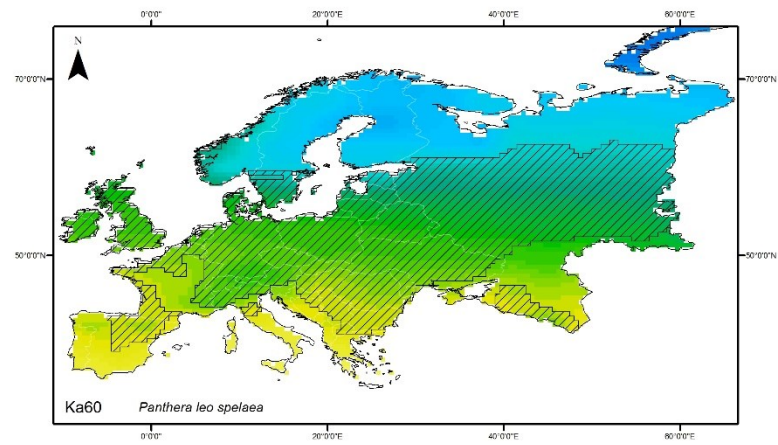












3.11 *Rangifer tarandus* model performance

Model	AUC	Threshold
Model 1 (original)	0.862	0.29
Model 2 (range+past dist)	0.862	0.32
Model 3 (past dist)	0.898	0.34
Model 4 (Bioclim means)	0.824	0.26
Model 5 (Bioclim all var)	0.844	0.30
Model 6 (Bridge all var)	0.855	0.34

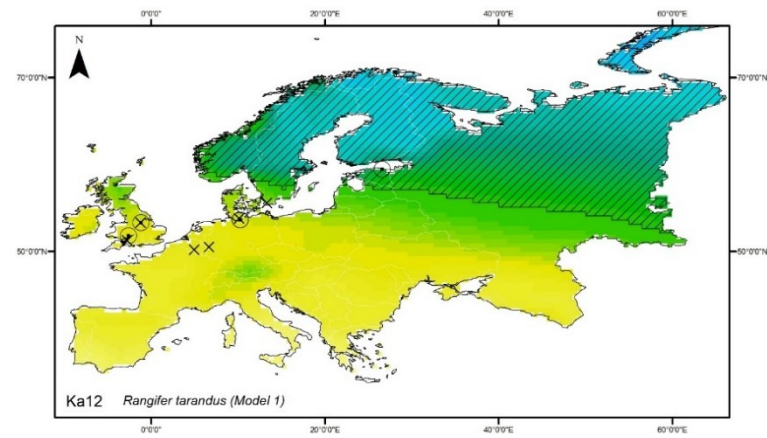
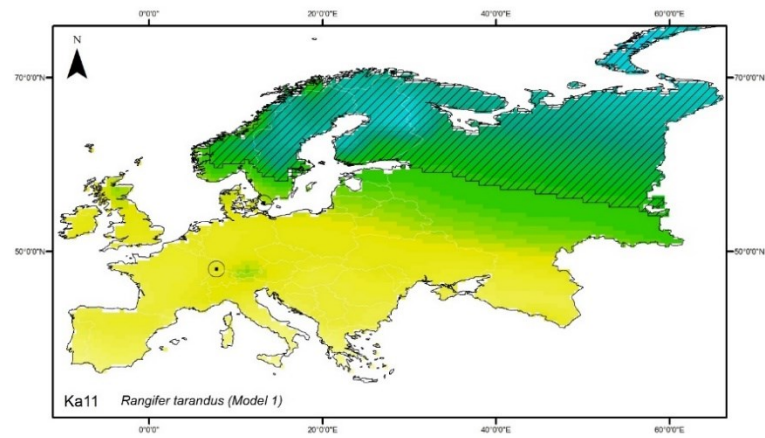
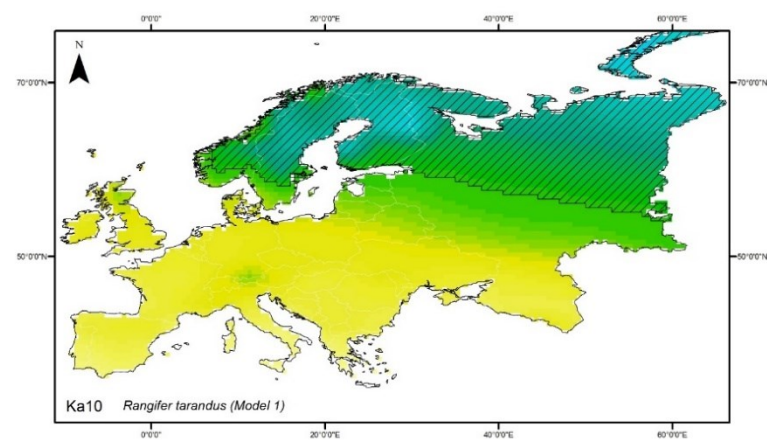
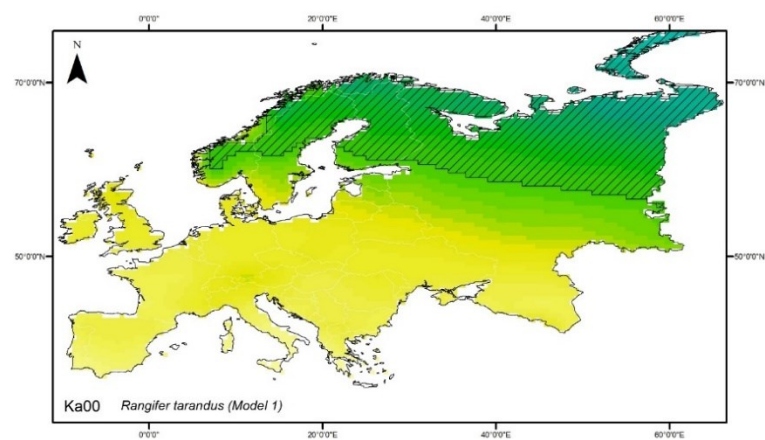
Table 3.1 Correlation matrix of Bioclim variables for model 4

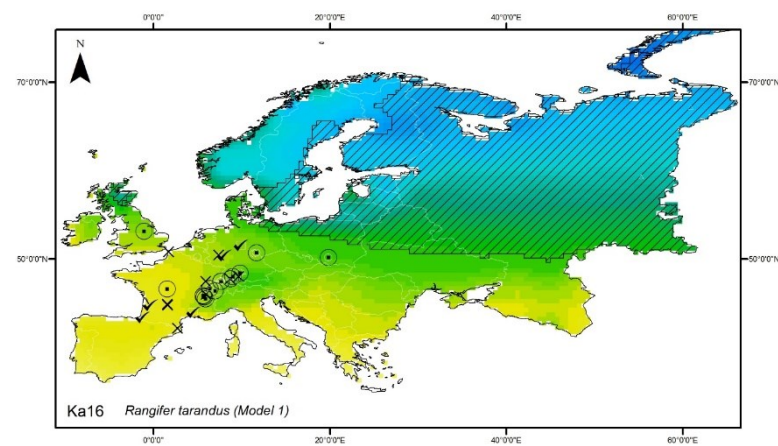
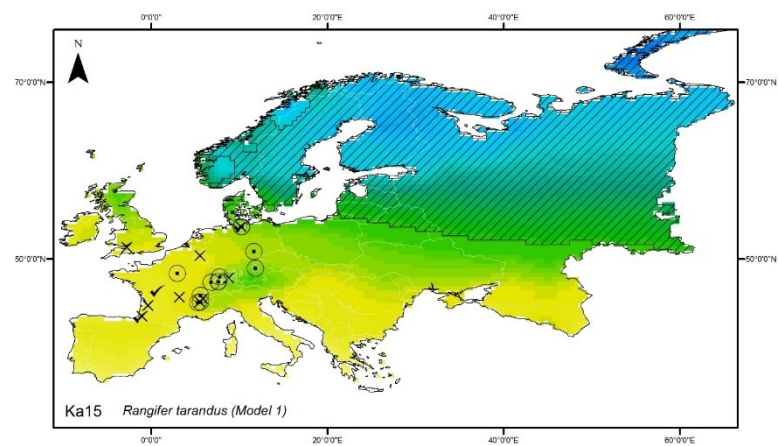
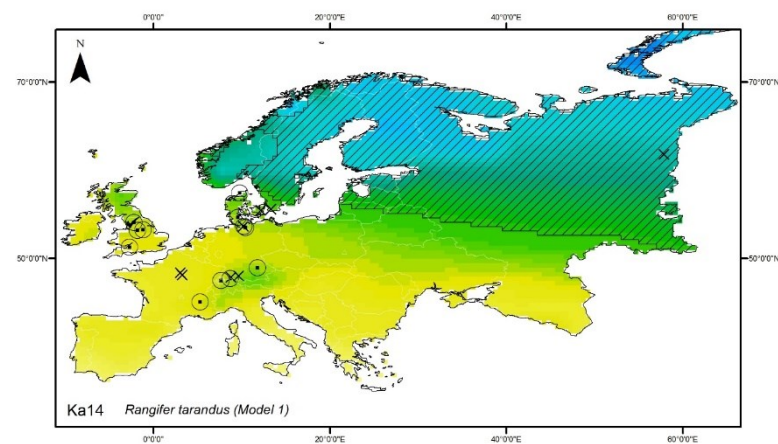
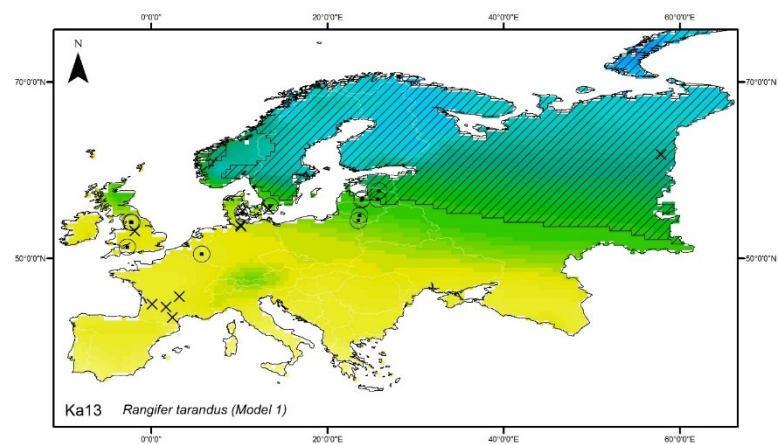
Bioclim	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1.00	0.36	0.69	0.61	-0.26	0.66	0.58	0.75	0.32	0.10	0.30	0.06	-0.47	0.35	0.04	-0.41	0.43	-0.23	0.25
2	0.36	1.00	0.58	0.76	-0.07	0.56	0.74	0.80	0.27	0.09	0.14	0.24	-0.39	0.30	0.04	-0.35	0.35	-0.20	0.22
3	0.69	0.58	1.00	0.47	-0.51	0.99	0.44	0.75	0.17	-0.02	0.14	-0.01	-0.37	0.21	-0.08	-0.29	0.25	-0.33	0.11
4	0.61	0.76	0.47	1.00	0.13	0.44	0.99	0.92	0.50	0.27	0.40	0.33	-0.61	0.53	0.21	-0.58	0.60	-0.12	0.44
5	-0.26	-0.07	-0.51	0.13	1.00	-0.51	0.18	-0.14	0.30	0.37	0.23	0.40	-0.07	0.26	0.41	-0.18	0.29	0.50	0.34
6	0.66	0.56	0.99	0.44	-0.51	1.00	0.40	0.71	0.15	-0.03	0.12	-0.02	-0.34	0.18	-0.09	-0.26	0.22	-0.32	0.09
7	0.58	0.74	0.44	0.99	0.18	0.40	1.00	0.90	0.51	0.28	0.40	0.34	-0.60	0.54	0.23	-0.57	0.59	-0.10	0.44
8	0.75	0.80	0.75	0.92	-0.14	0.71	0.90	1.00	0.46	0.20	0.37	0.24	-0.62	0.50	0.13	-0.56	0.58	-0.23	0.38
9	0.32	0.27	0.17	0.50	0.30	0.15	0.51	0.46	1.00	0.84	0.95	0.71	-0.83	1.00	0.80	-0.91	0.88	0.42	0.98
10	0.10	0.09	-0.02	0.27	0.37	-0.03	0.28	0.20	0.84	1.00	0.83	0.85	-0.41	0.80	0.99	-0.55	0.62	0.61	0.93
11	0.30	0.14	0.14	0.40	0.23	0.12	0.40	0.37	0.95	0.83	1.00	0.59	-0.75	0.94	0.80	-0.84	0.79	0.45	0.94
12	0.06	0.24	-0.01	0.33	0.40	-0.02	0.34	0.24	0.71	0.85	0.59	1.00	-0.34	0.68	0.85	-0.46	0.59	0.49	0.80
13	-0.47	-0.39	-0.37	-0.61	-0.07	-0.34	-0.60	-0.62	-0.83	-0.41	-0.75	-0.34	1.00	-0.87	-0.33	0.97	-0.82	0.03	-0.70
14	0.35	0.30	0.21	0.53	0.26	0.18	0.54	0.50	1.00	0.80	0.94	0.68	-0.87	1.00	0.76	-0.93	0.88	0.34	0.96
15	0.04	0.04	-0.08	0.21	0.41	-0.09	0.23	0.13	0.80	0.99	0.80	0.85	-0.33	0.76	1.00	-0.50	0.60	0.70	0.91
16	-0.41	-0.35	-0.29	-0.58	-0.18	-0.26	-0.57	-0.56	-0.91	-0.55	-0.84	-0.46	0.97	-0.93	-0.50	1.00	-0.89	-0.20	-0.81
17	0.43	0.35	0.25	0.60	0.29	0.22	0.59	0.58	0.88	0.62	0.79	0.59	-0.82	0.88	0.60	-0.89	1.00	0.38	0.82
18	-0.23	-0.20	-0.33	-0.12	0.50	-0.32	-0.10	-0.23	0.42	0.61	0.45	0.49	0.03	0.34	0.70	-0.20	0.38	1.00	0.52
19	0.25	0.22	0.11	0.44	0.34	0.09	0.44	0.38	0.98	0.93	0.94	0.80	-0.70	0.96	0.91	-0.81	0.82	0.52	1.00

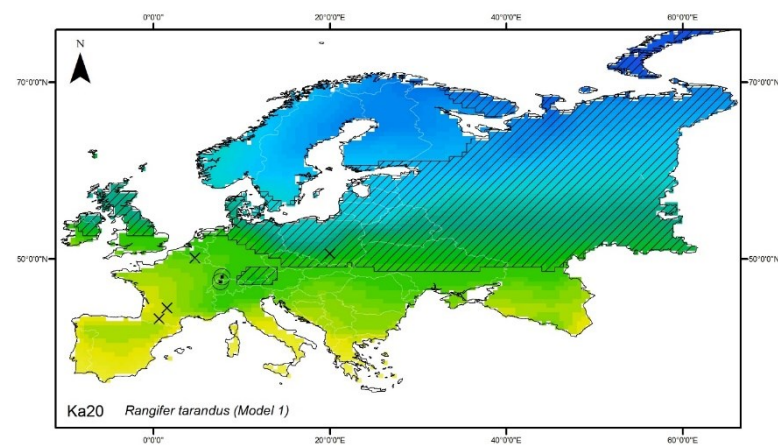
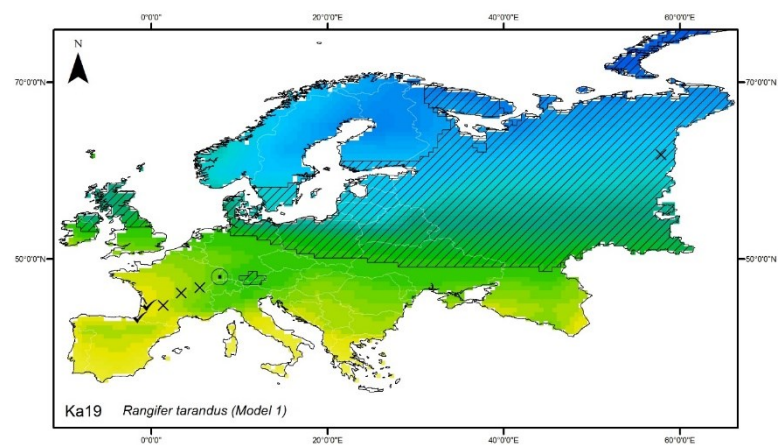
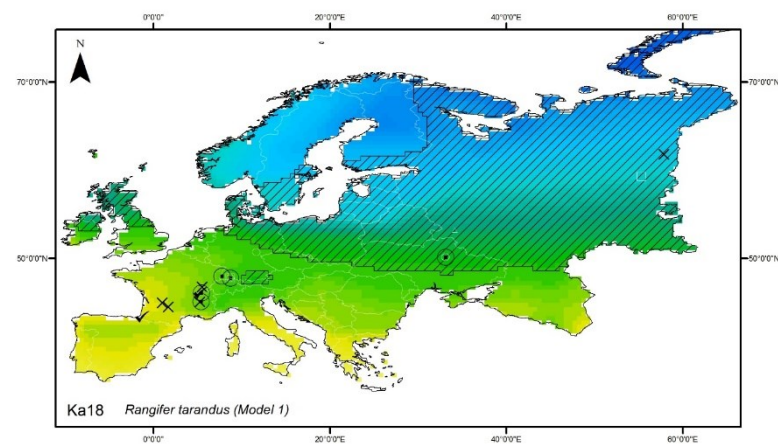
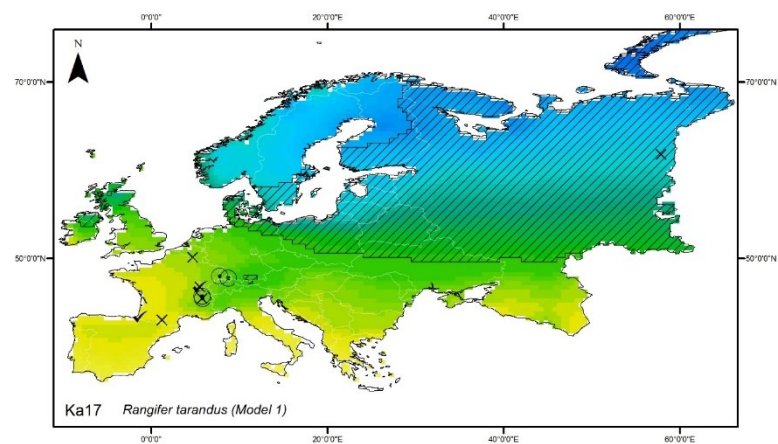
Table 3.2 Correlation matrix for model 6

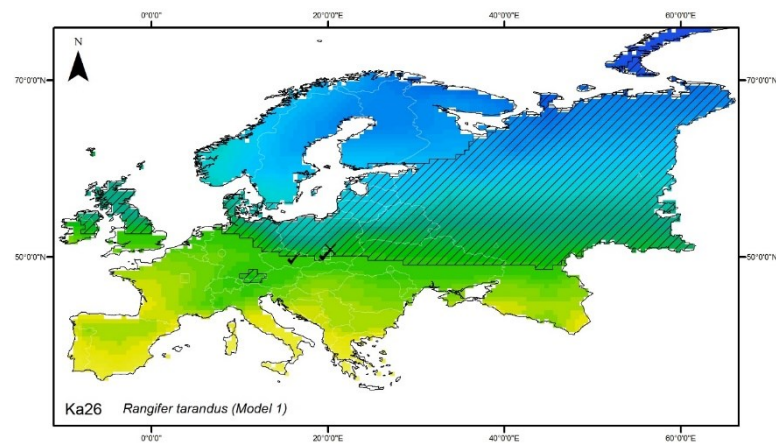
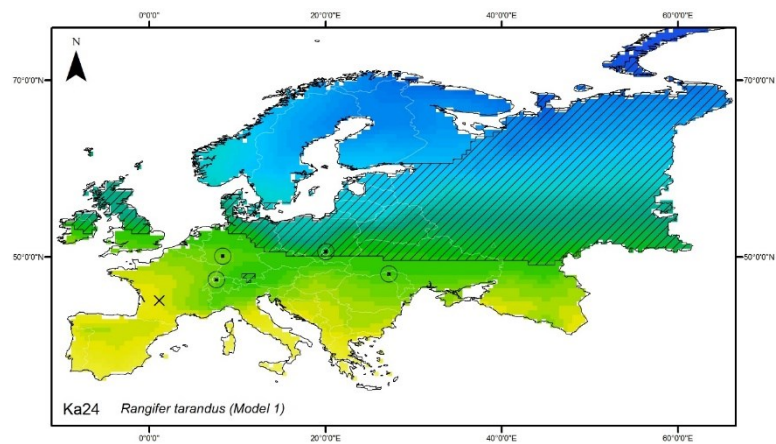
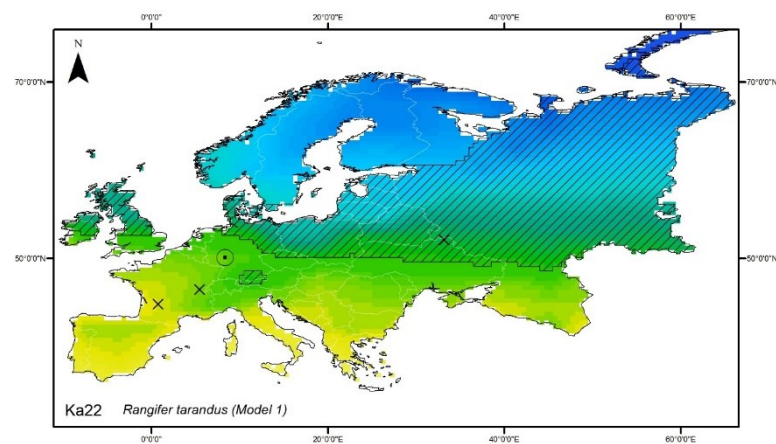
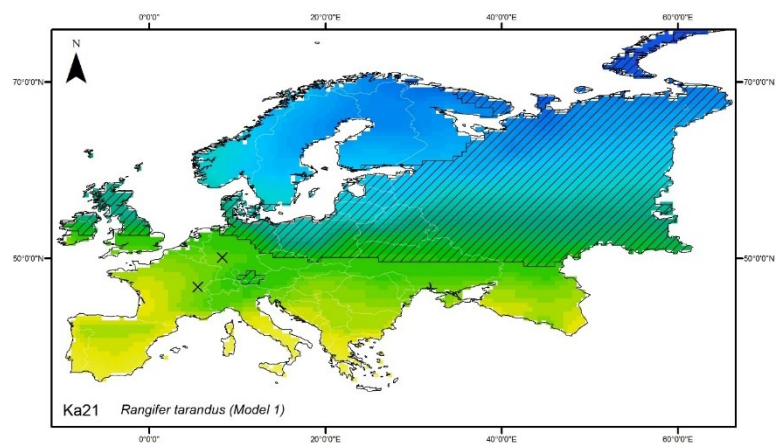
Bioclim	1	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1.00	0.02	0.66	0.02	0.01	0.46	0.72	0.76	0.46	0.21	0.36	0.08	-0.52	0.46	0.19	-0.52	0.39
4	0.02	1.00	0.54	1.00	0.04	0.45	0.61	0.62	0.17	0.05	0.17	0.11	-0.21	0.17	0.05	-0.21	0.14
5	0.66	0.54	1.00	0.54	-0.15	0.63	0.80	0.93	0.48	0.23	0.39	0.20	-0.54	0.48	0.21	-0.53	0.41
6	0.02	1.00	0.54	1.00	0.04	0.45	0.61	0.62	0.17	0.05	0.17	0.11	-0.21	0.17	0.05	-0.21	0.14
7	0.01	0.04	-0.15	0.04	1.00	-0.52	0.25	-0.08	0.29	0.37	0.35	0.33	-0.16	0.28	0.38	-0.17	0.34
8	0.46	0.45	0.63	0.45	-0.52	1.00	0.39	0.67	0.10	-0.06	0.05	-0.05	-0.20	0.11	-0.08	-0.19	0.05
9	0.72	0.61	0.80	0.61	0.25	0.39	1.00	0.91	0.54	0.29	0.48	0.21	-0.59	0.55	0.27	-0.60	0.48
10	0.76	0.62	0.93	0.62	-0.08	0.67	0.91	1.00	0.47	0.20	0.39	0.15	-0.55	0.48	0.18	-0.55	0.40
11	0.46	0.17	0.48	0.17	0.29	0.10	0.54	0.47	1.00	0.80	0.97	0.66	-0.92	1.00	0.77	-0.92	0.98
12	0.21	0.05	0.23	0.05	0.37	-0.06	0.29	0.20	0.80	1.00	0.91	0.92	-0.50	0.80	1.00	-0.50	0.90
13	0.36	0.17	0.39	0.17	0.35	0.05	0.48	0.39	0.97	0.91	1.00	0.79	-0.80	0.97	0.88	-0.80	1.00
14	0.08	0.11	0.20	0.11	0.33	-0.05	0.21	0.15	0.66	0.92	0.79	1.00	-0.35	0.66	0.92	-0.35	0.78
15	-0.52	-0.21	-0.54	-0.21	-0.16	-0.20	-0.59	-0.55	-0.92	-0.50	-0.80	-0.35	1.00	-0.92	-0.45	1.00	-0.82
16	0.46	0.17	0.48	0.17	0.28	0.11	0.55	0.48	1.00	0.80	0.97	0.66	-0.92	1.00	0.76	-0.92	0.98
17	0.19	0.05	0.21	0.05	0.38	-0.08	0.27	0.18	0.77	1.00	0.88	0.92	-0.45	0.76	1.00	-0.45	0.88
18	-0.52	-0.21	-0.53	-0.21	-0.17	-0.19	-0.60	-0.55	-0.92	-0.50	-0.80	-0.35	1.00	-0.92	-0.45	1.00	-0.82
19	0.39	0.14	0.41	0.14	0.34	0.05	0.48	0.40	0.98	0.90	1.00	0.78	-0.82	0.98	0.88	-0.82	1.00

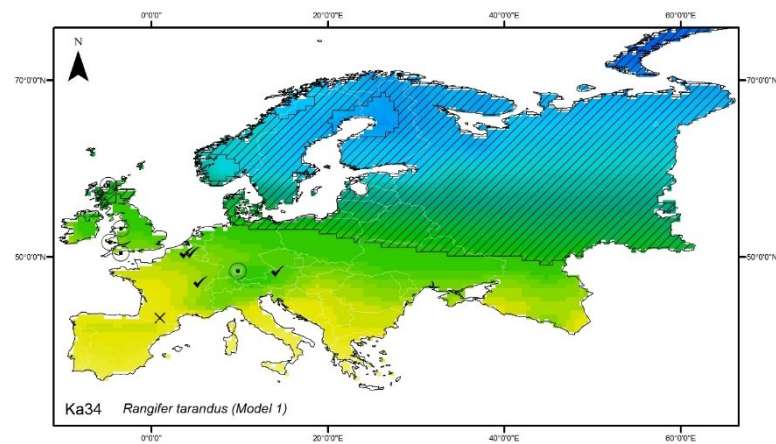
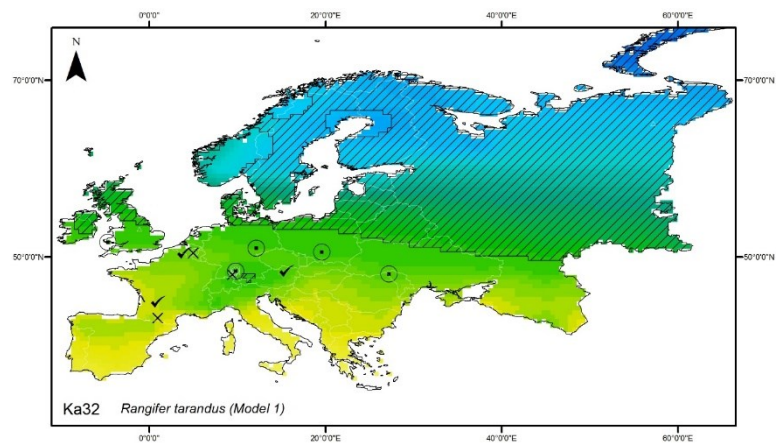
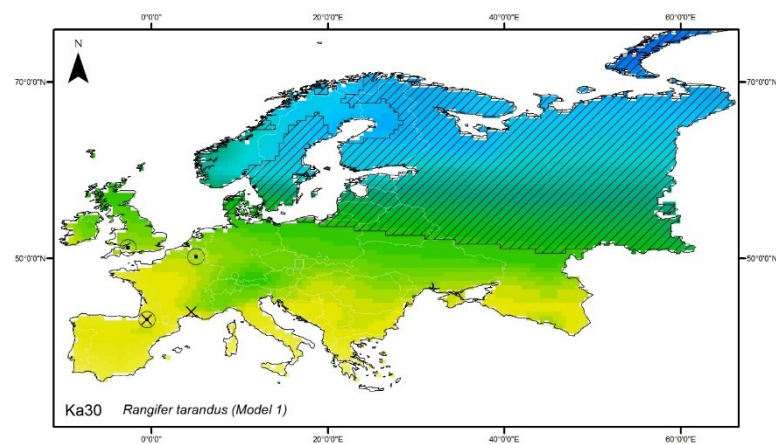
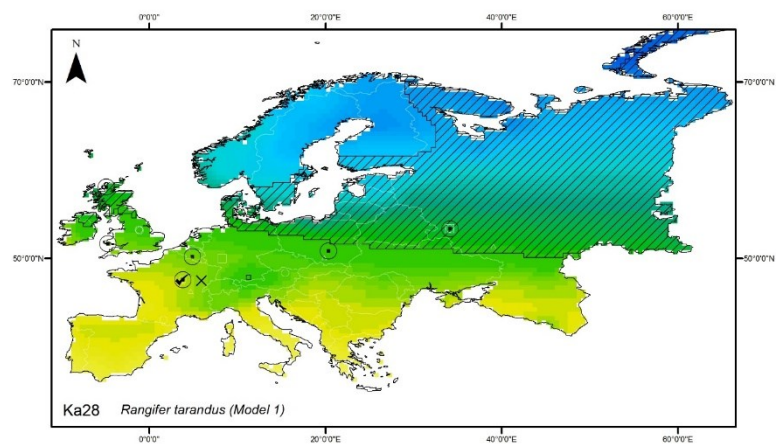
3.12 Rangifer tarandus (Model 1)

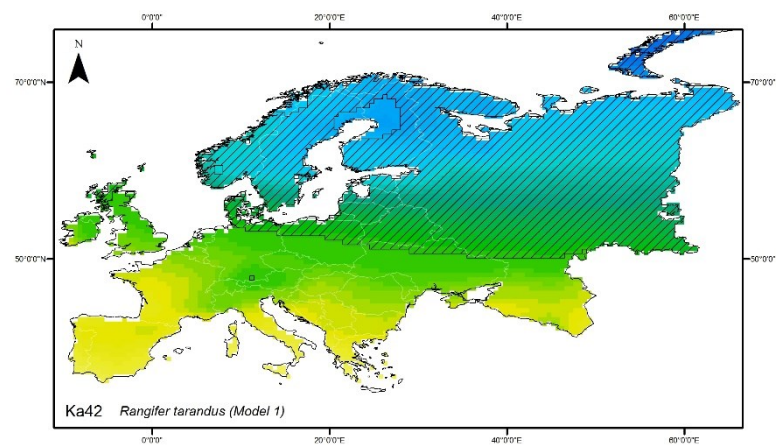
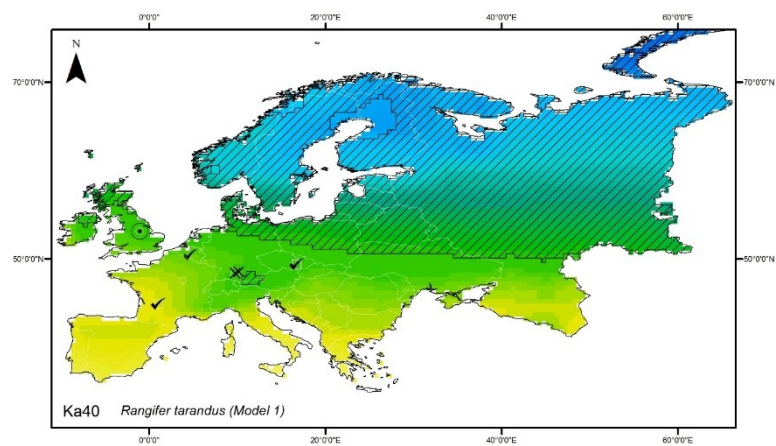
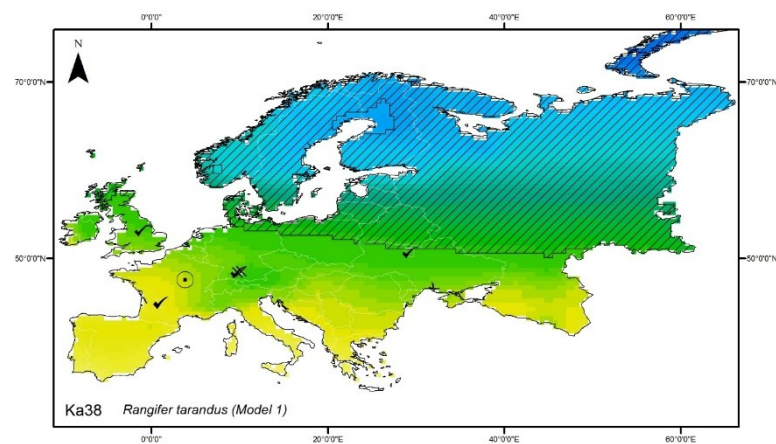
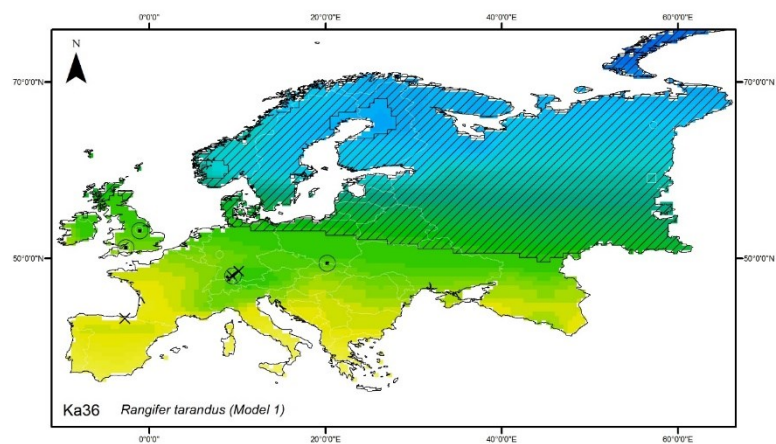


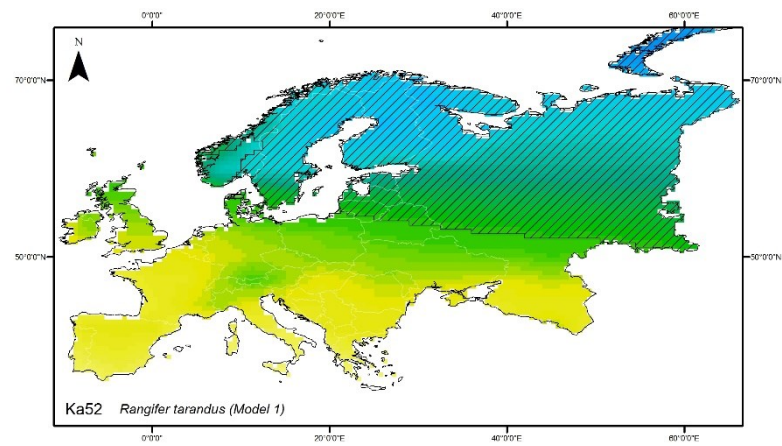
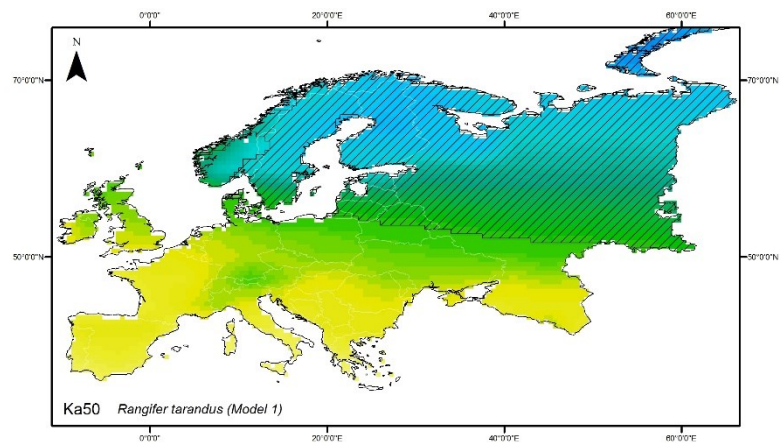
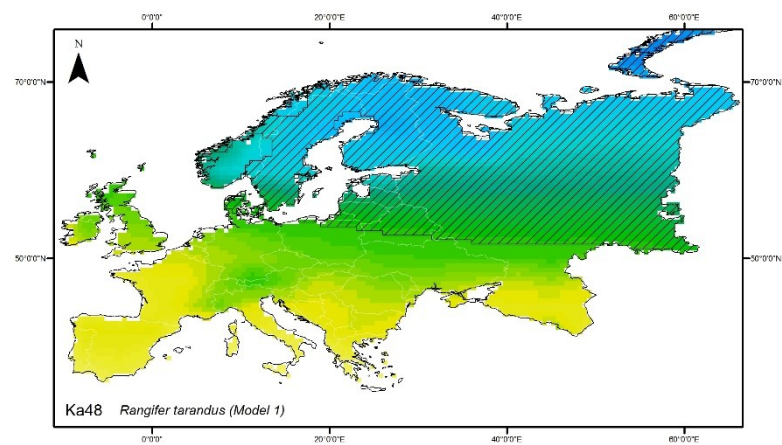
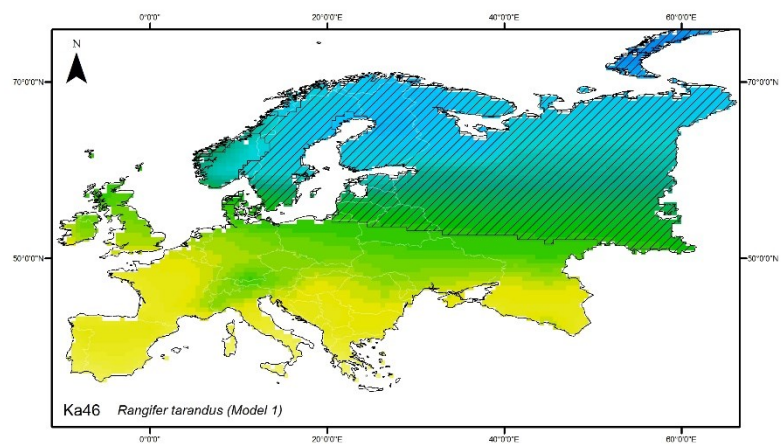


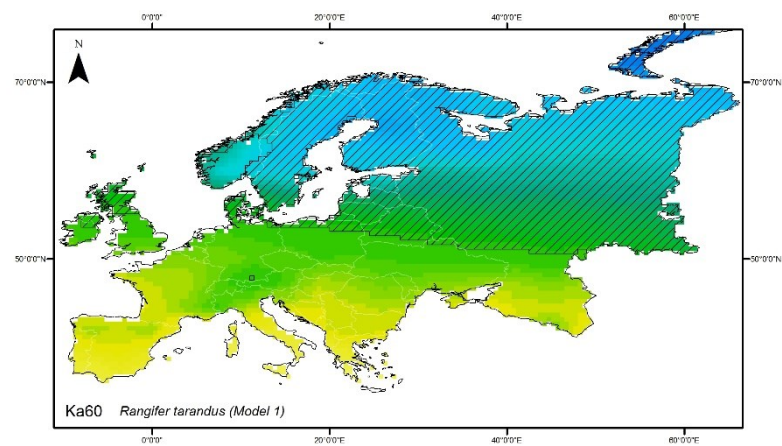
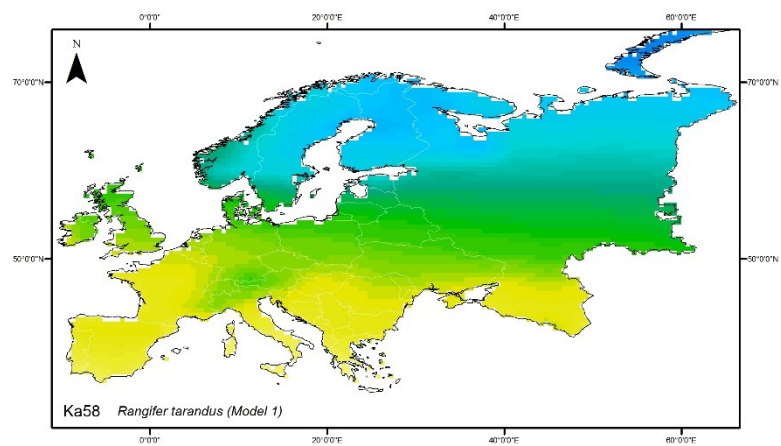
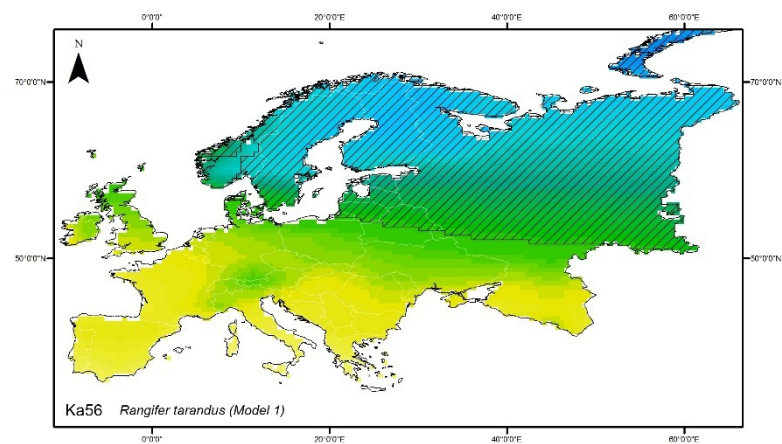
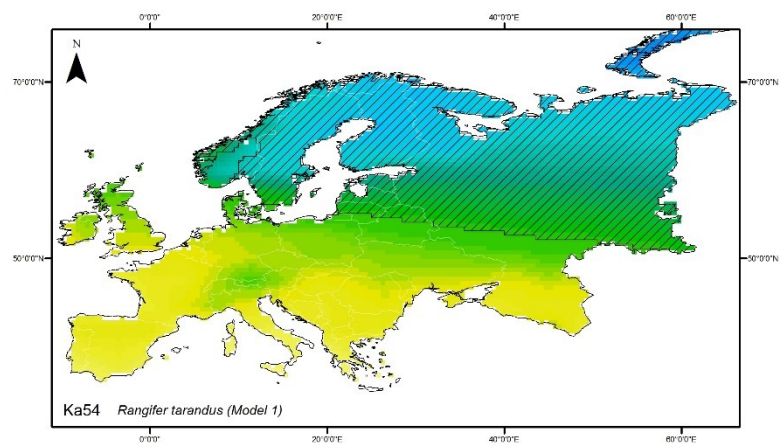




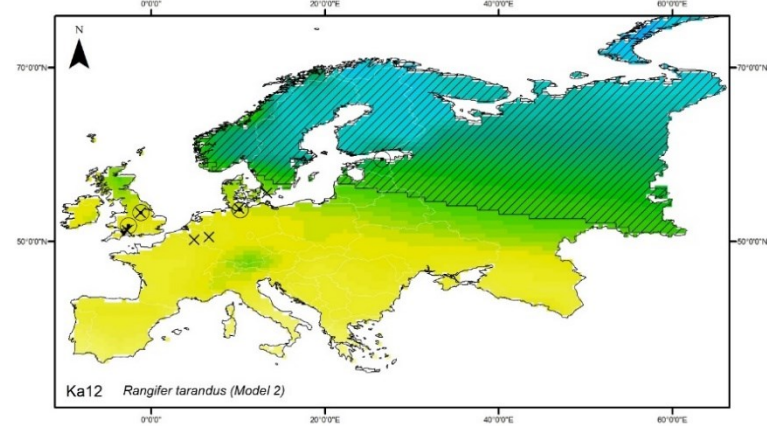
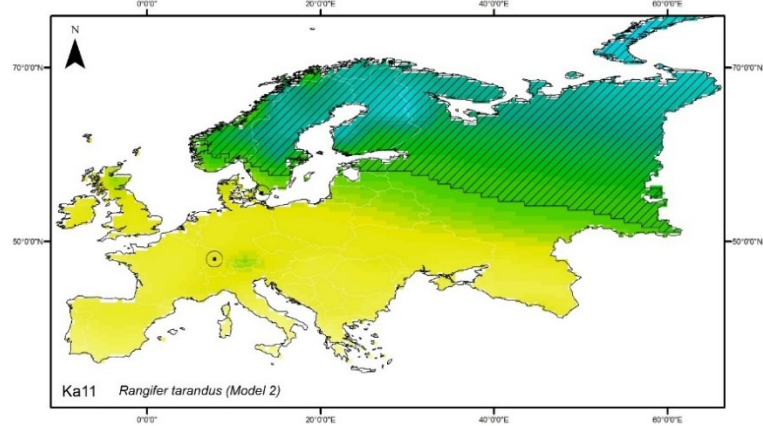
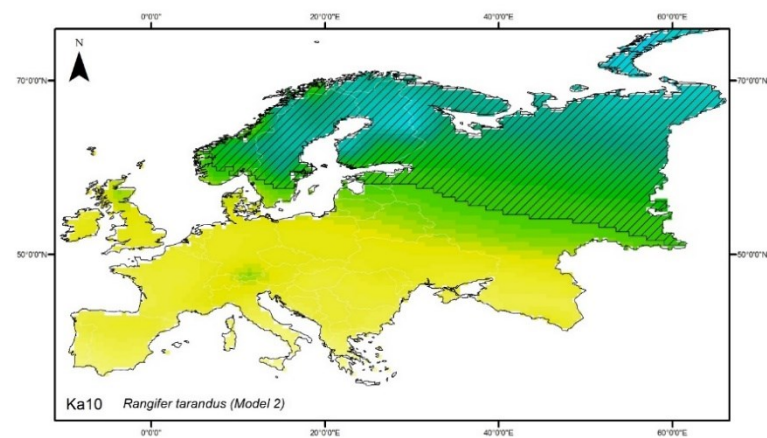
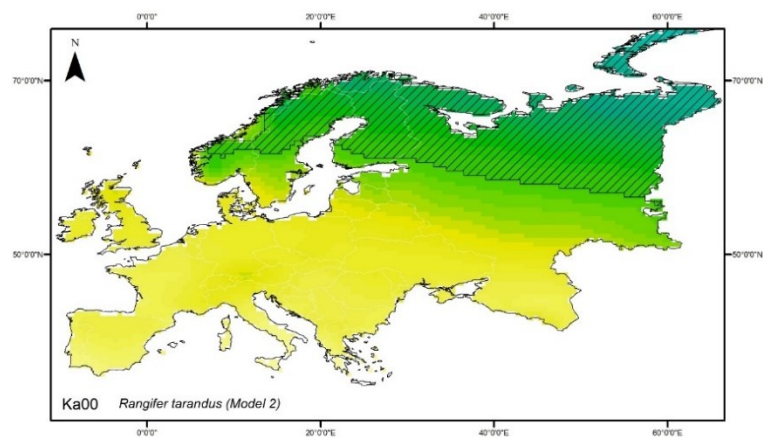


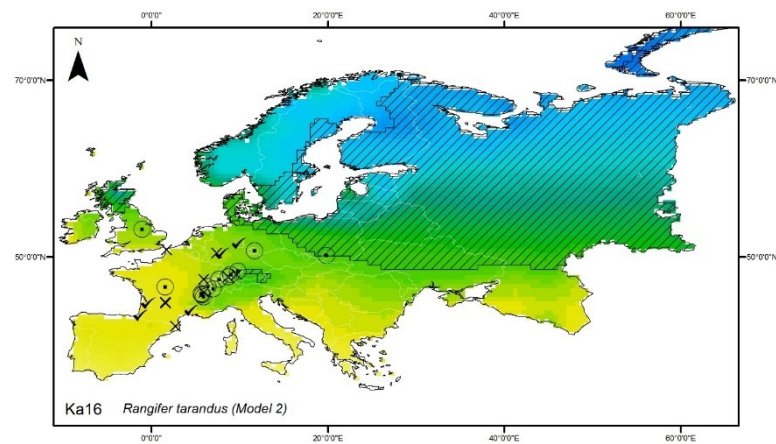
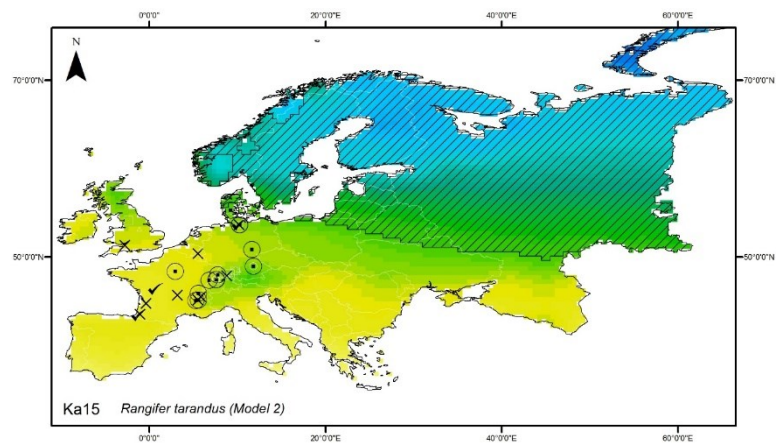
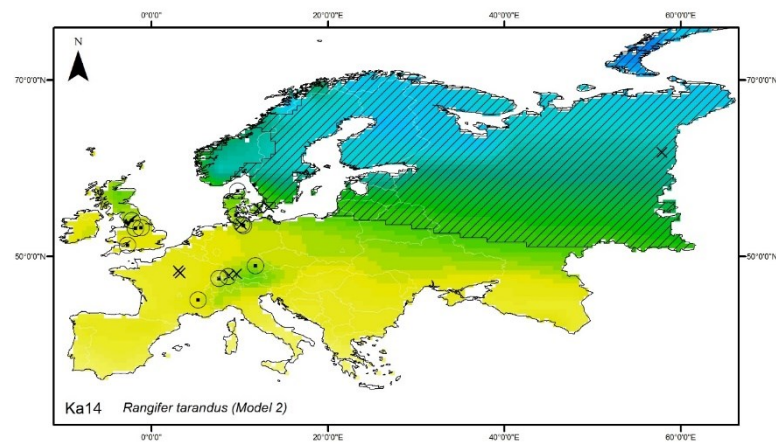
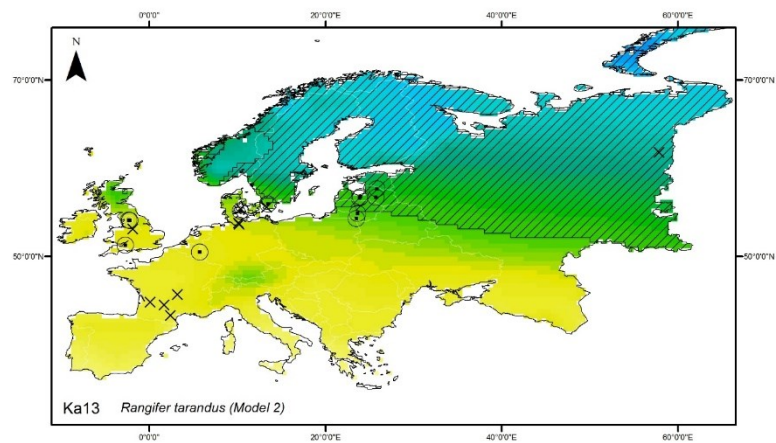


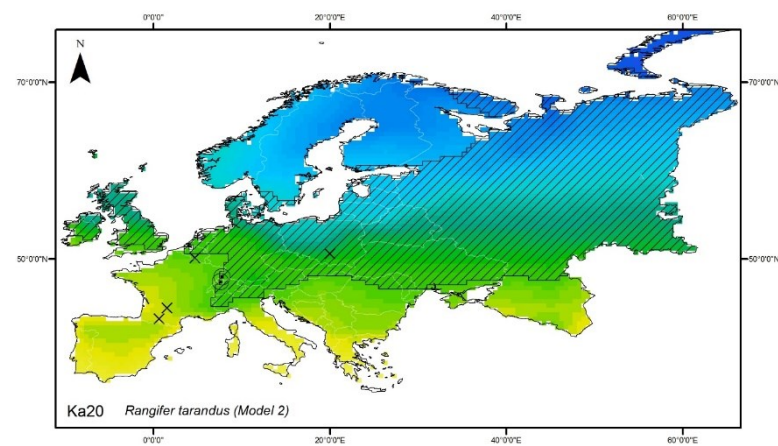
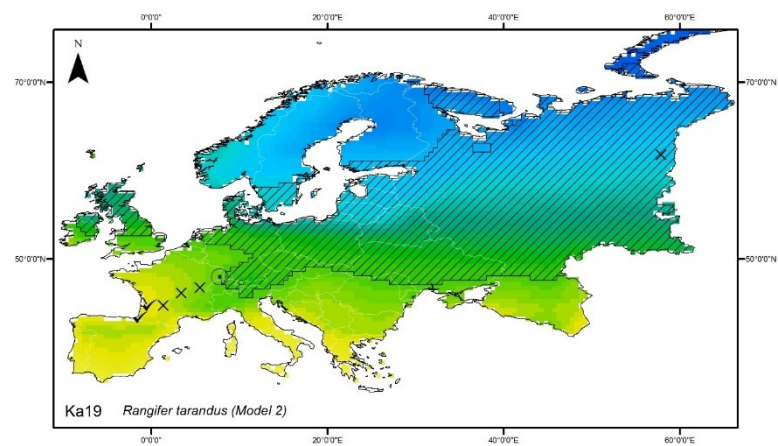
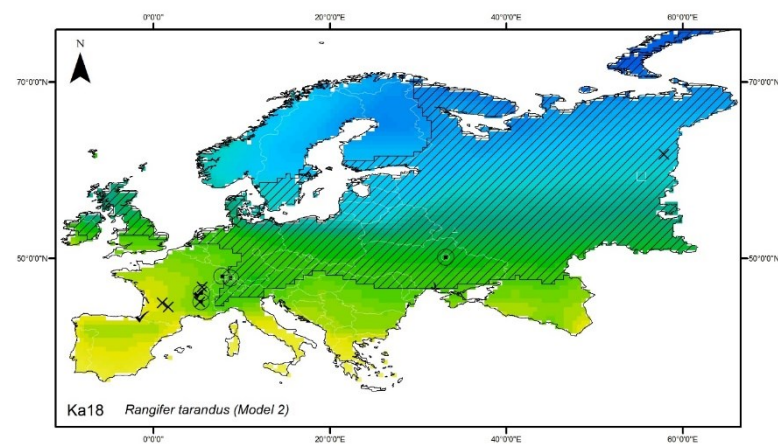
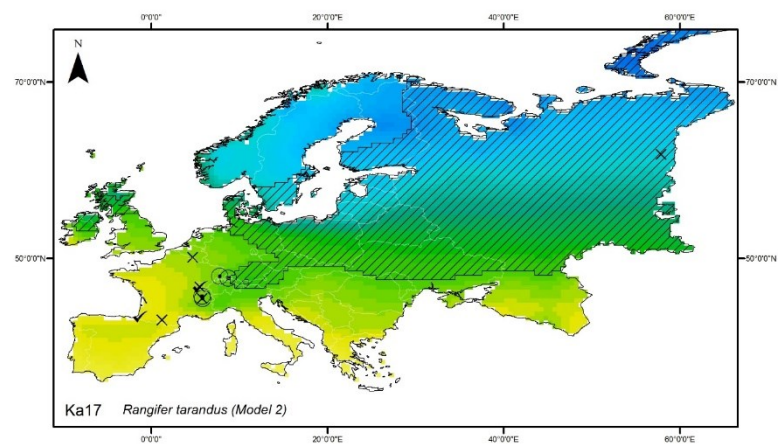


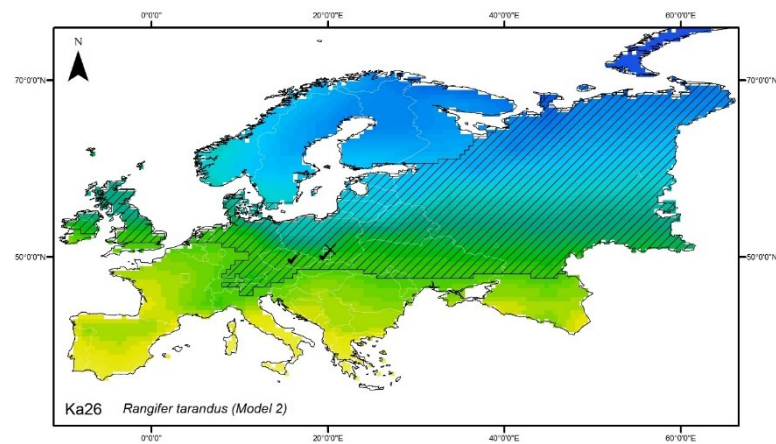
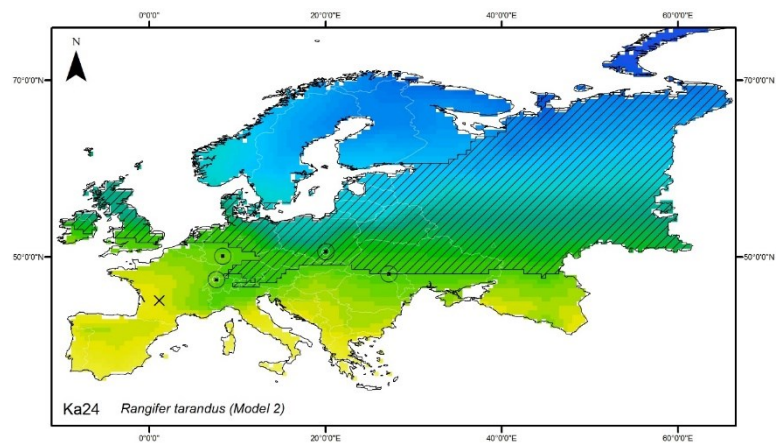
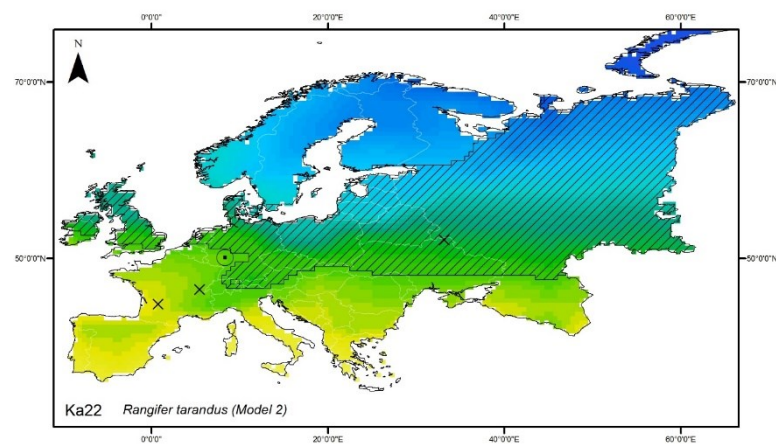
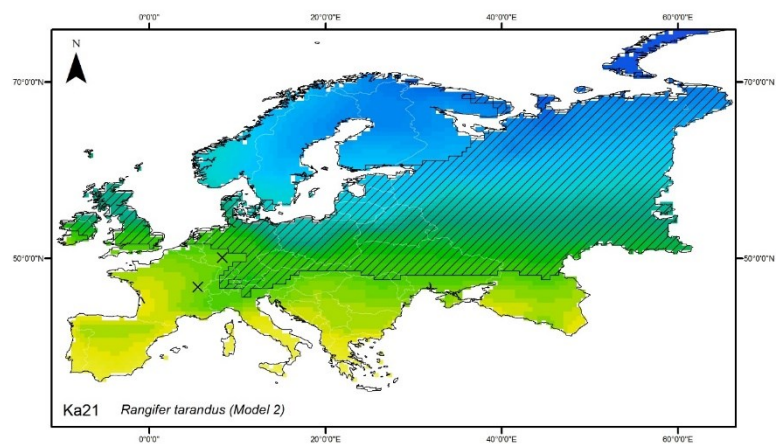


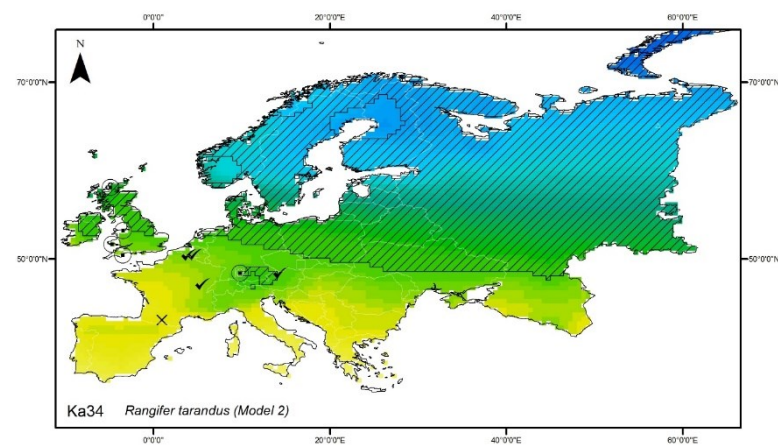
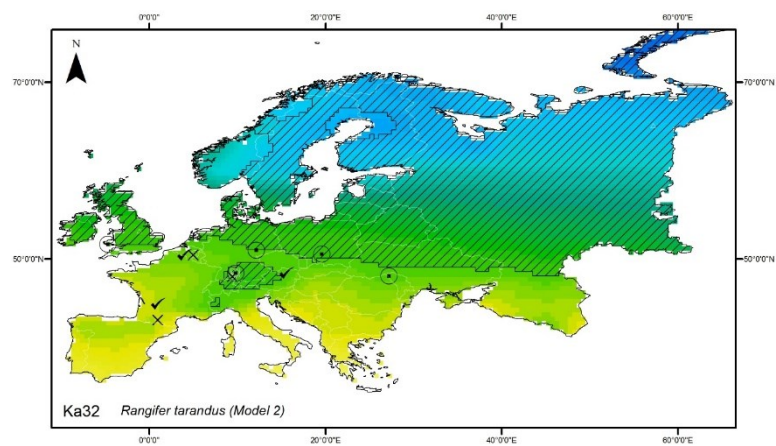
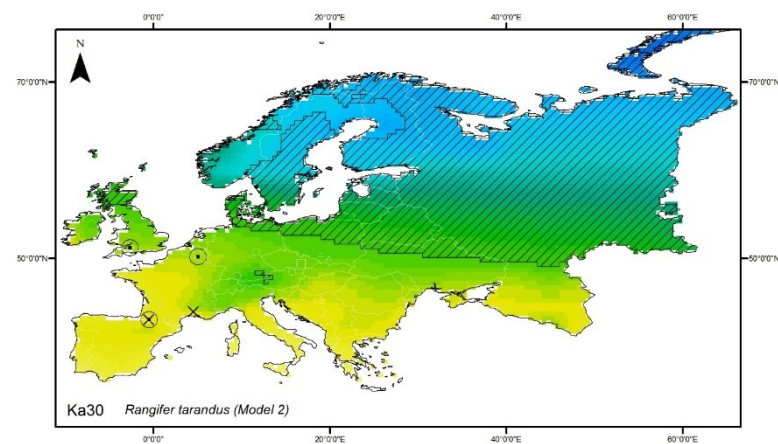
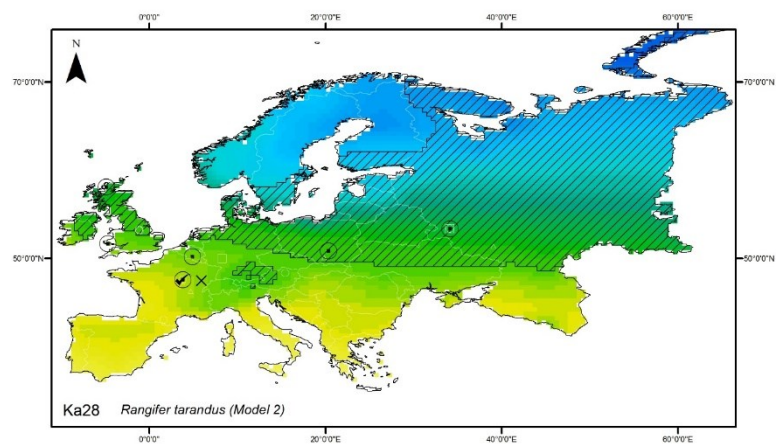
3.13 Rangifer tarandus (Model 2)

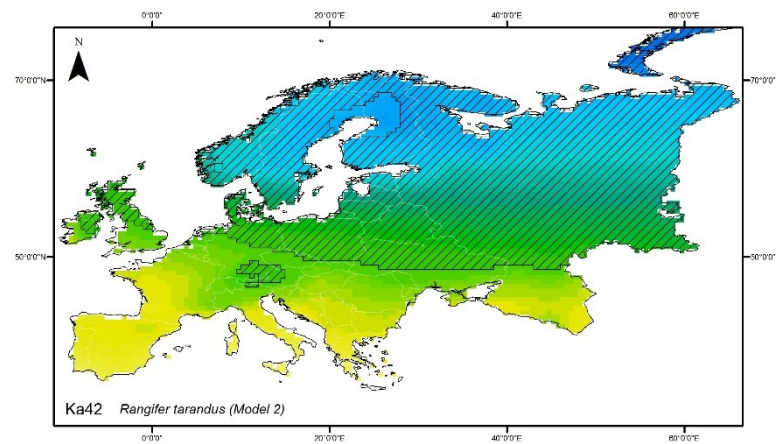
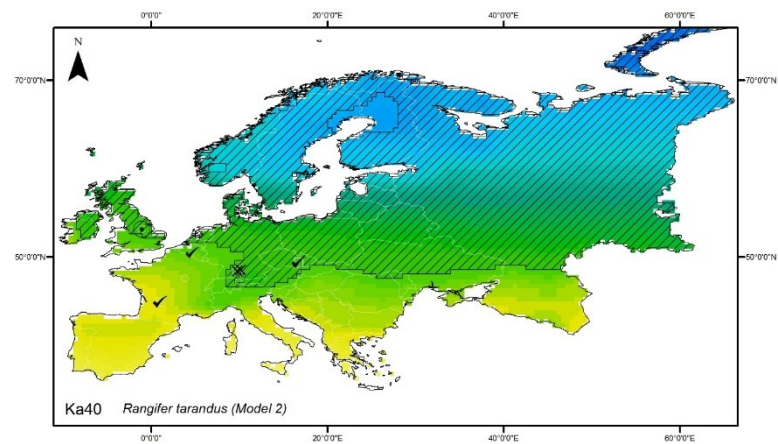
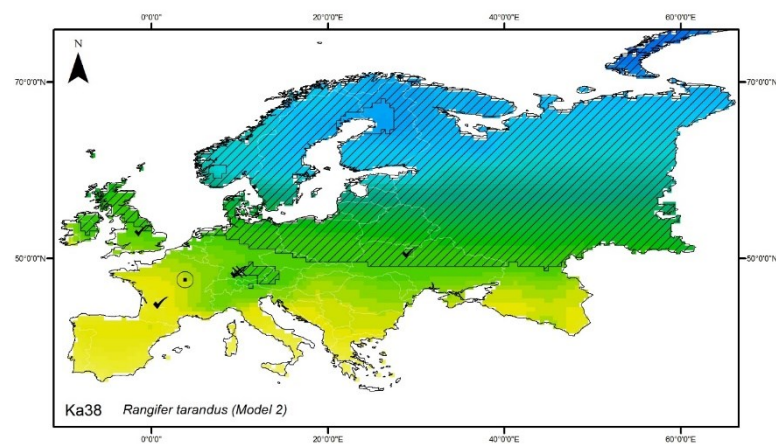
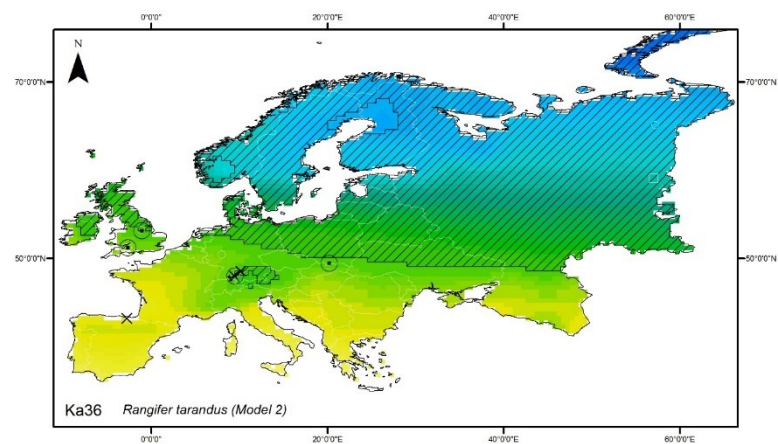


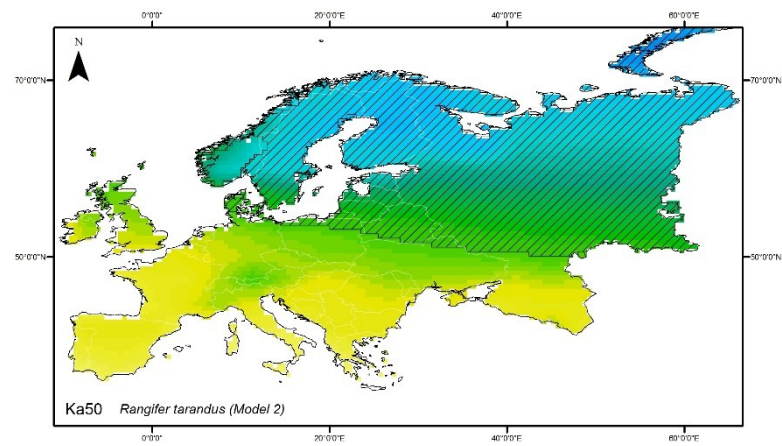
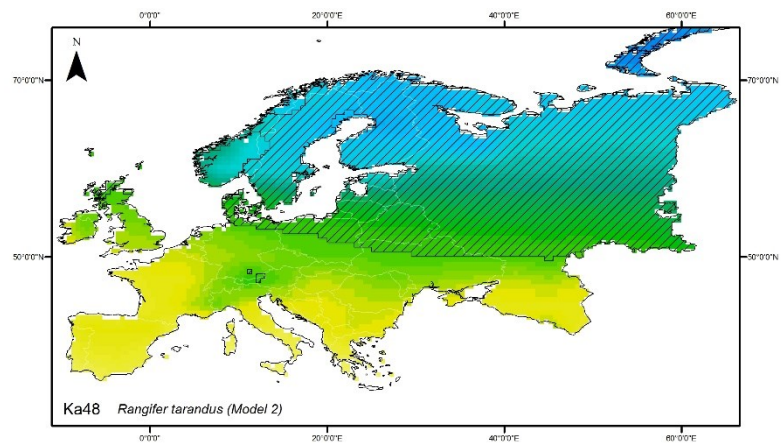
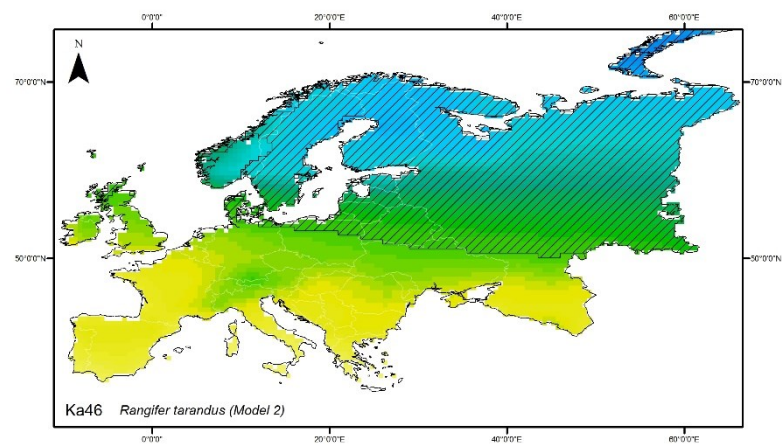
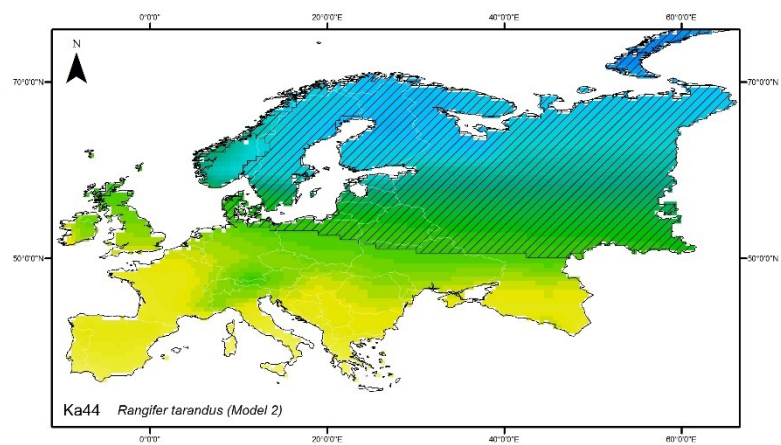


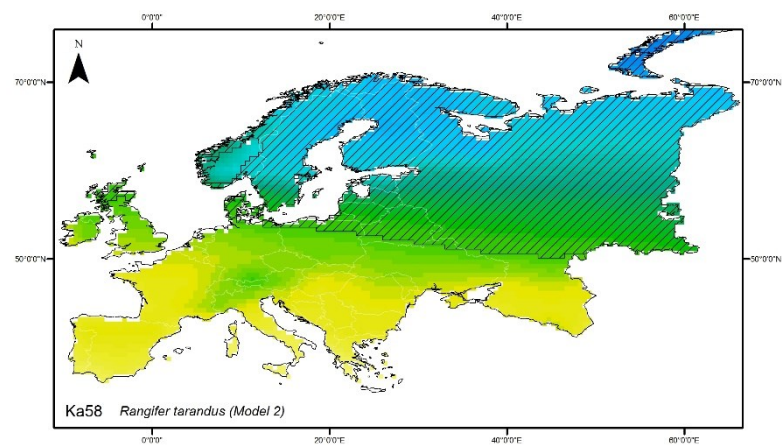
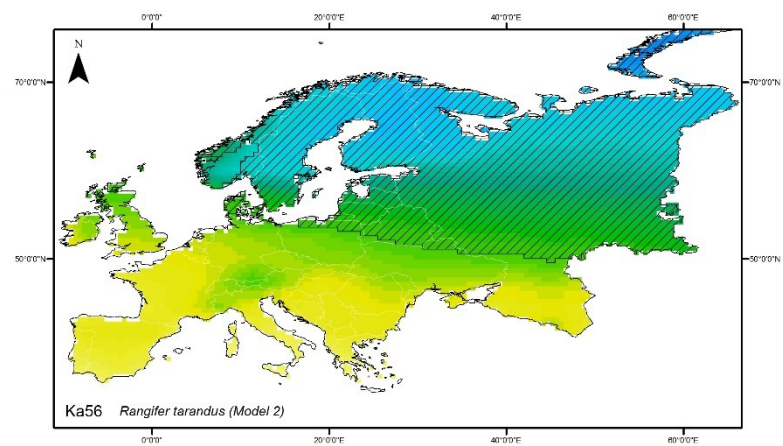
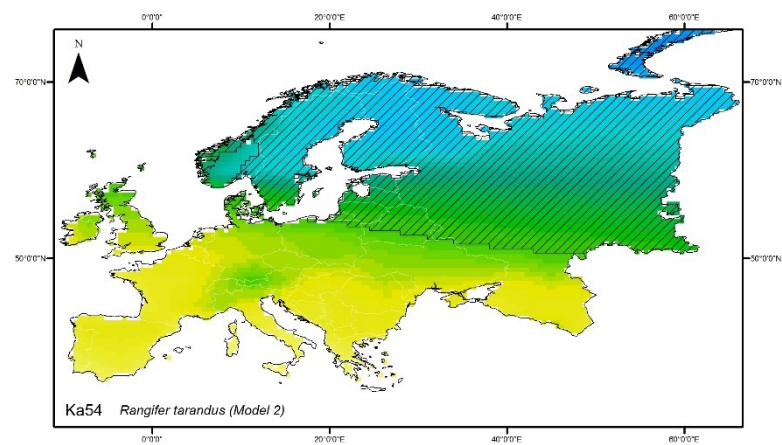
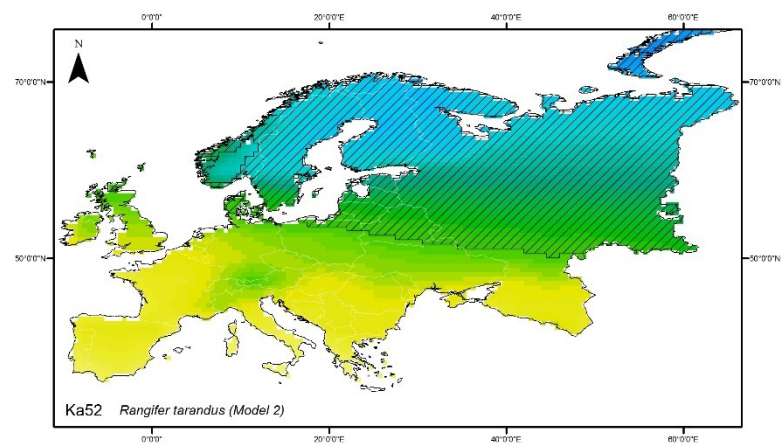


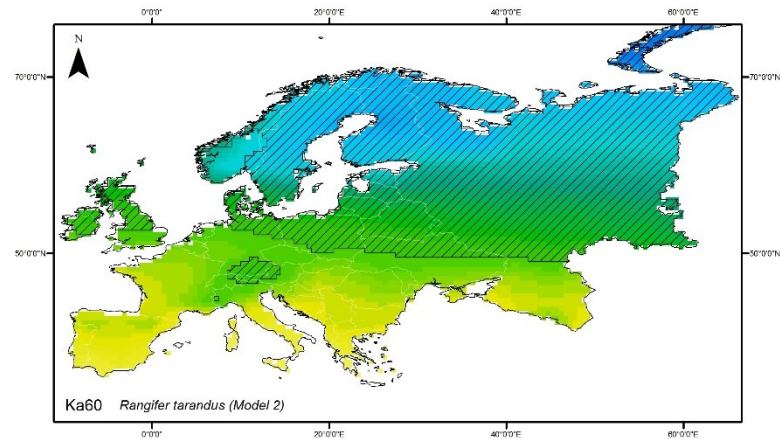




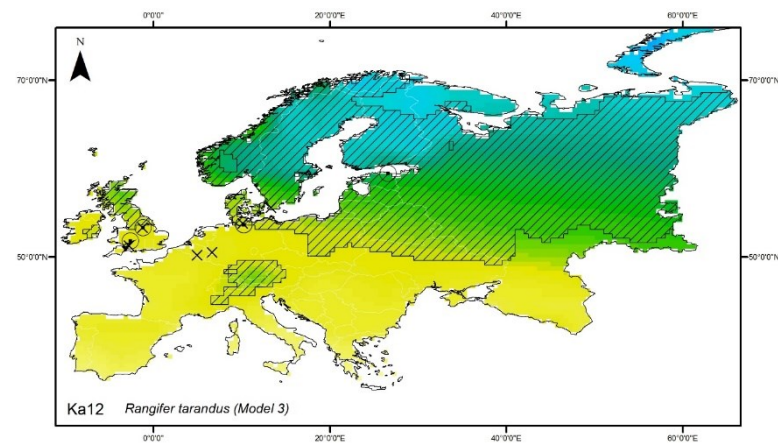
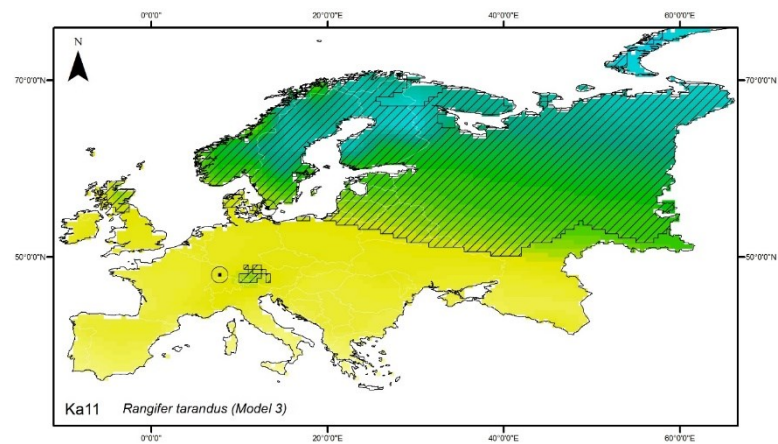
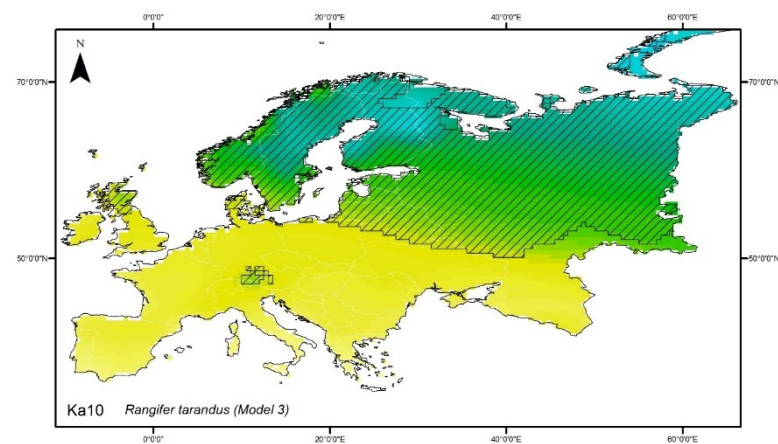
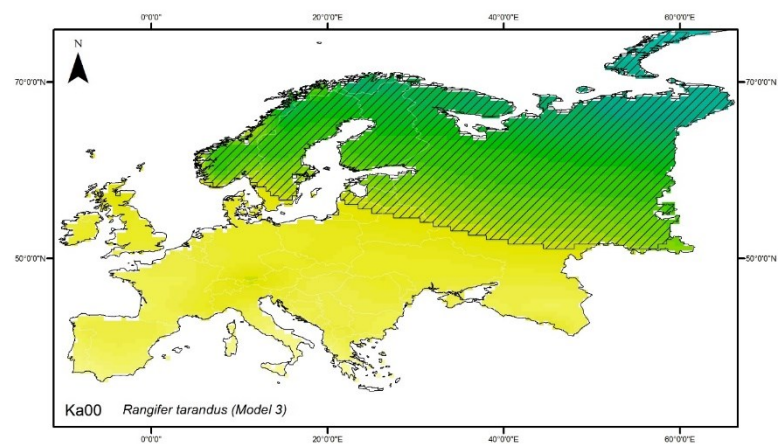


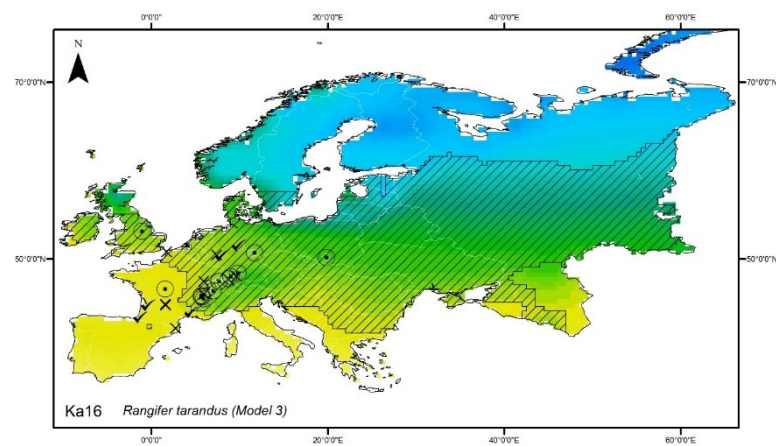
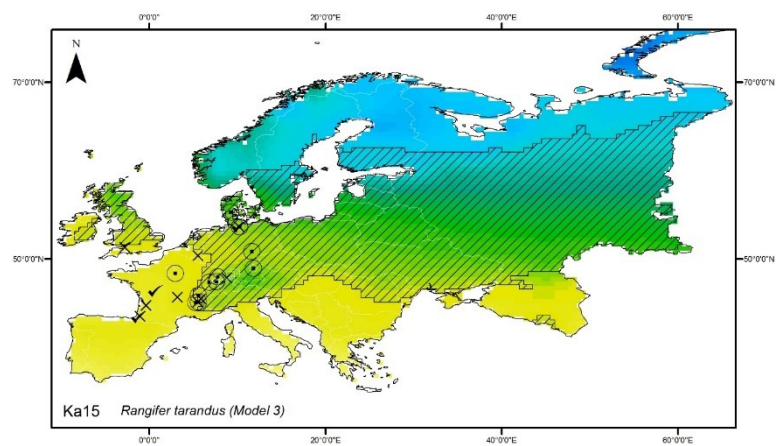
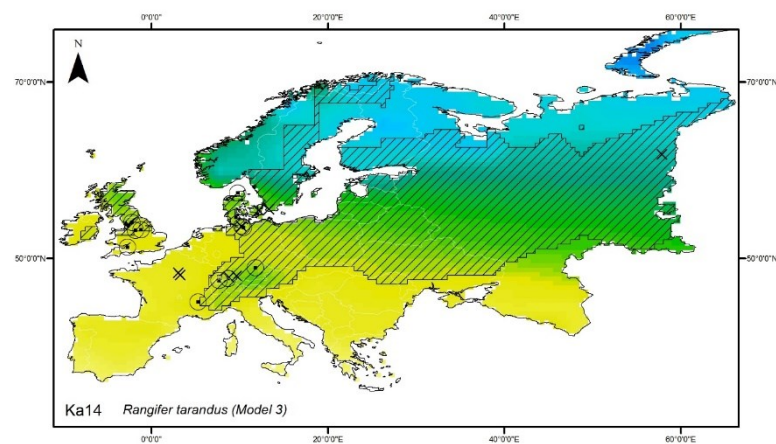
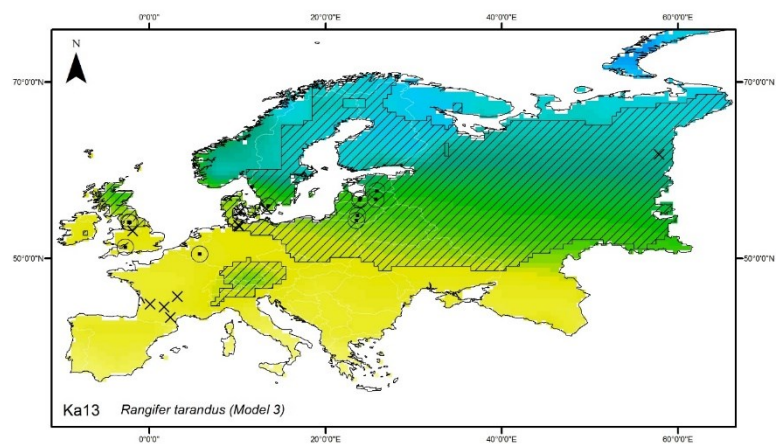


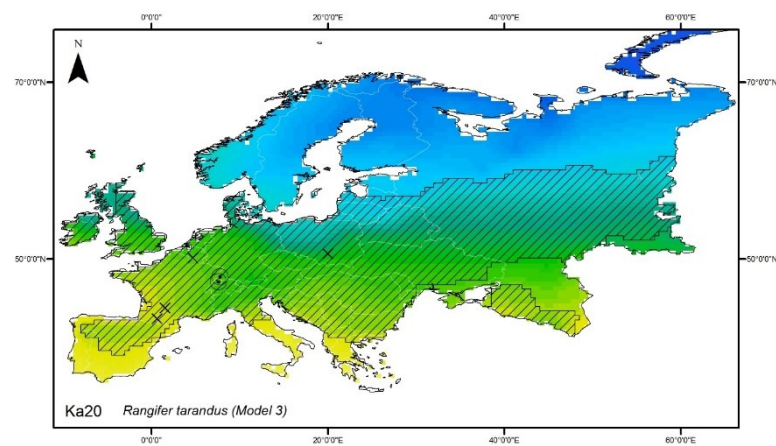
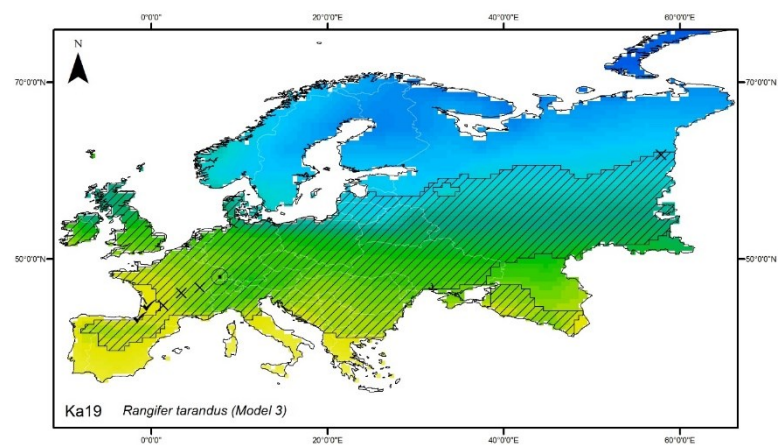
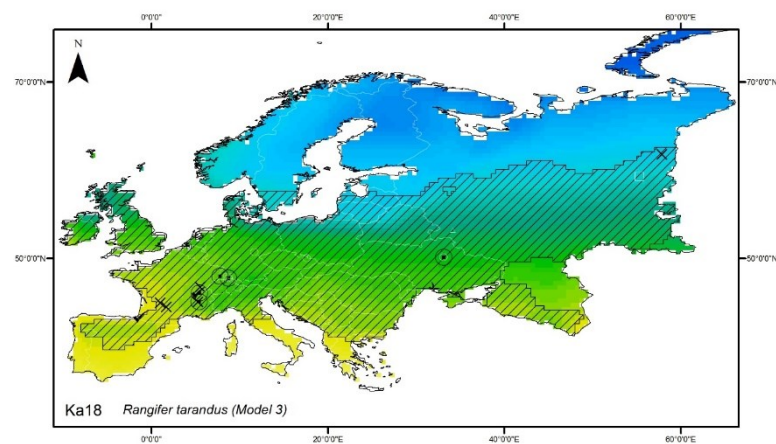
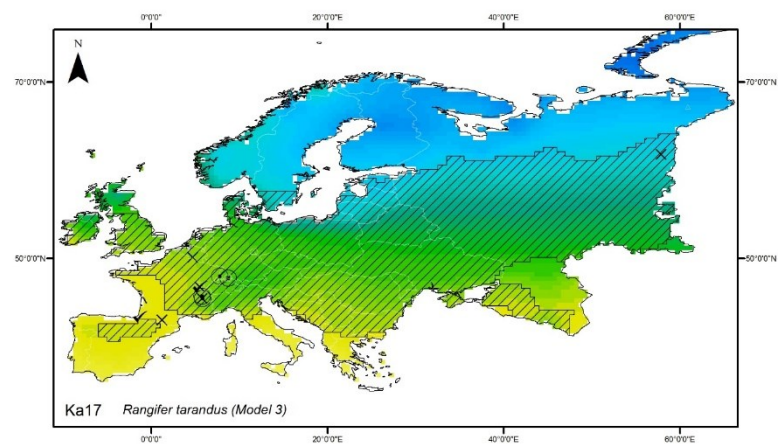


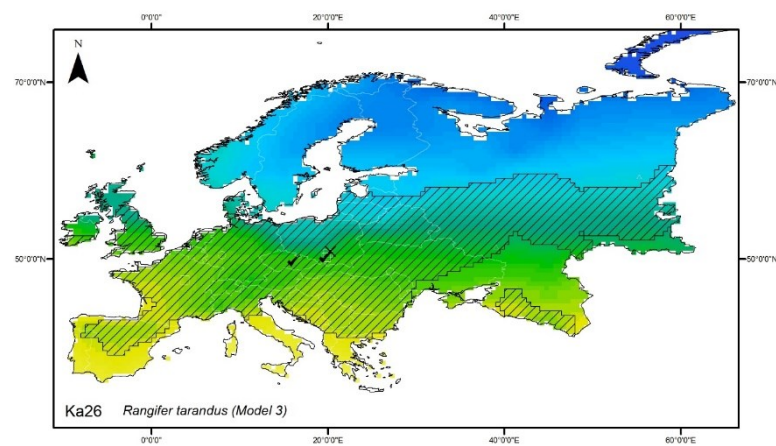
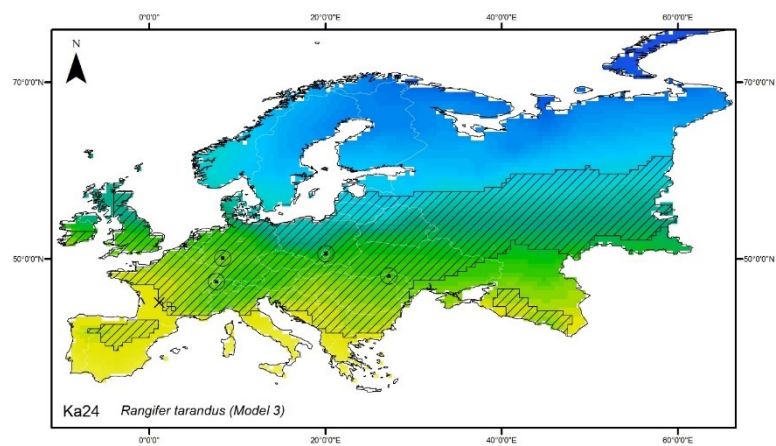
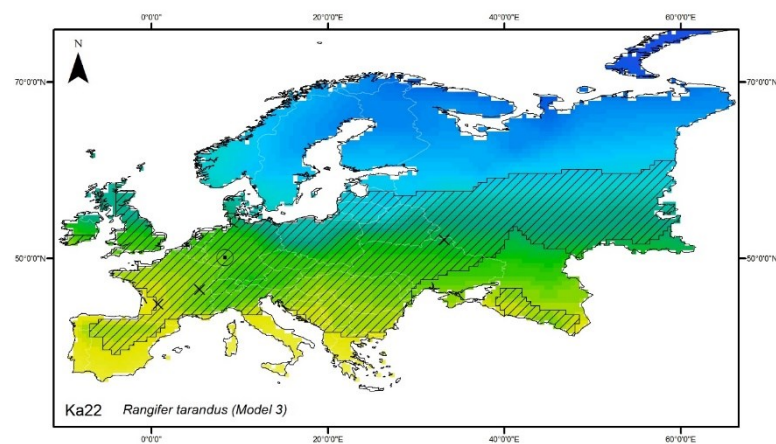
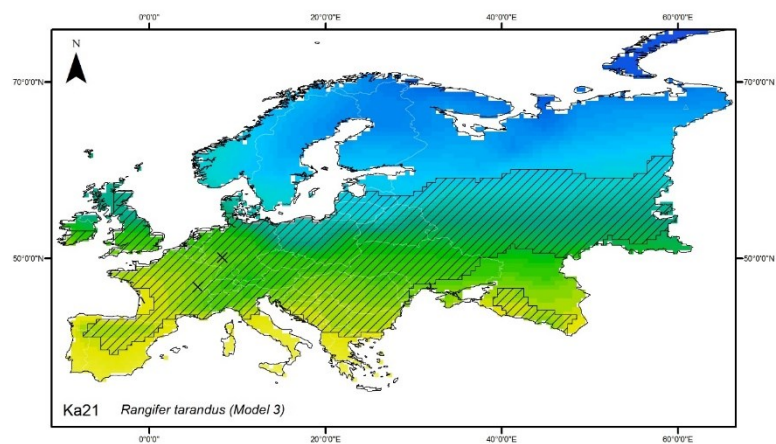


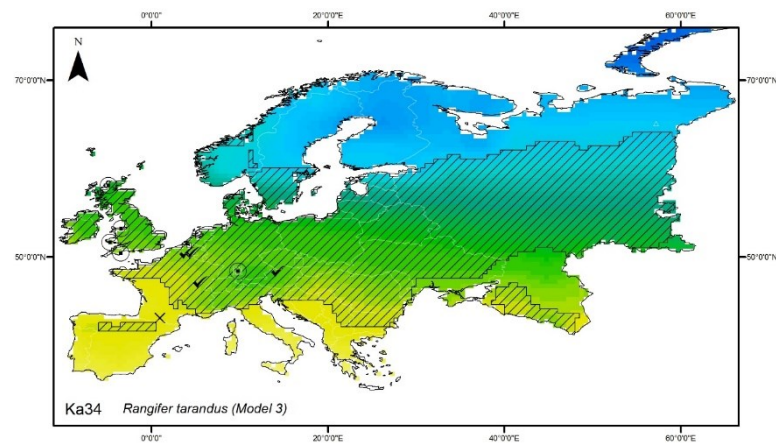
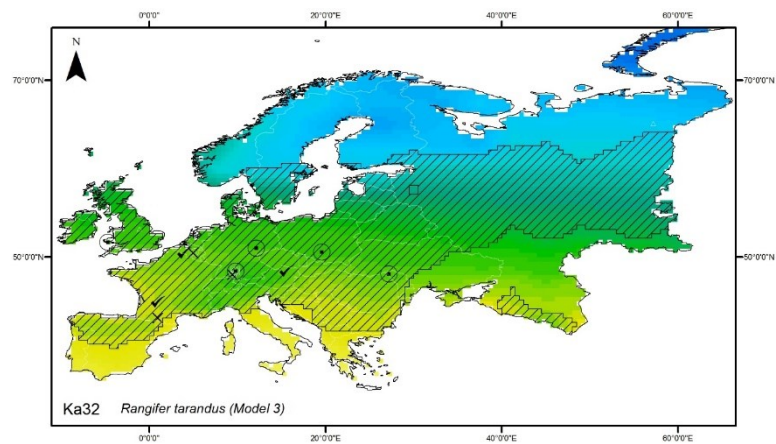
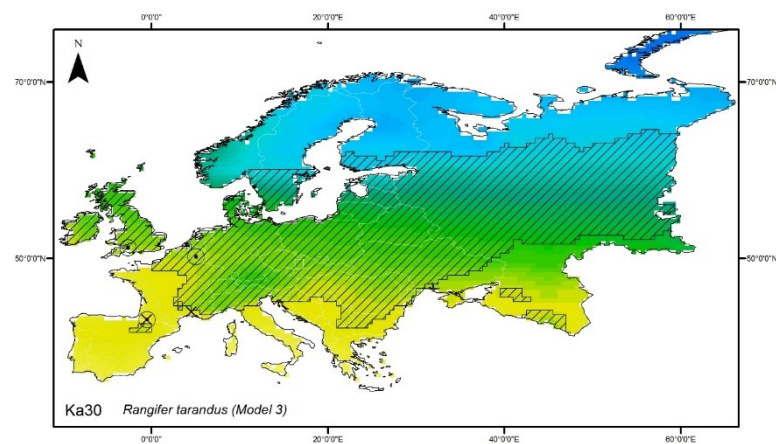
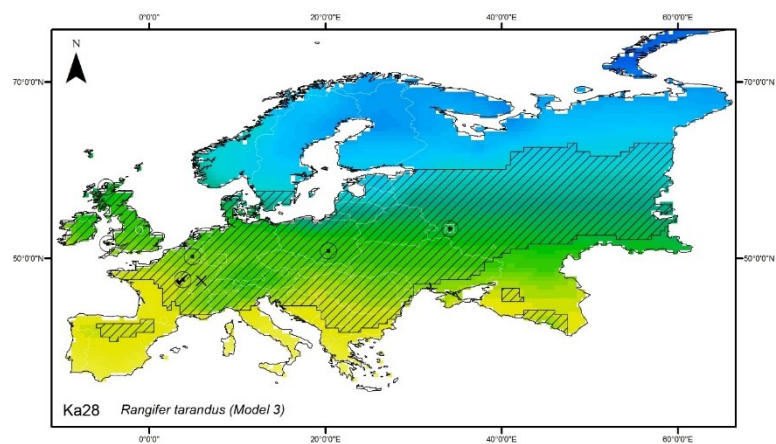
Appendix: *Rangifer tarandus* (Model 3)

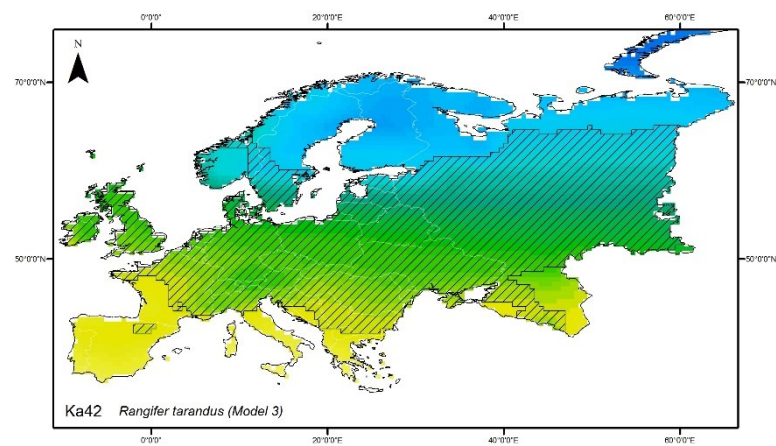
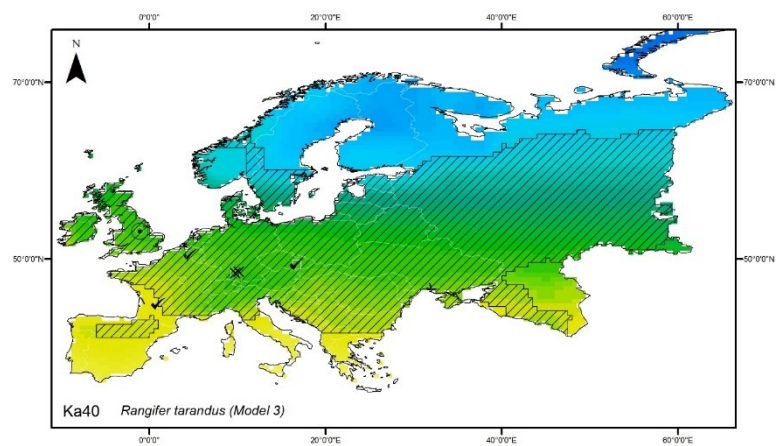
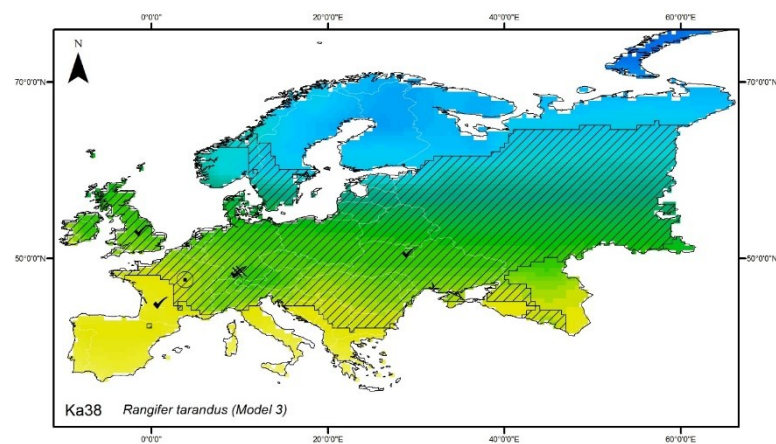
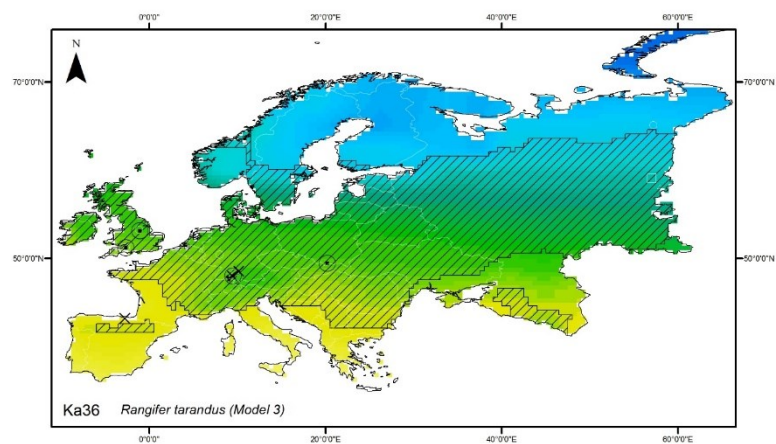


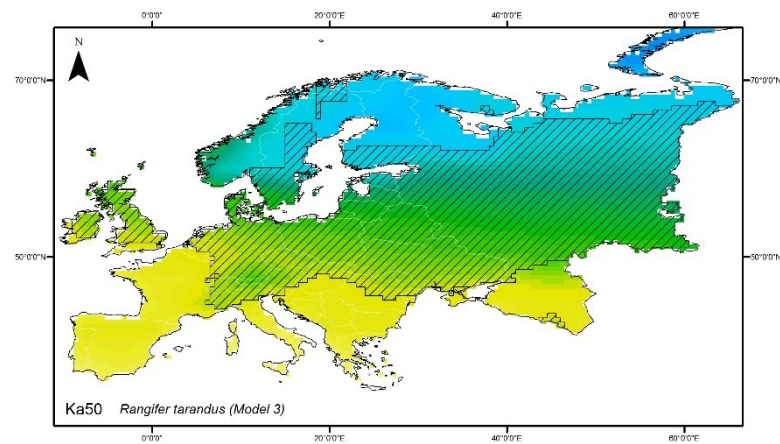
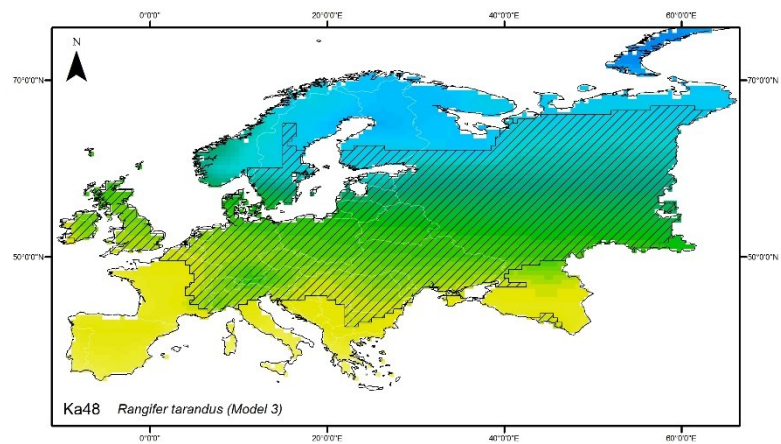
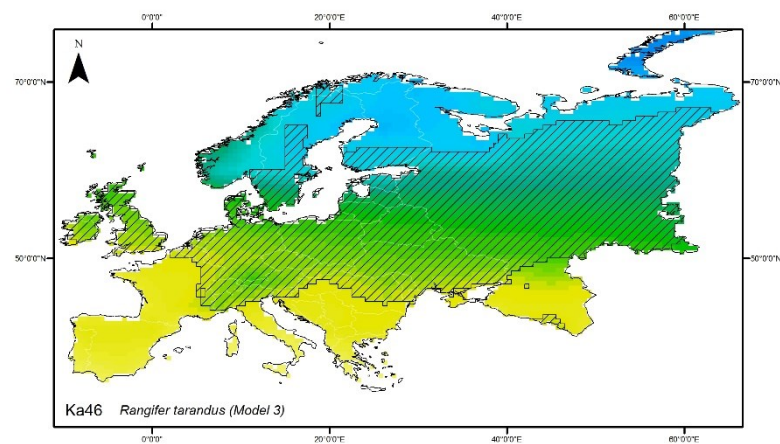
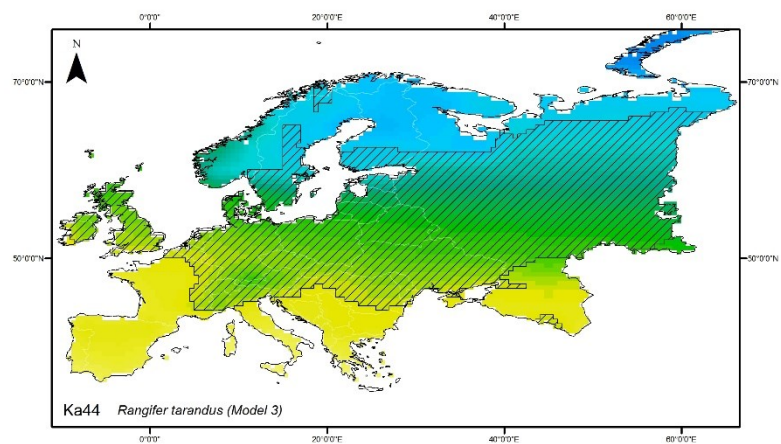


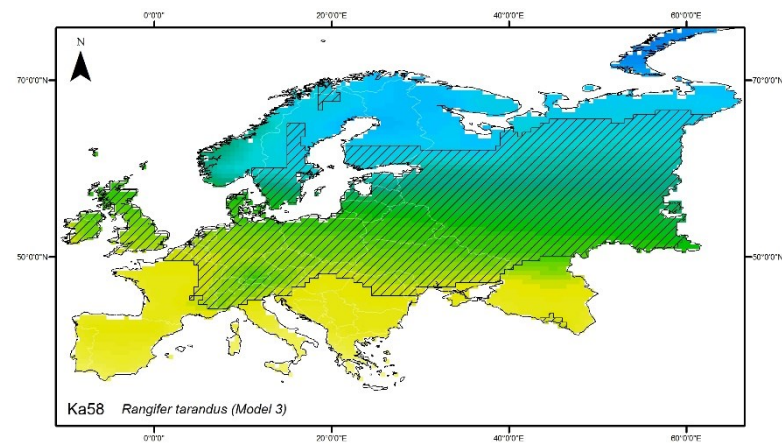
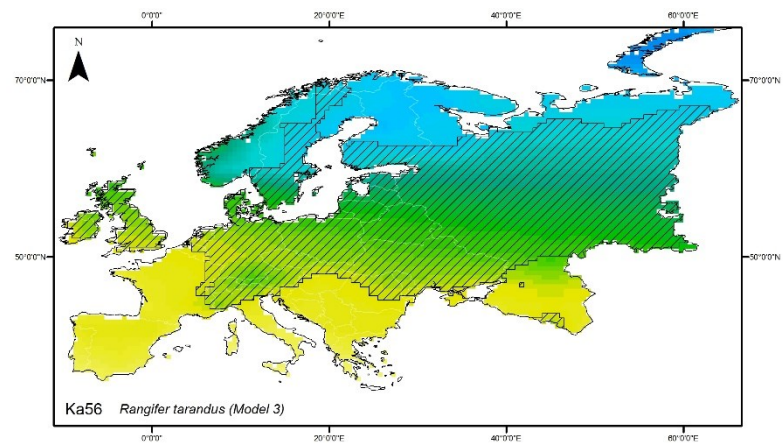
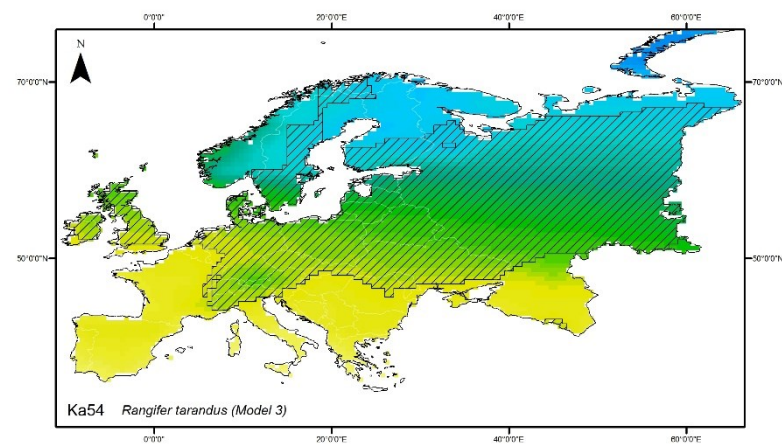
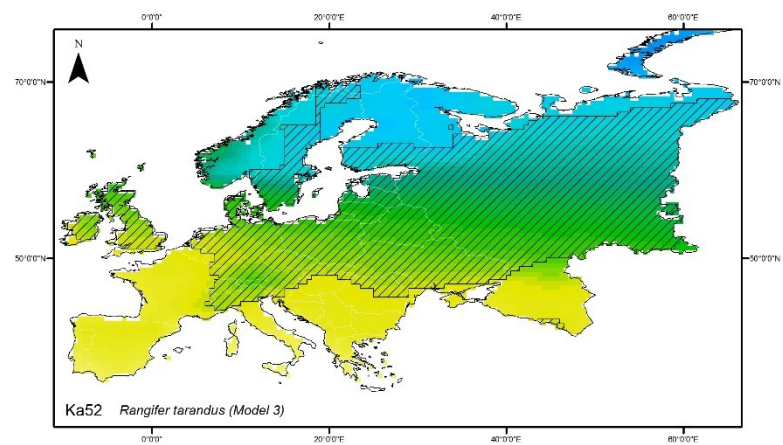


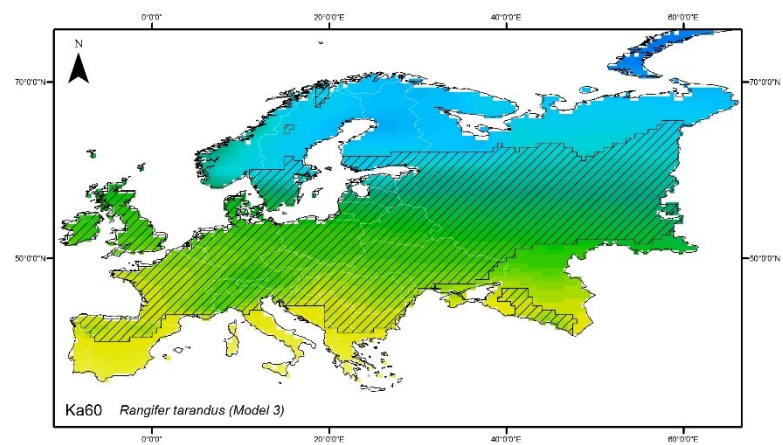




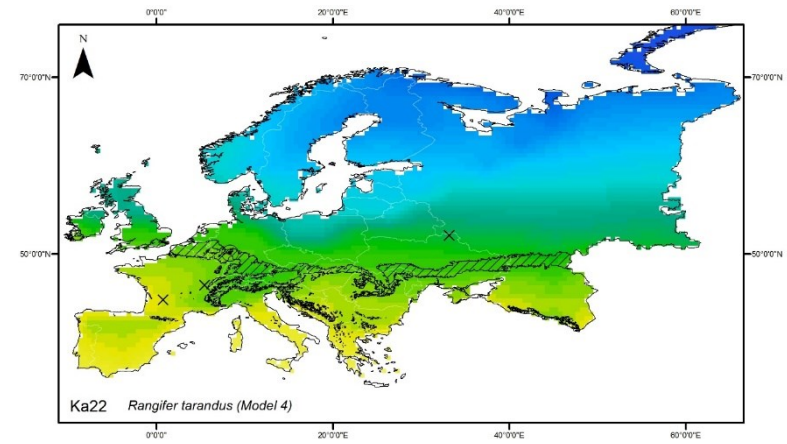
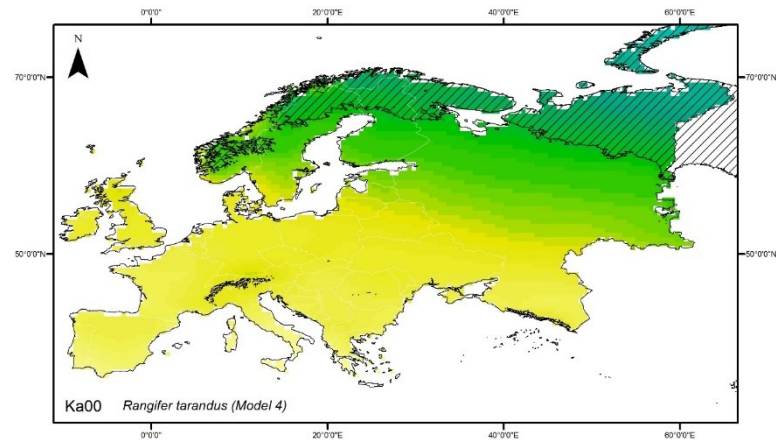




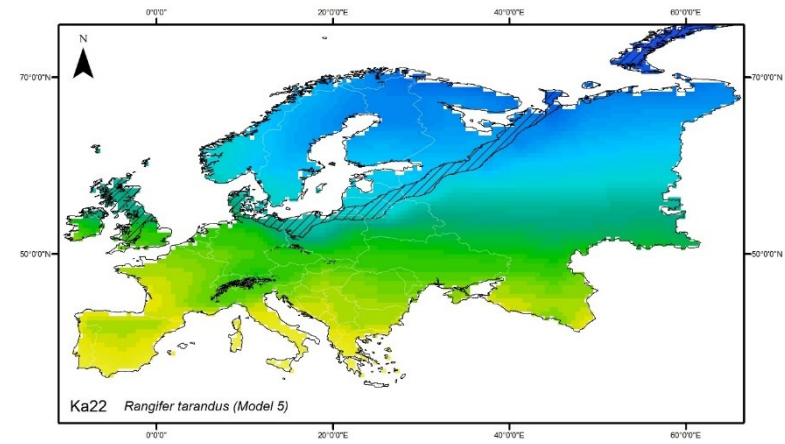
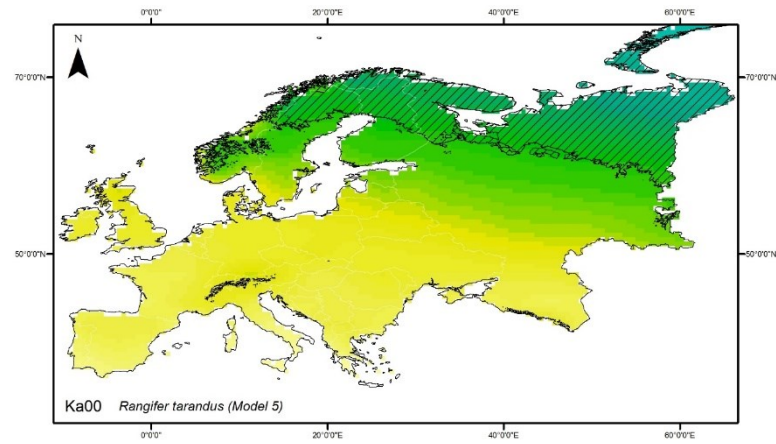




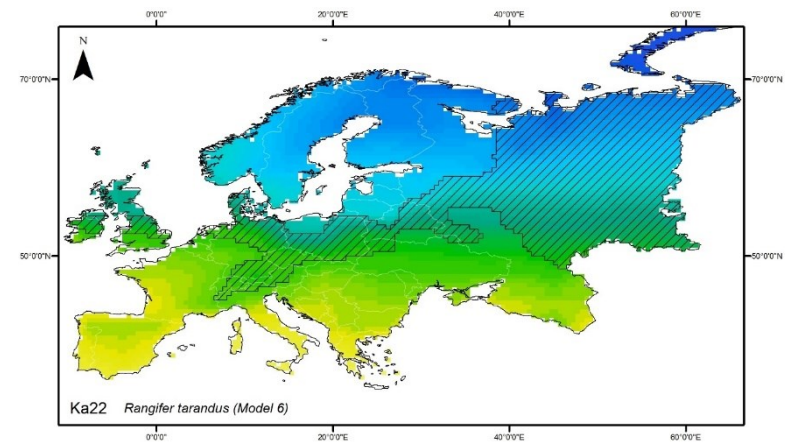
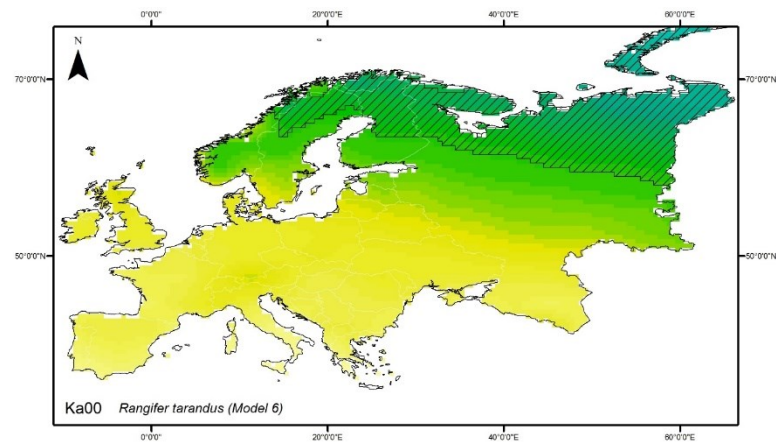
3.14 Rangifer tarandus (Model 4)

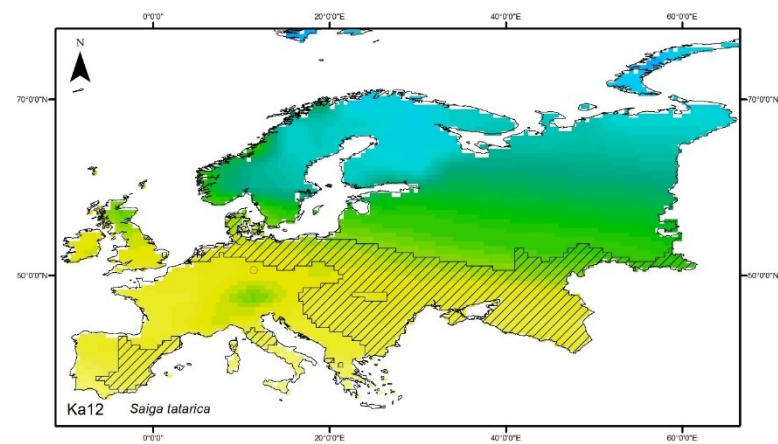
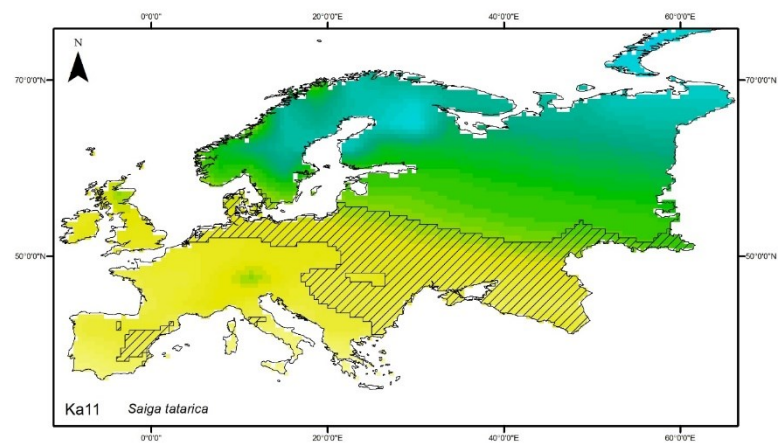
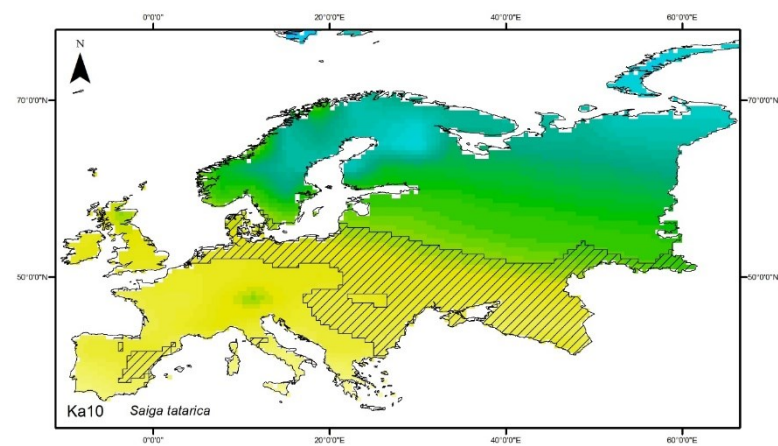
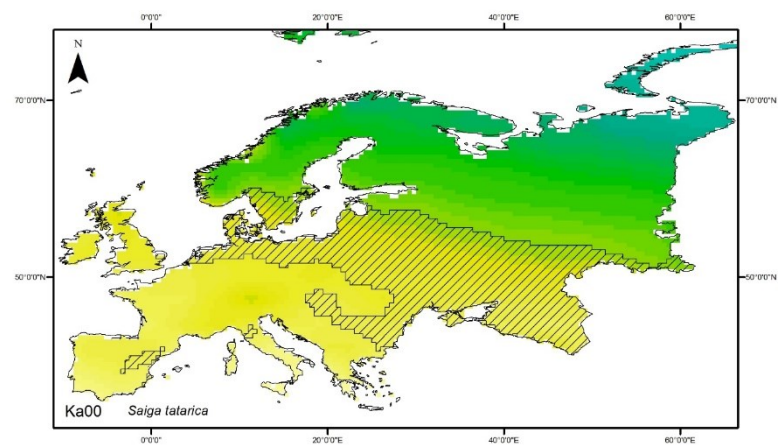


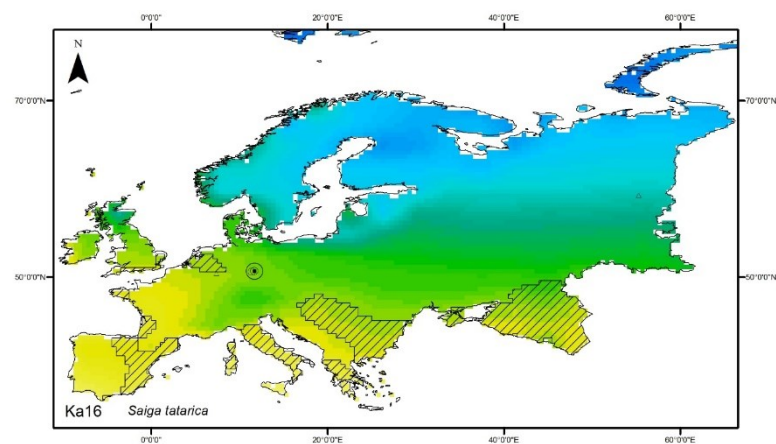
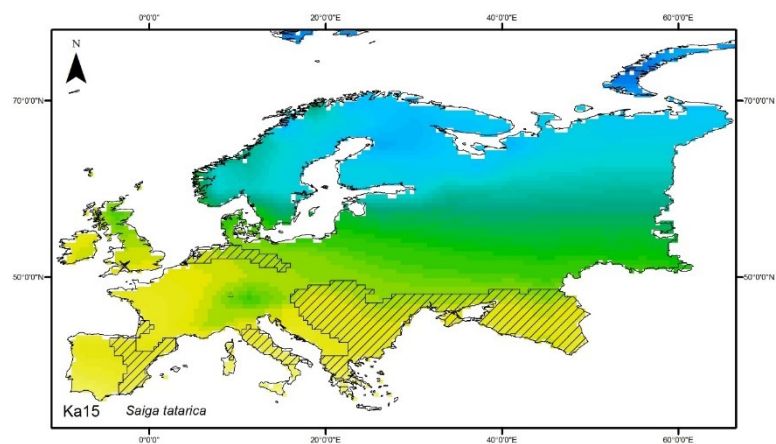
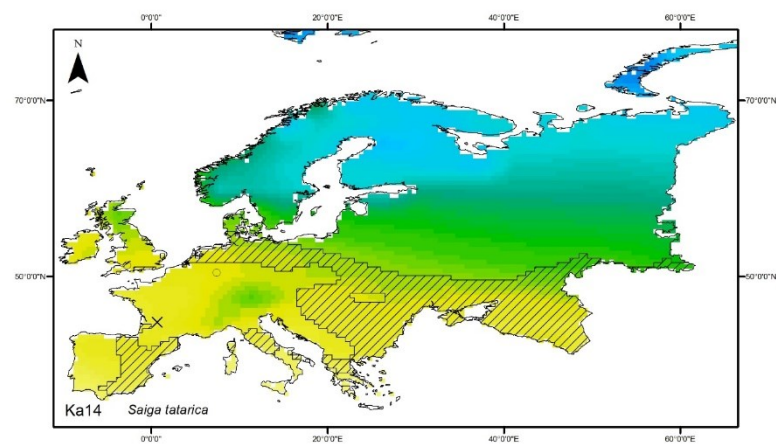
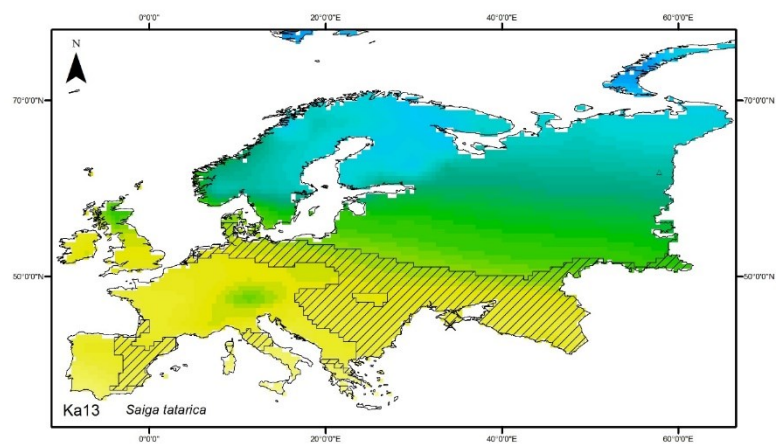
3.15 Rangifer tarandus (Model 5)

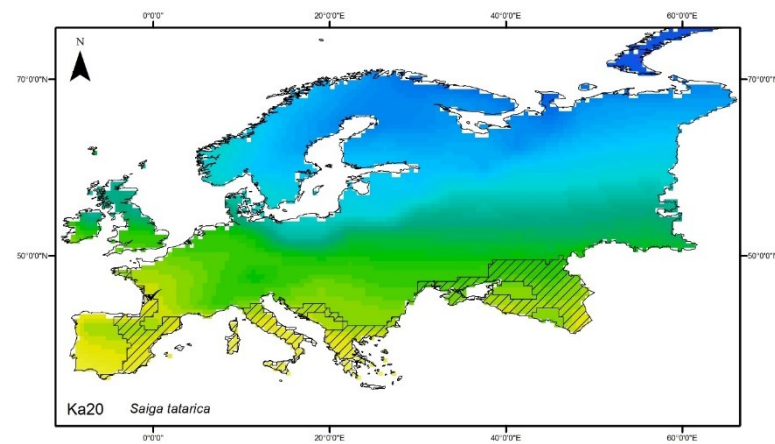
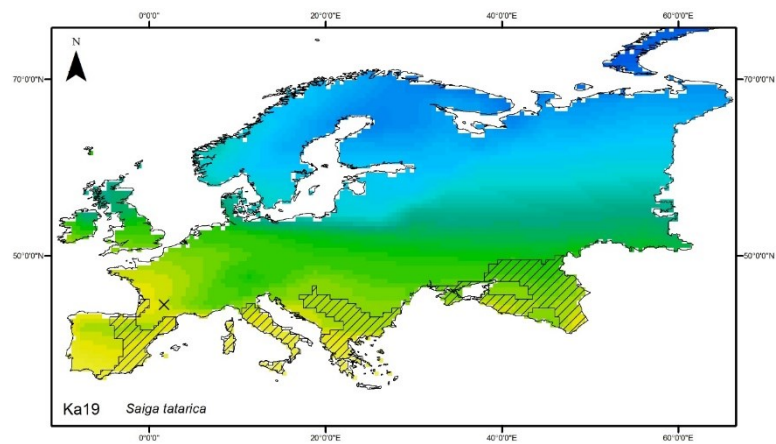
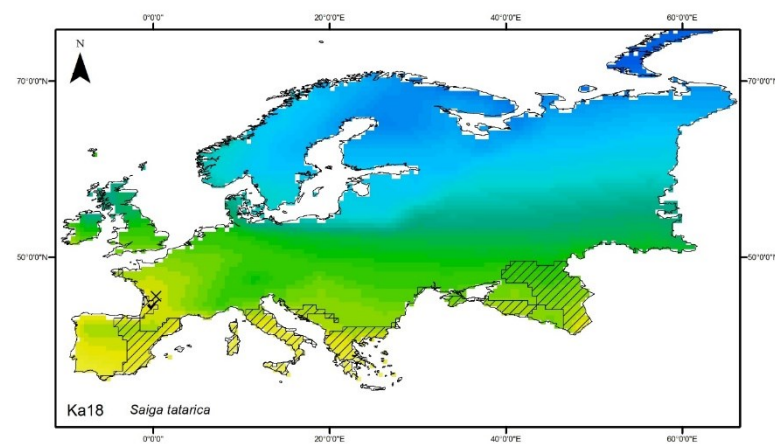
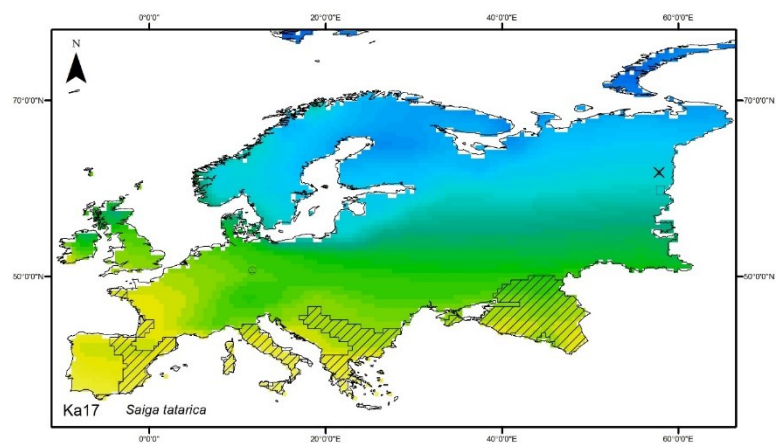


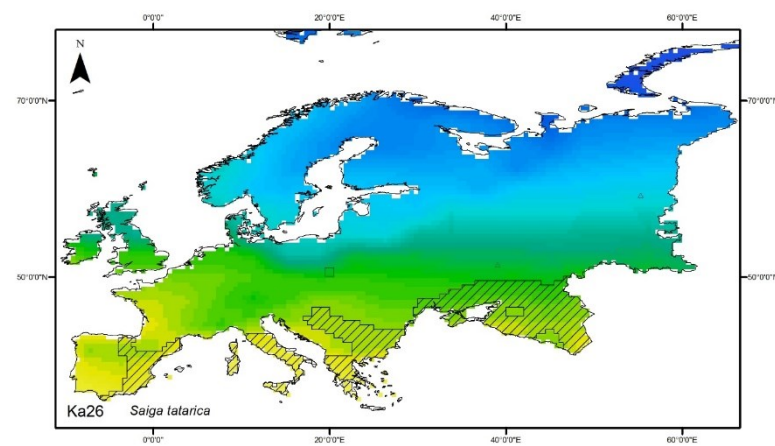
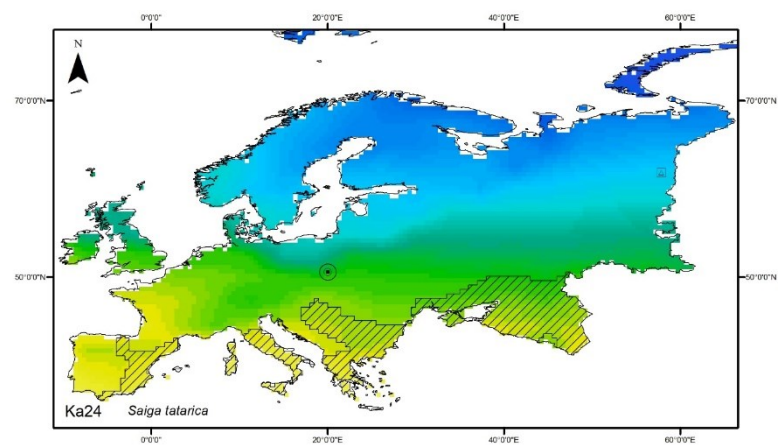
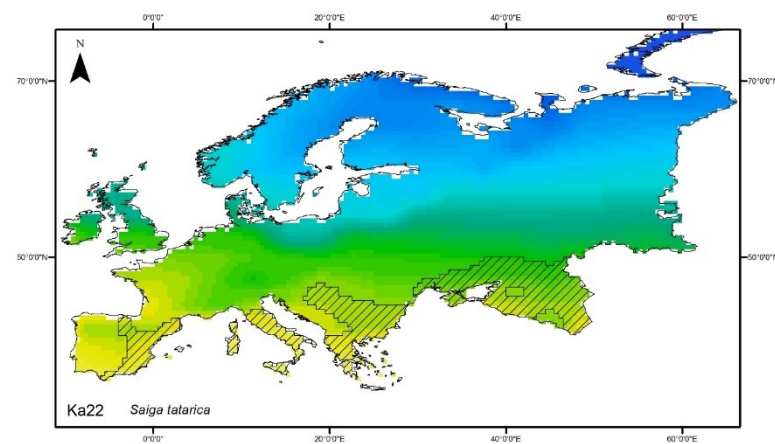
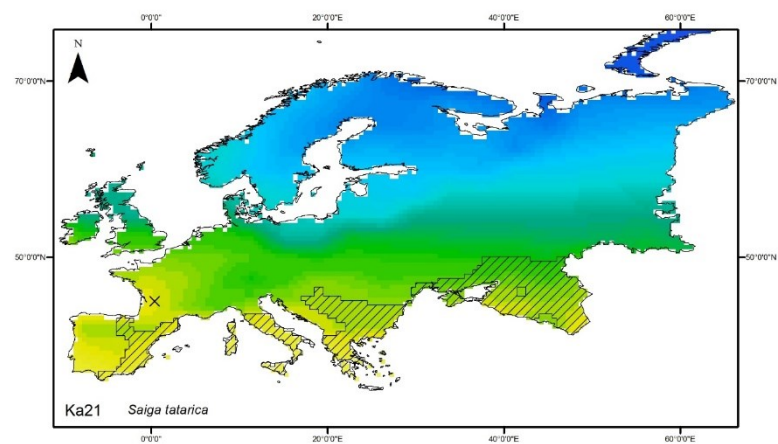
3.16 Rangifer tarandus (Model 6)

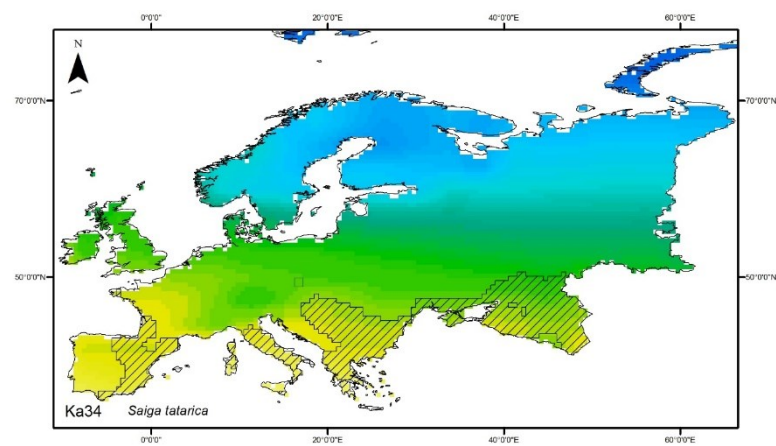
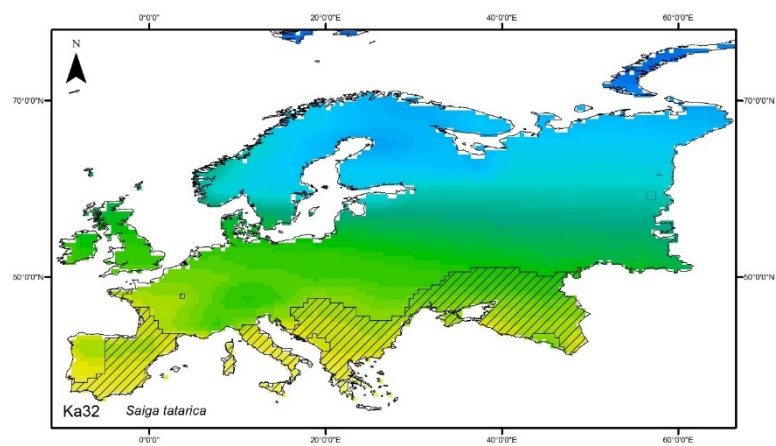
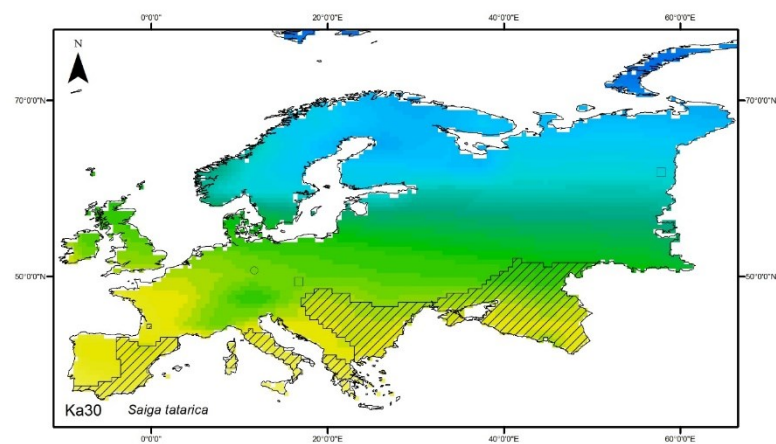
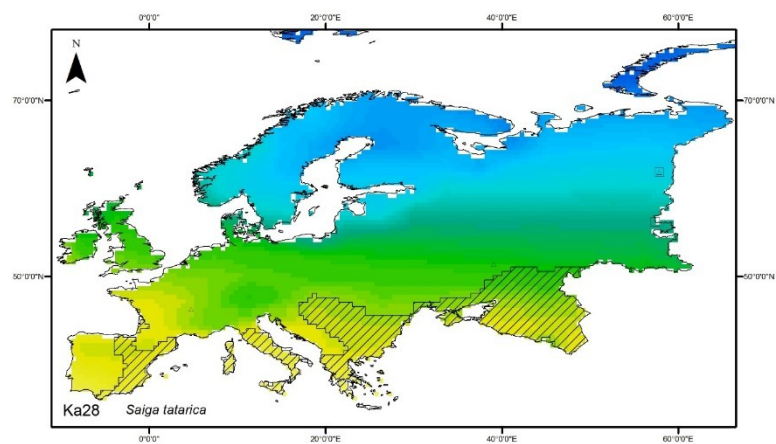


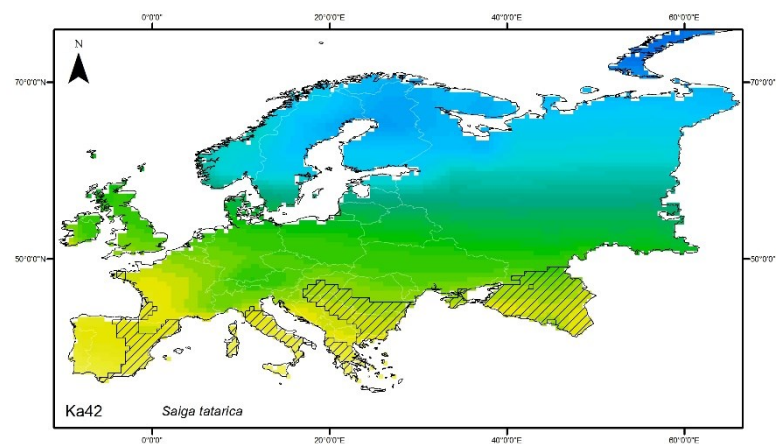
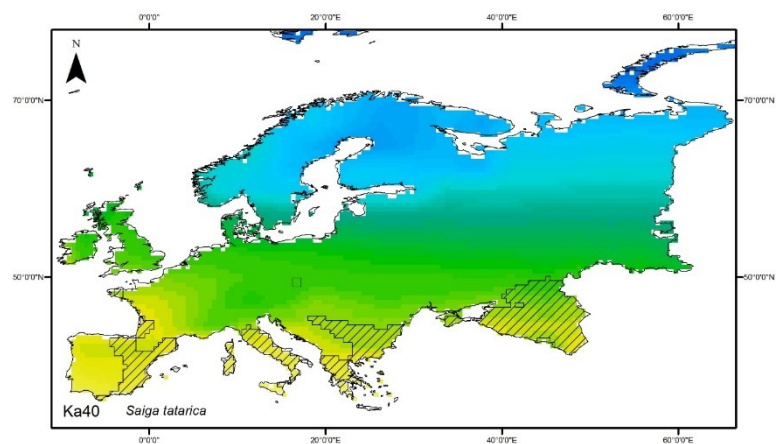
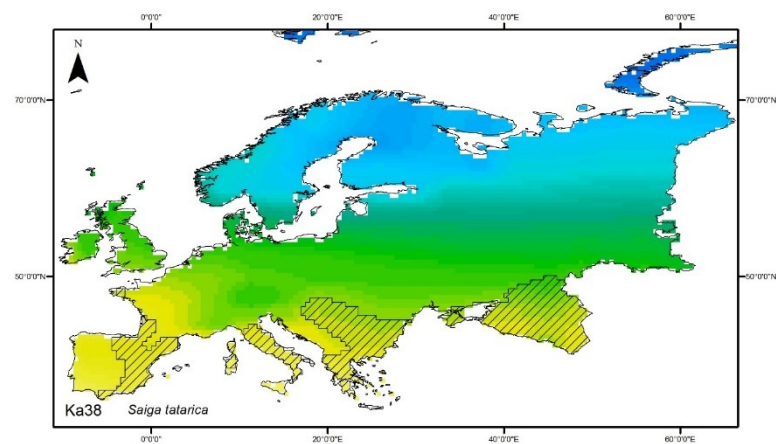
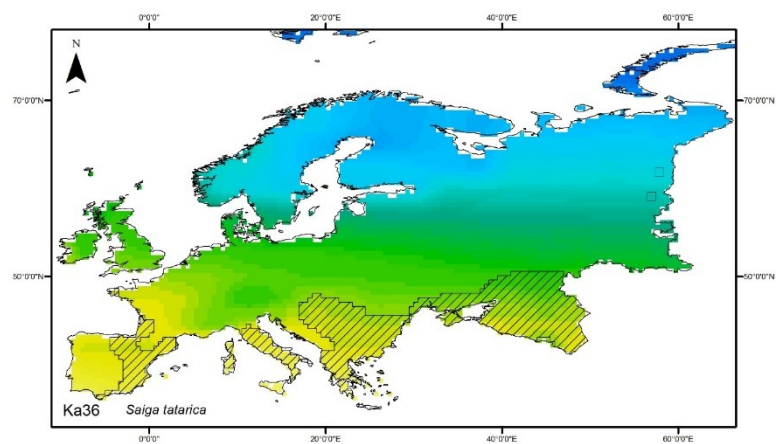
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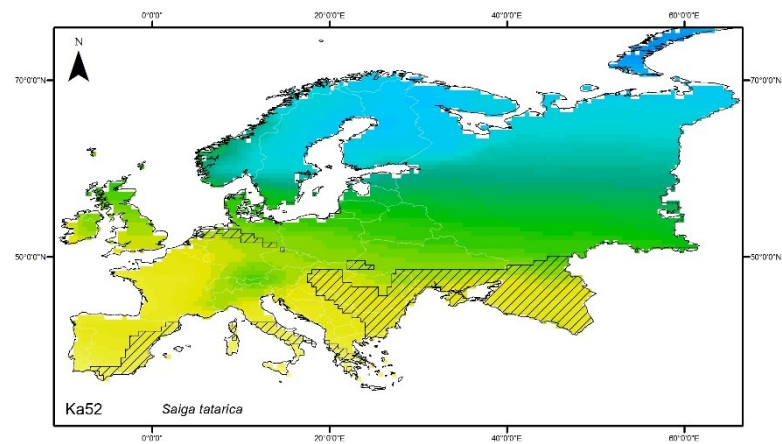
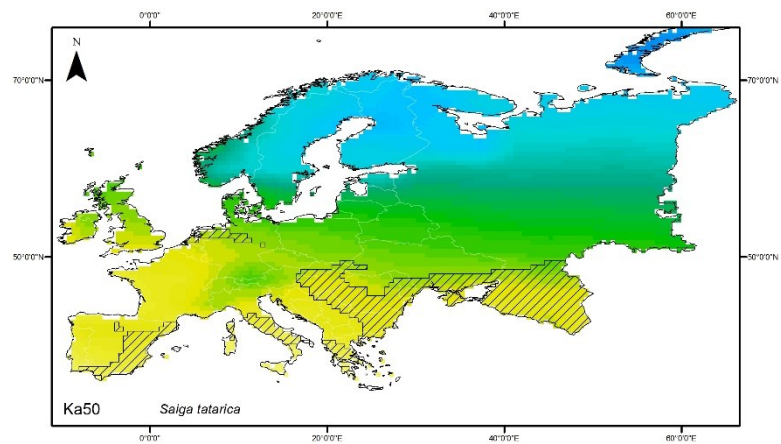
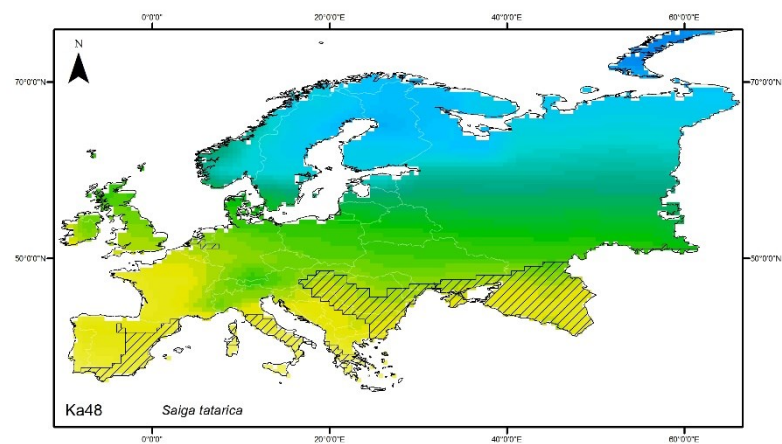
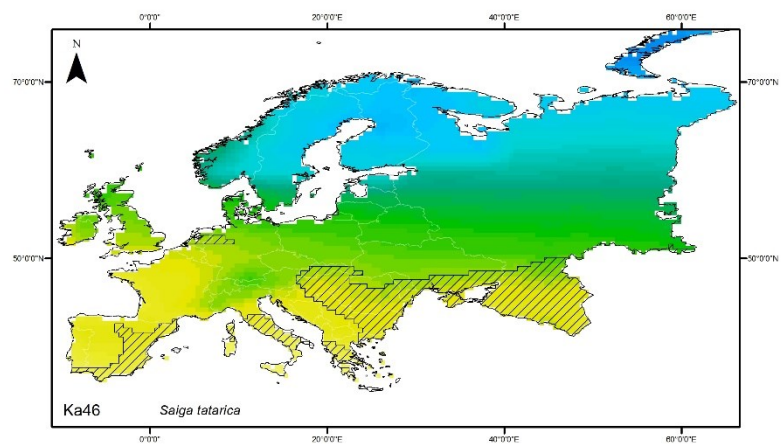


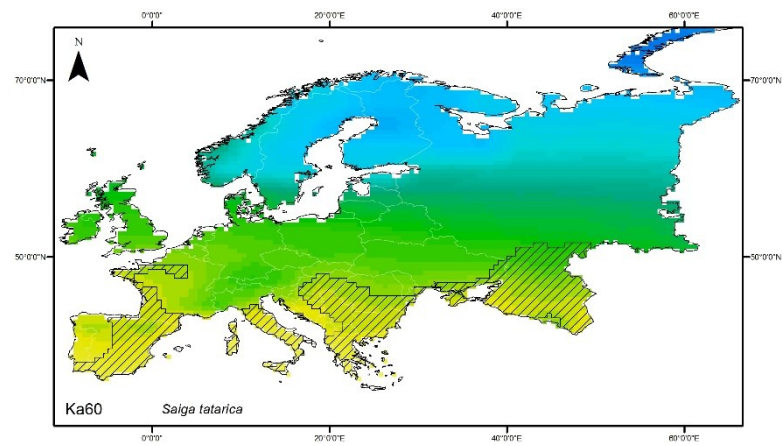
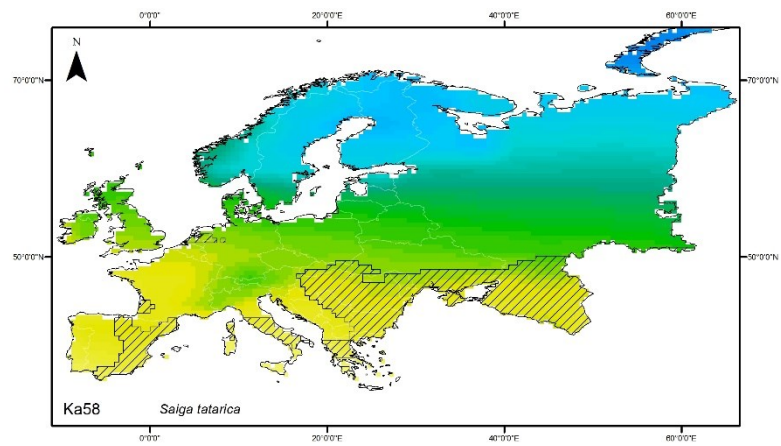
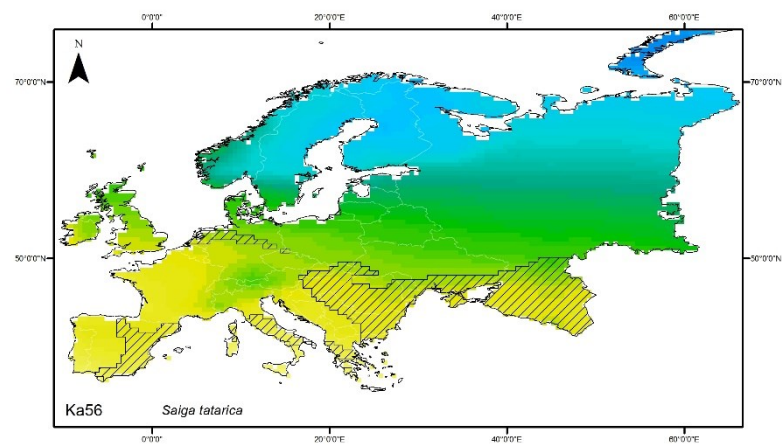
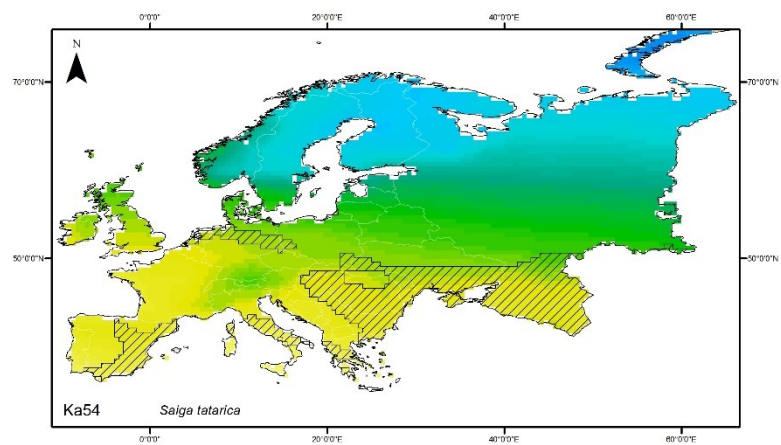


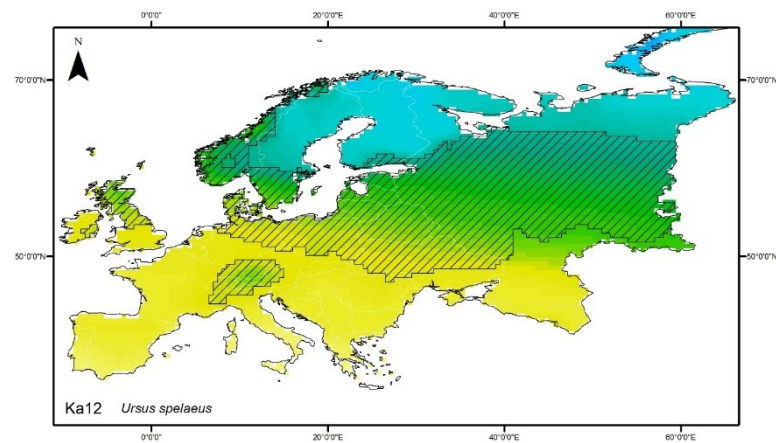
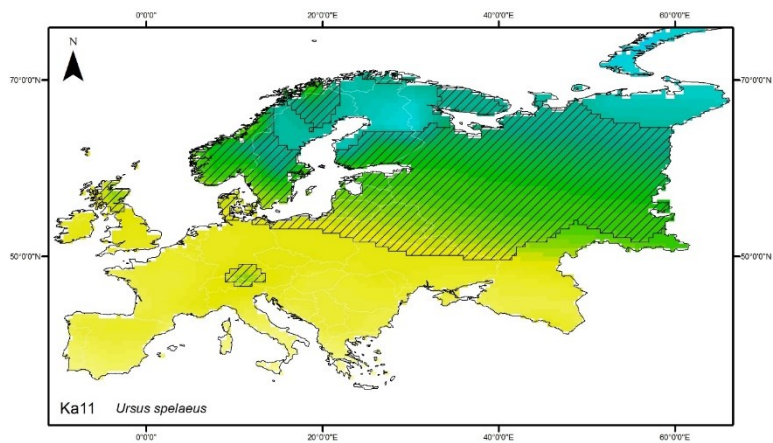
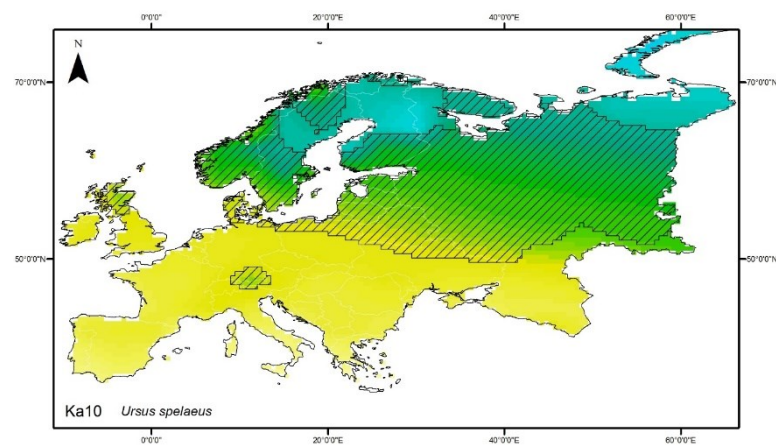
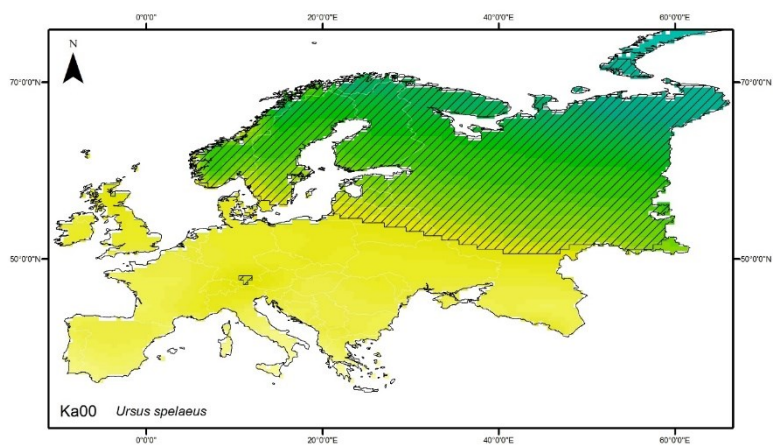


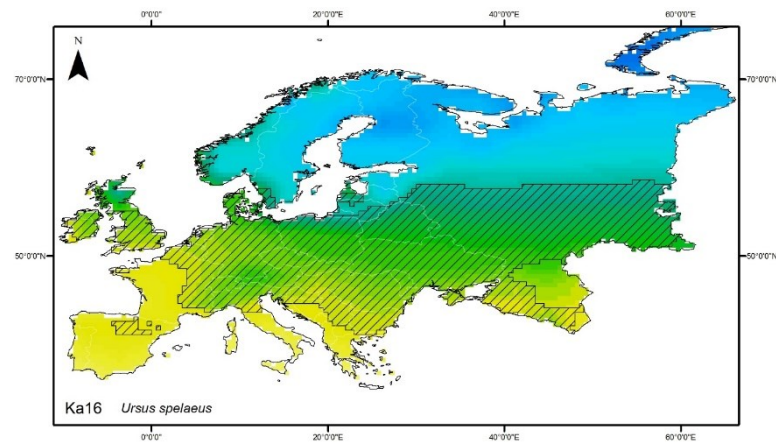
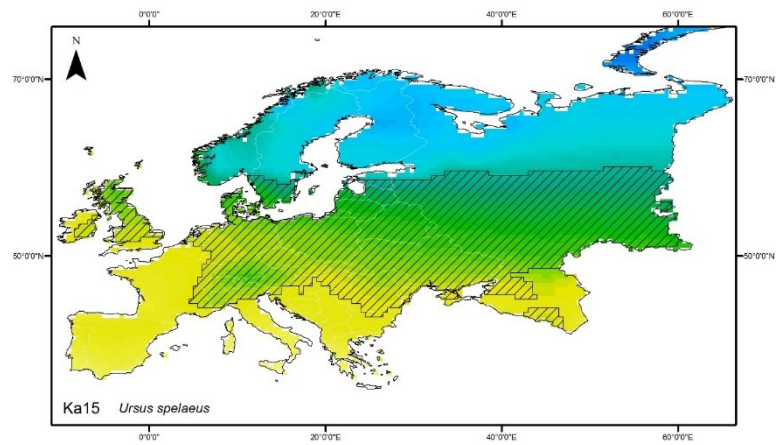
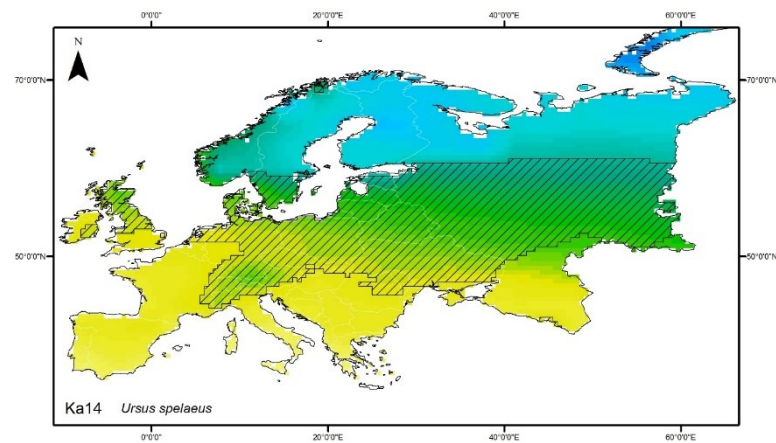
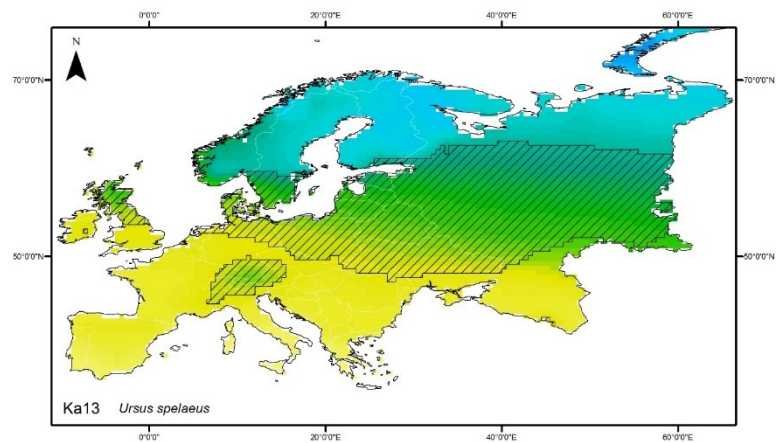


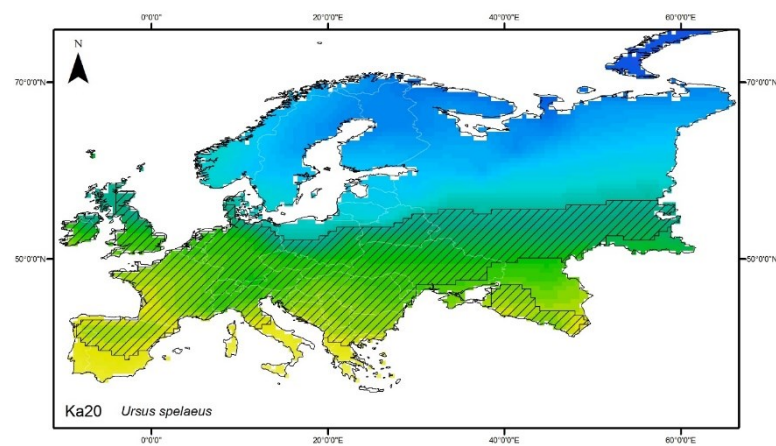
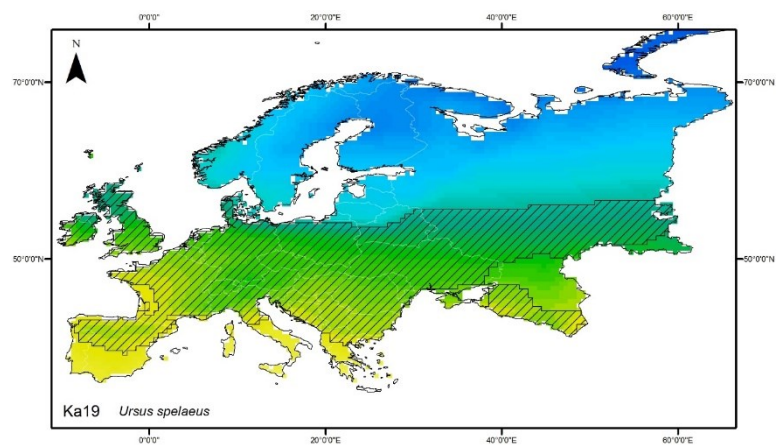
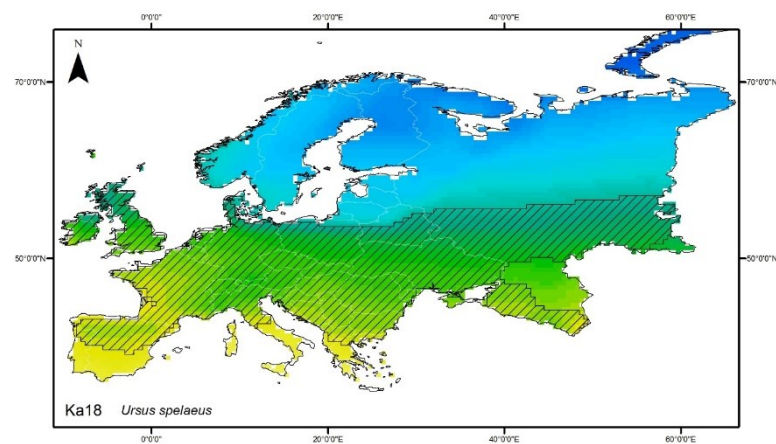
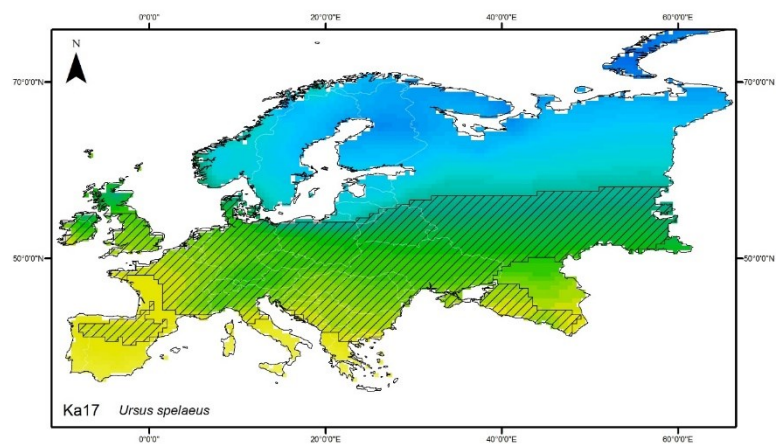


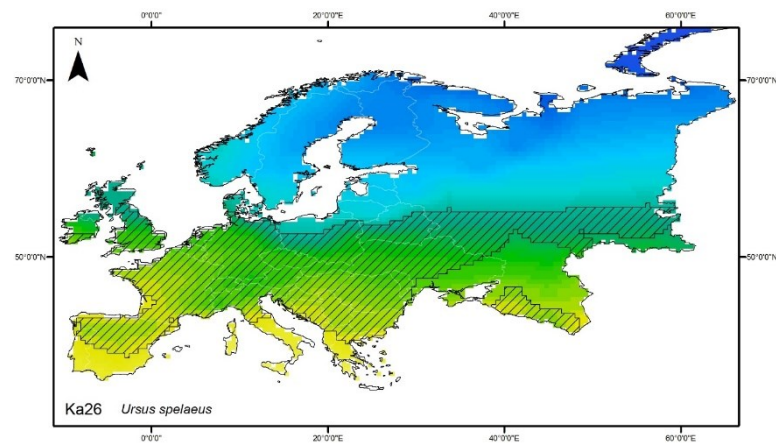
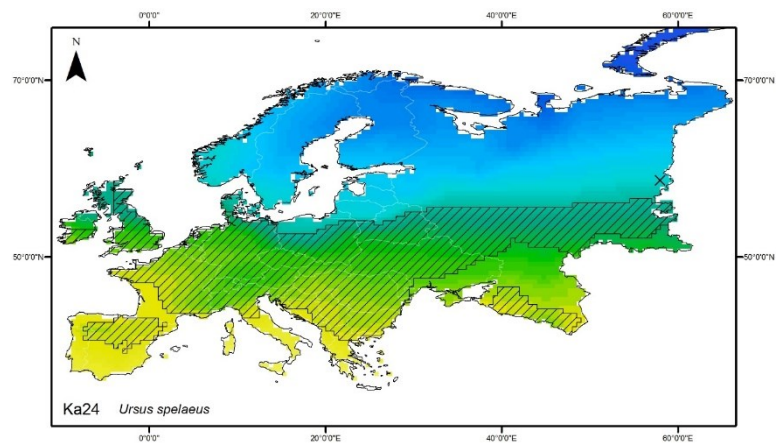
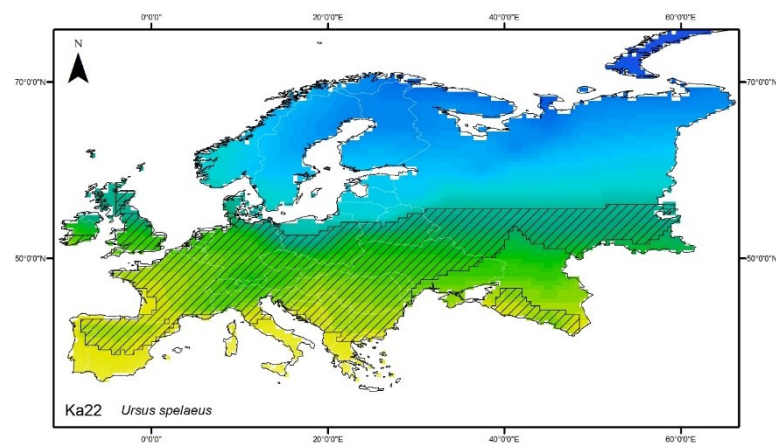
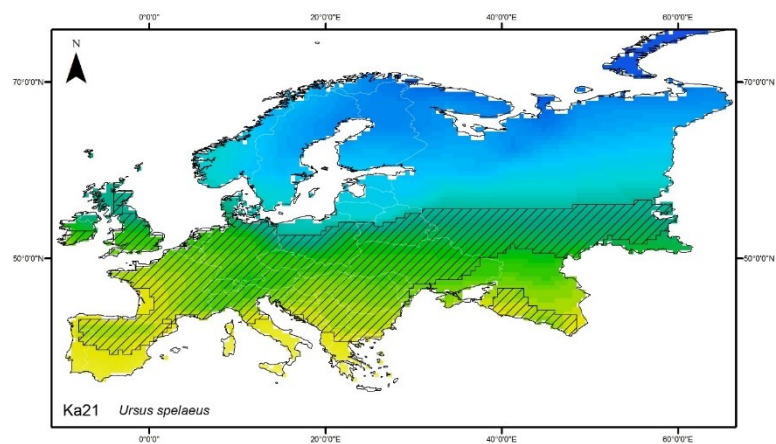


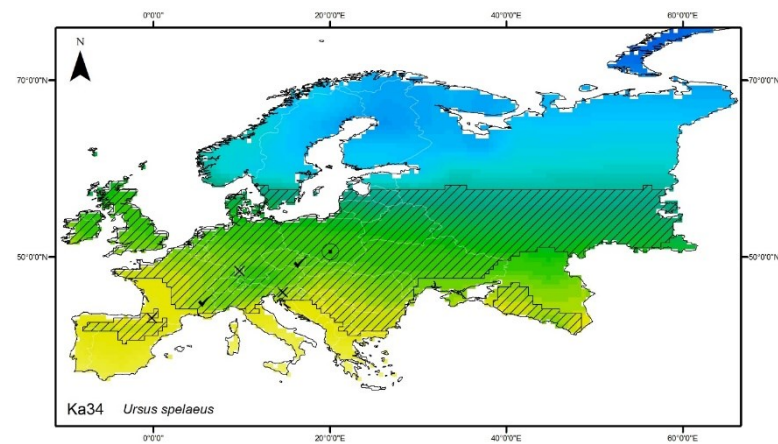
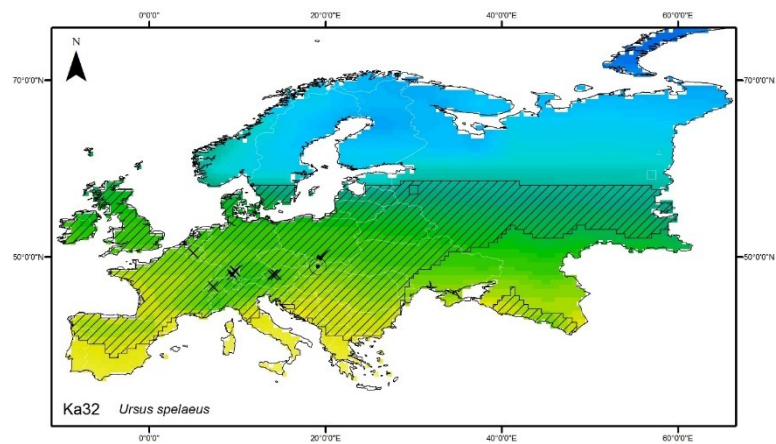
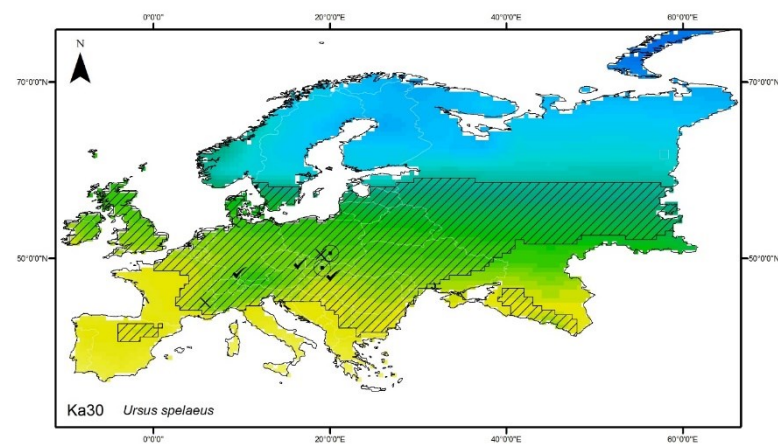
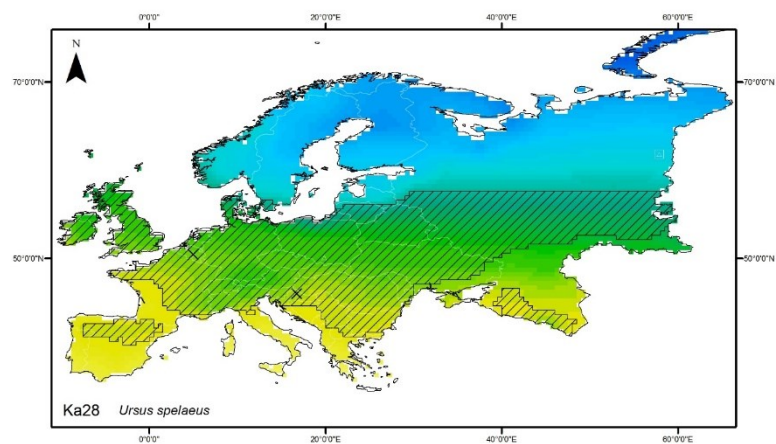


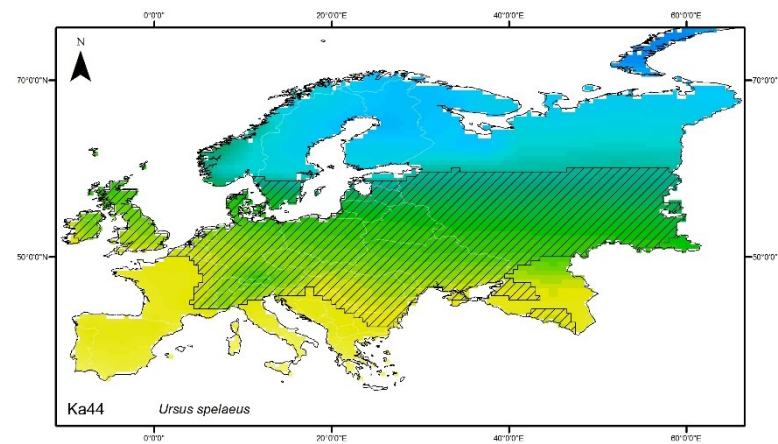
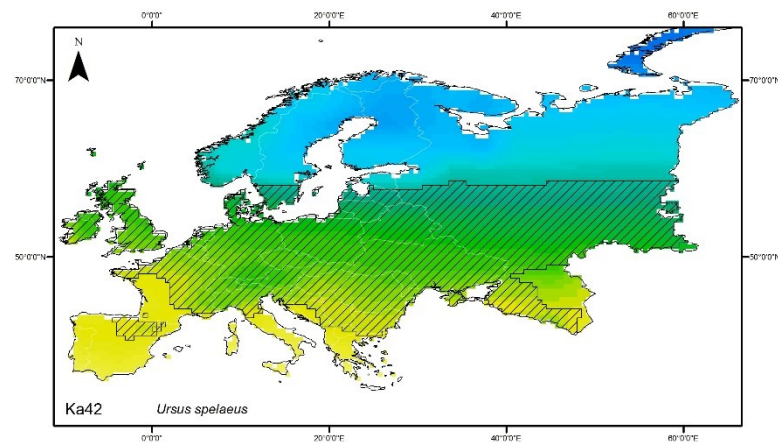
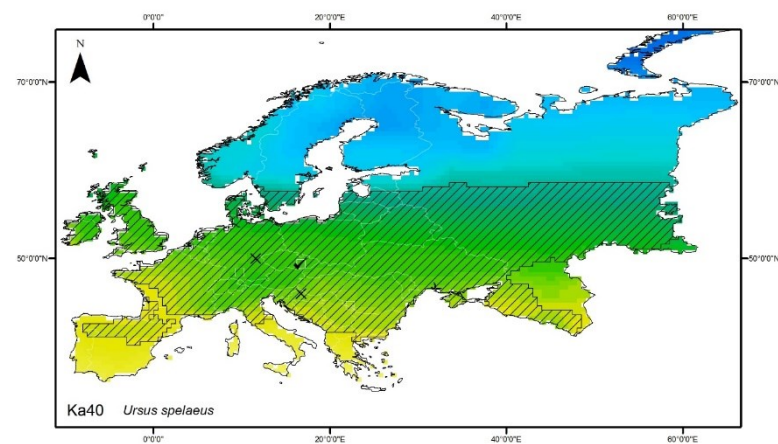
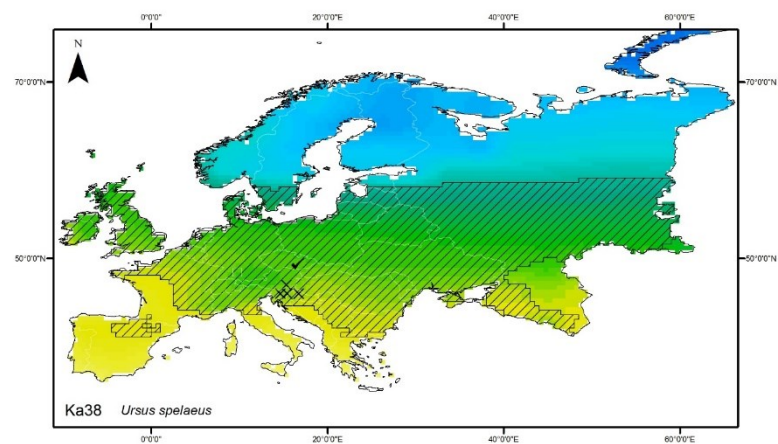
3.18 *Ursus spelaeus*

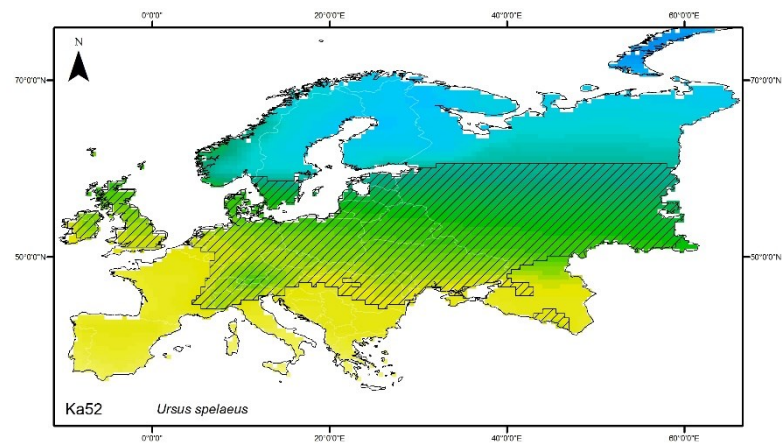
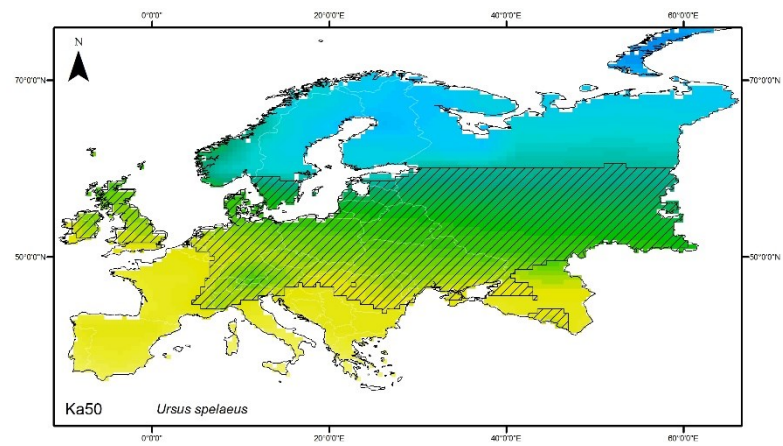
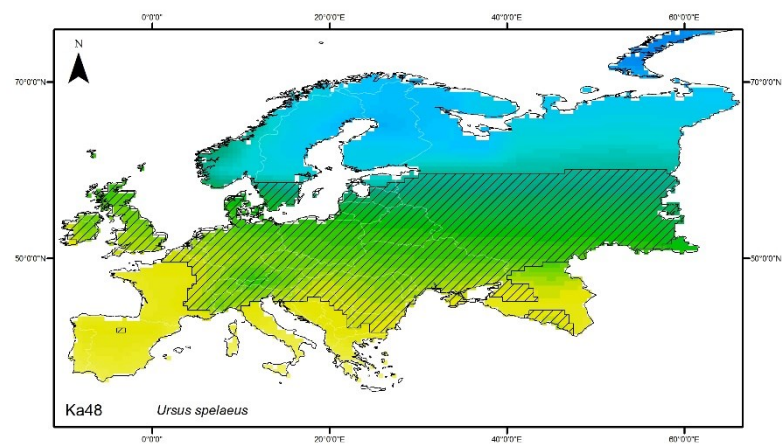
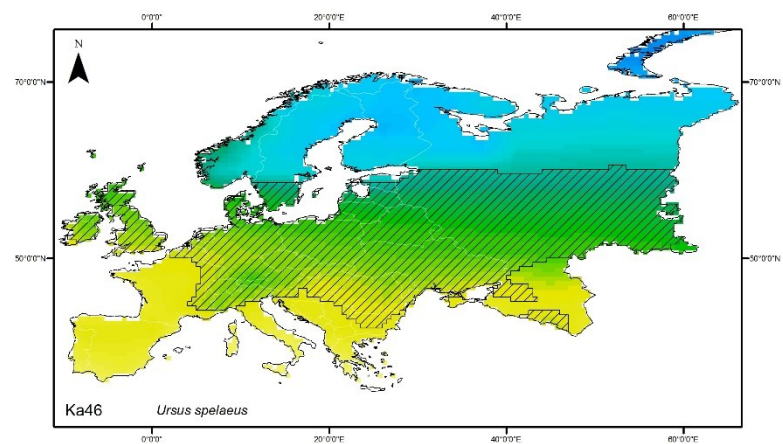


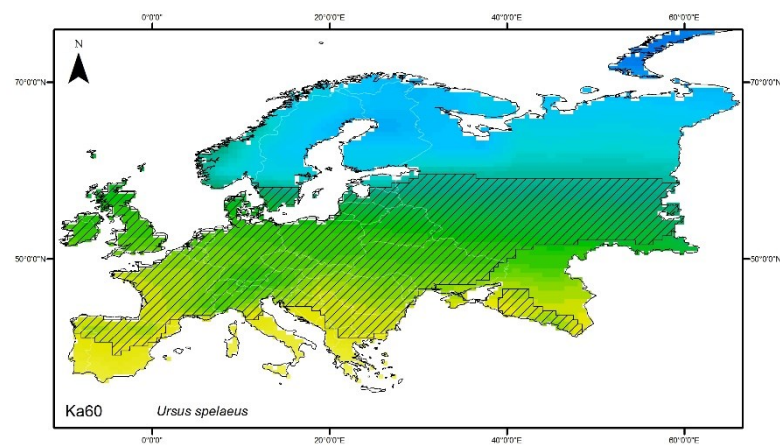
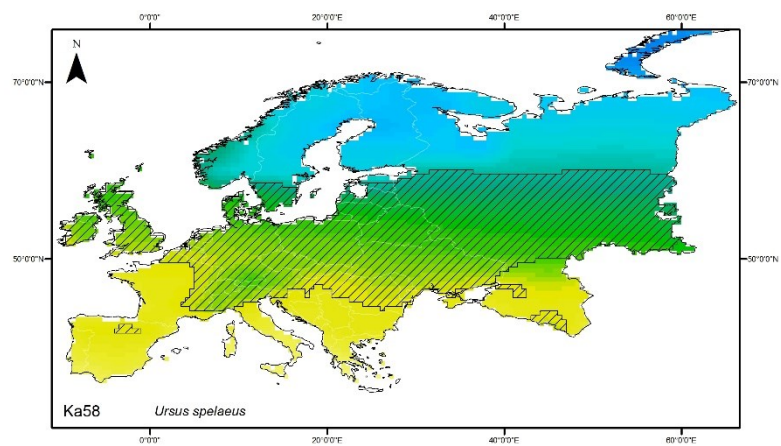
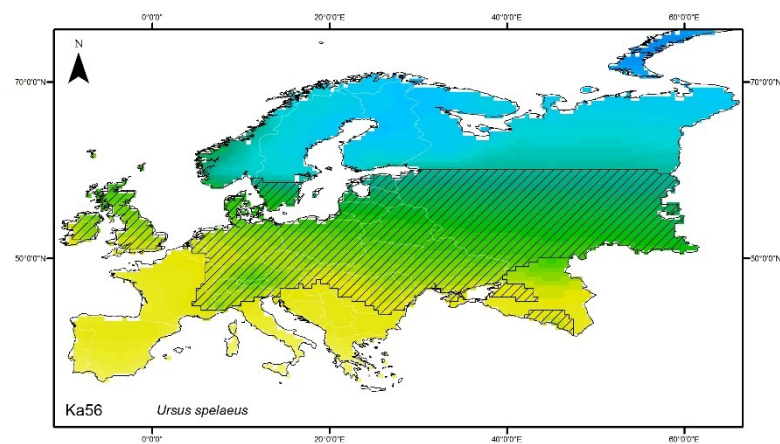
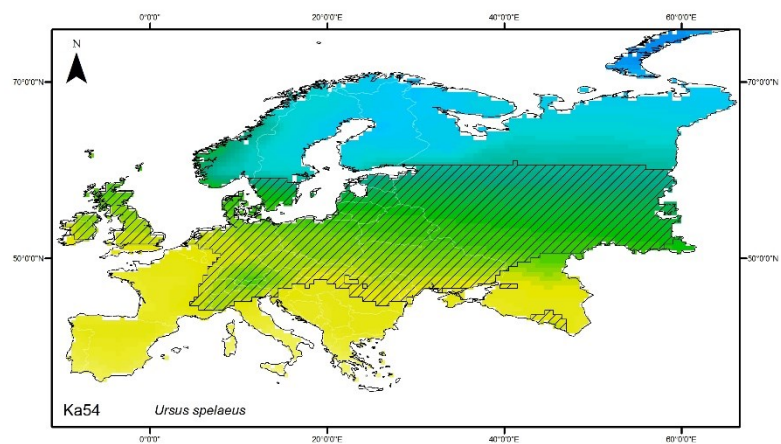


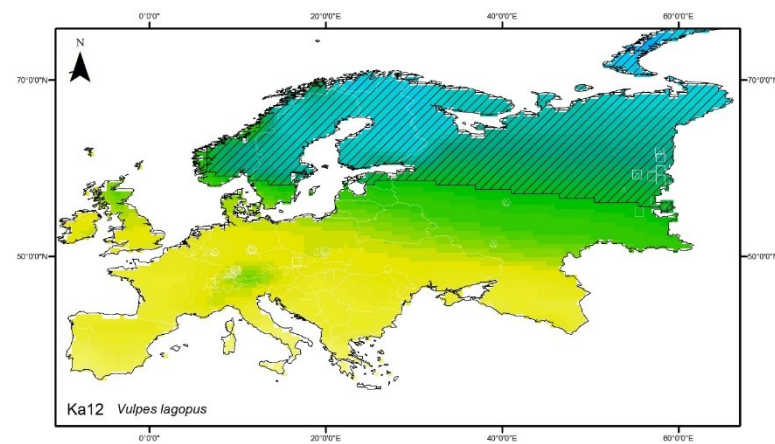
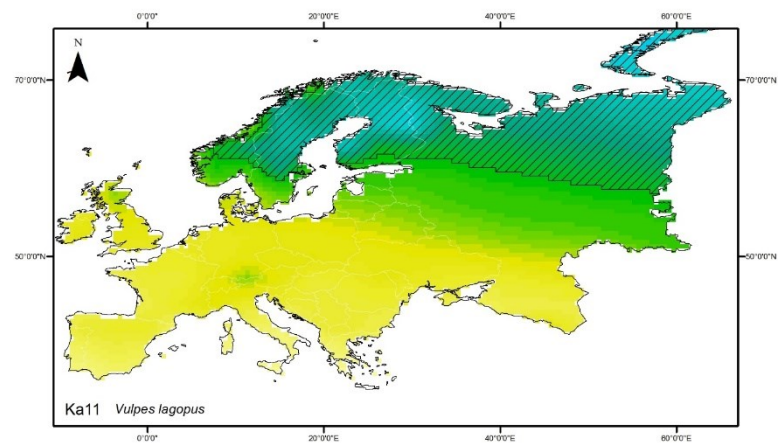
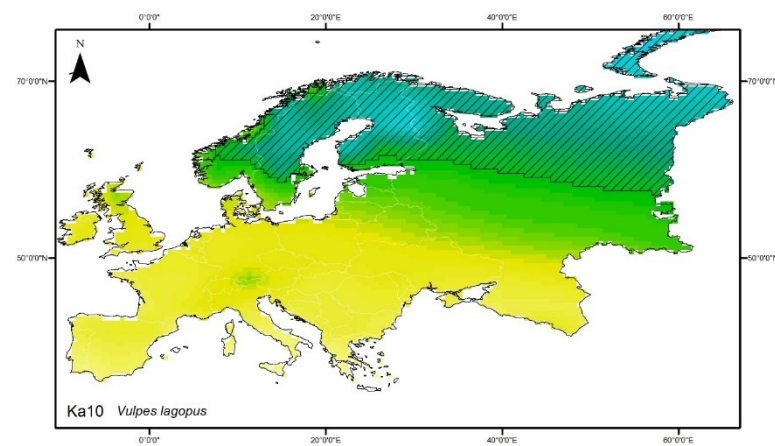
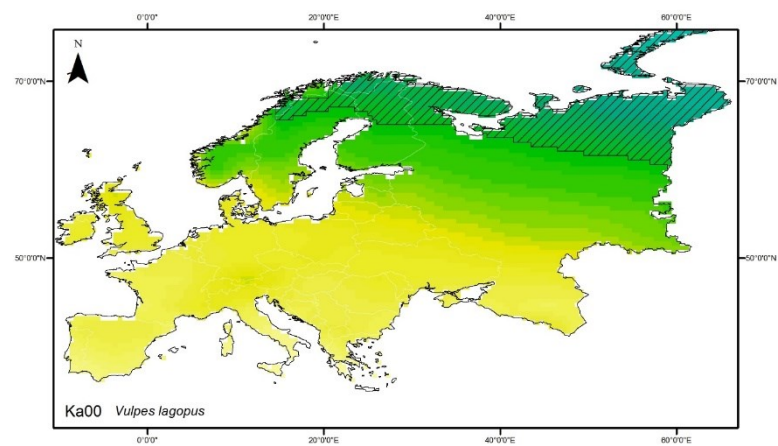


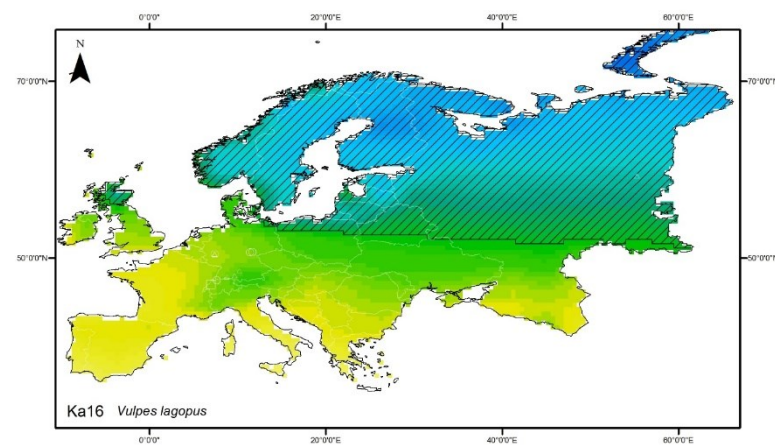
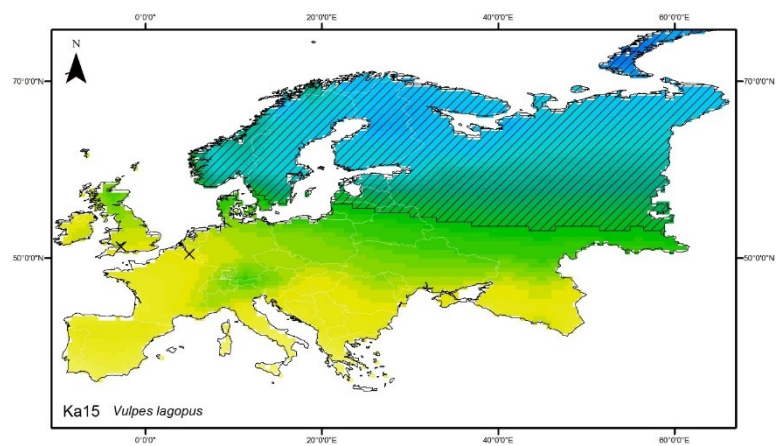
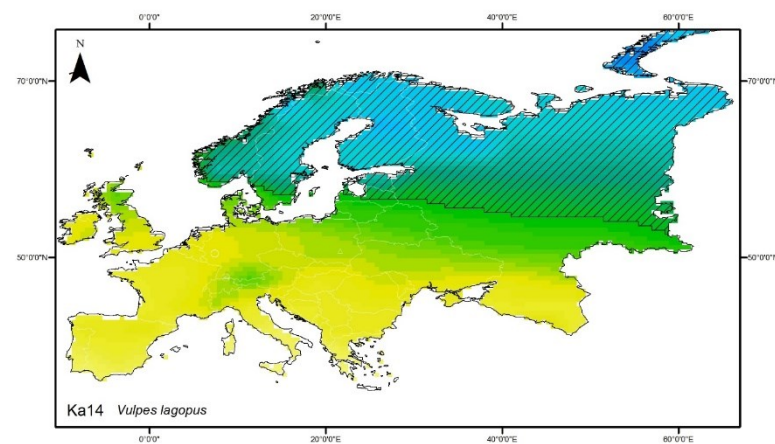
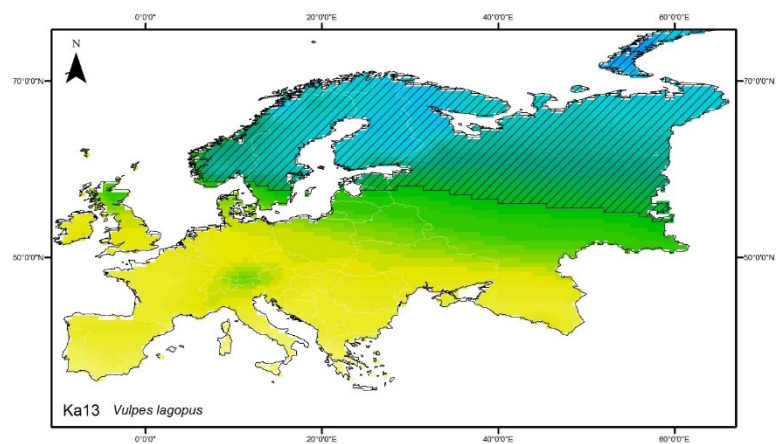


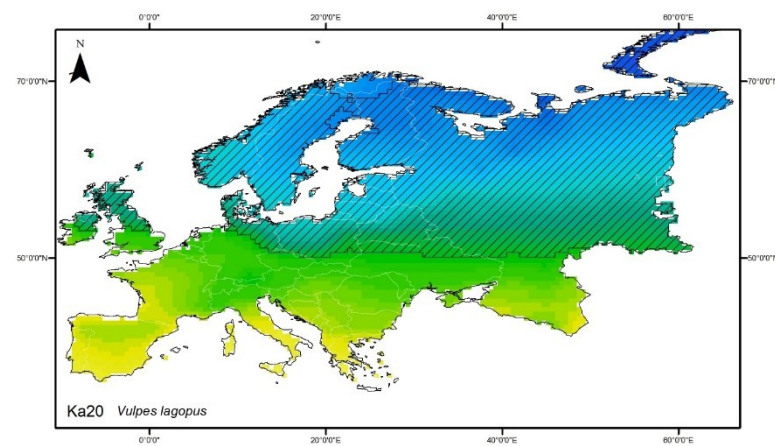
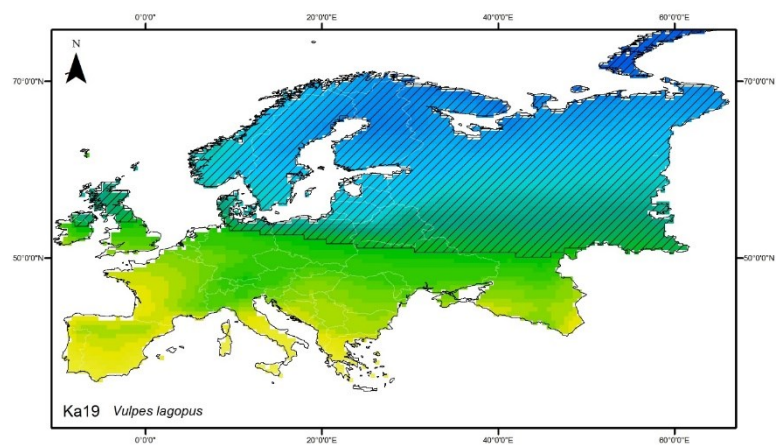
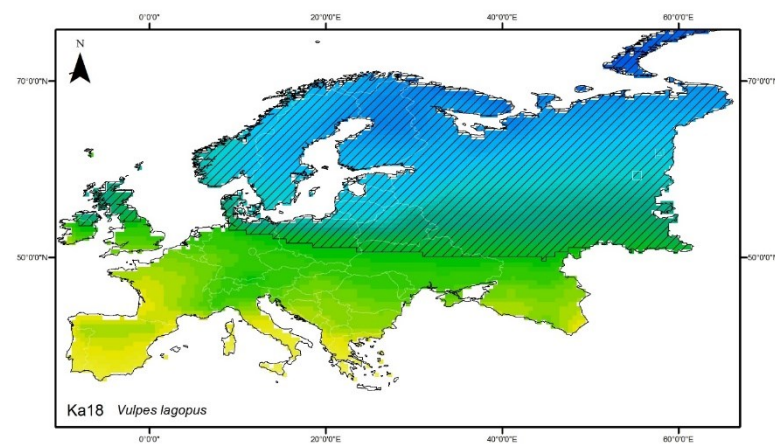
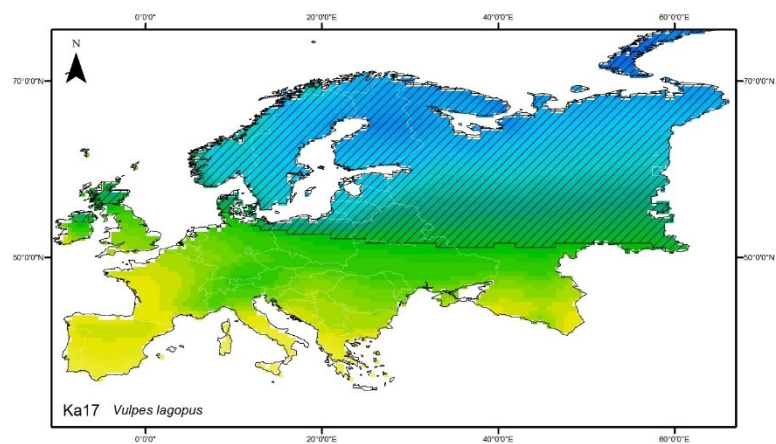


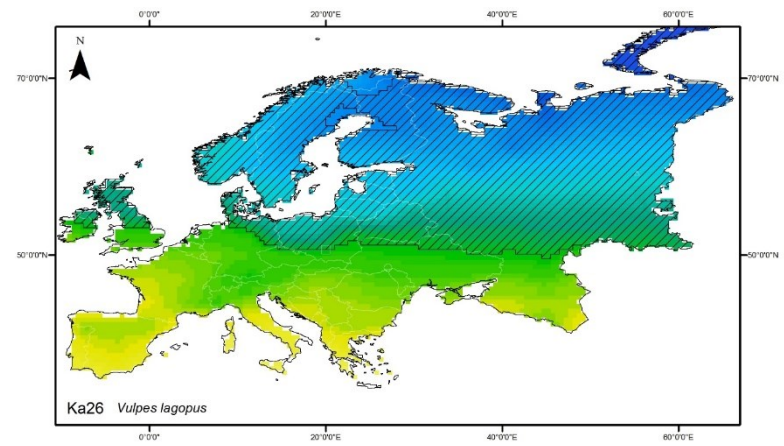
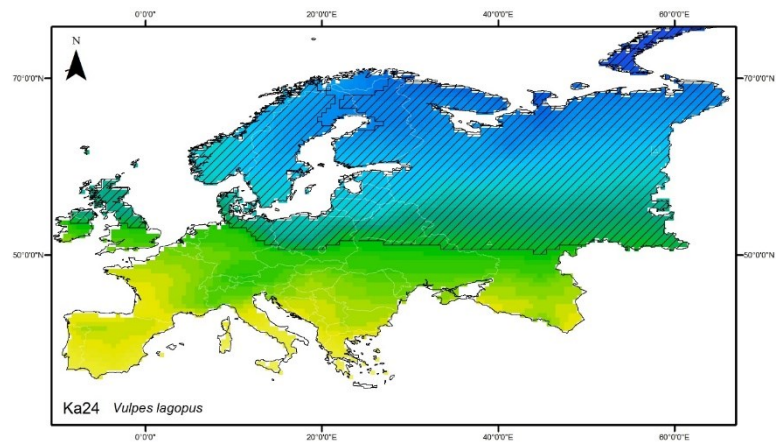
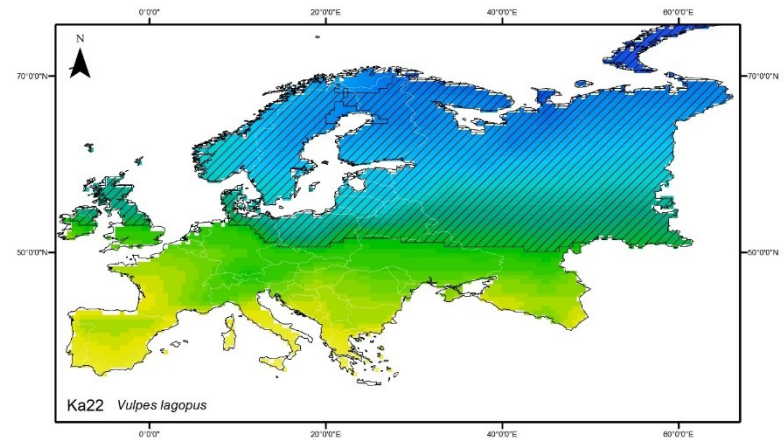
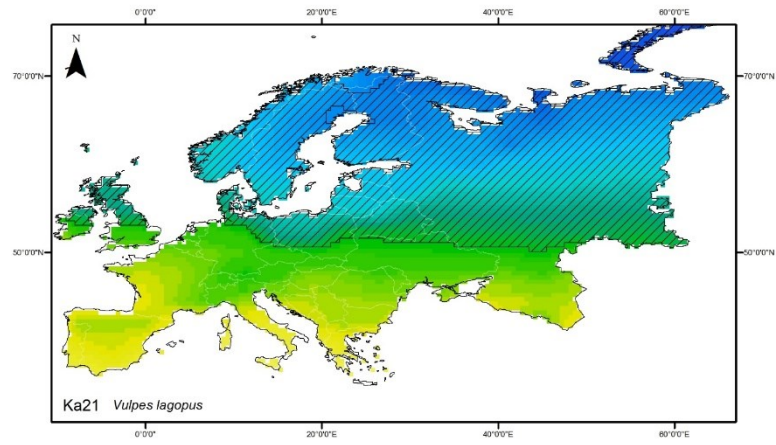


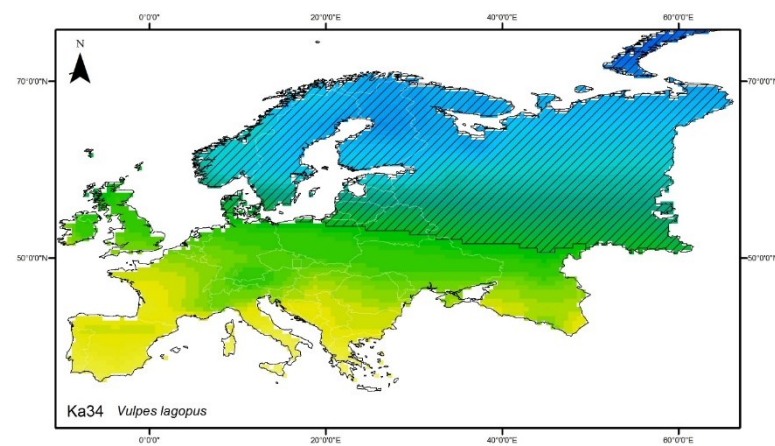
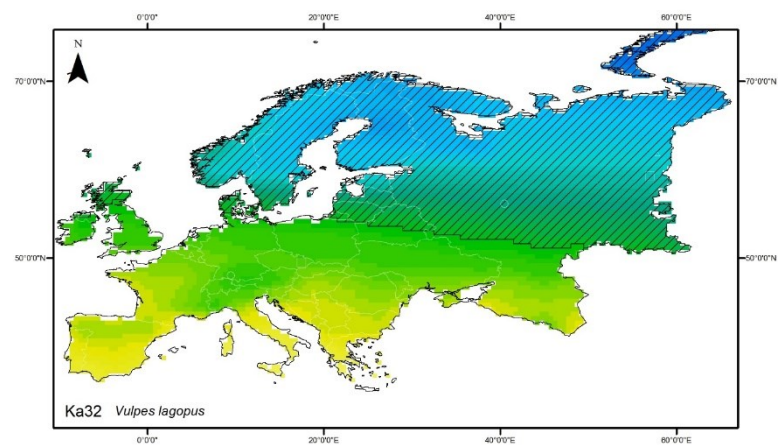
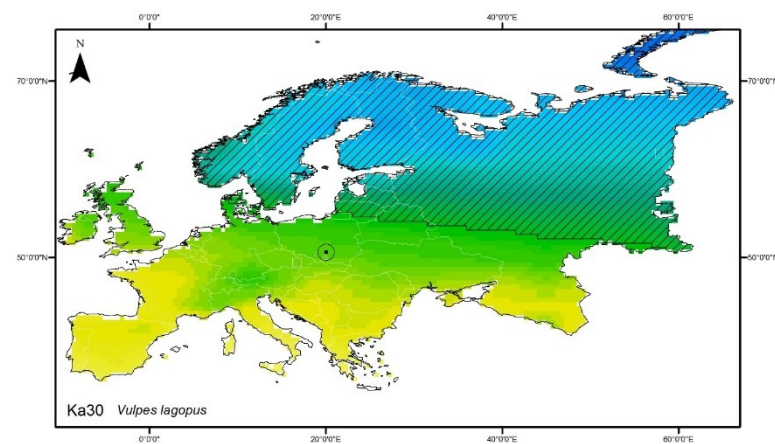
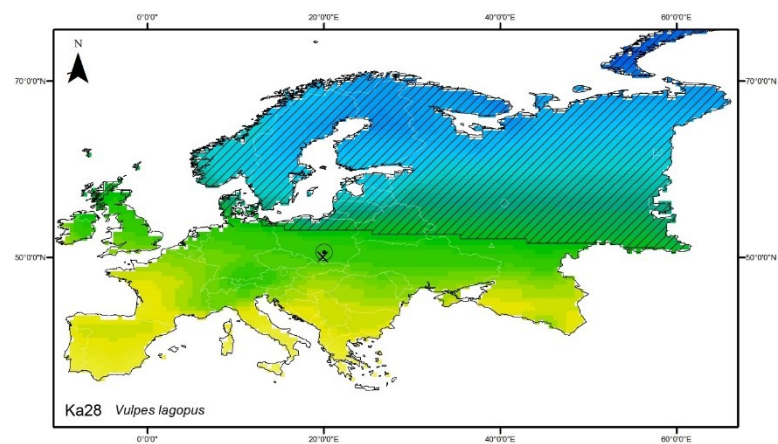


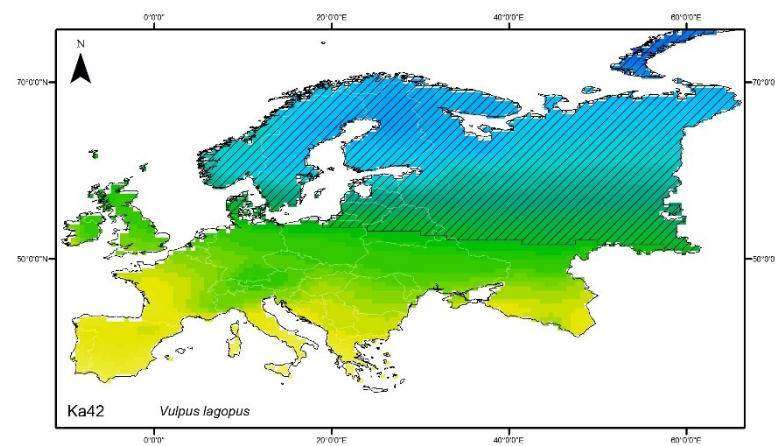
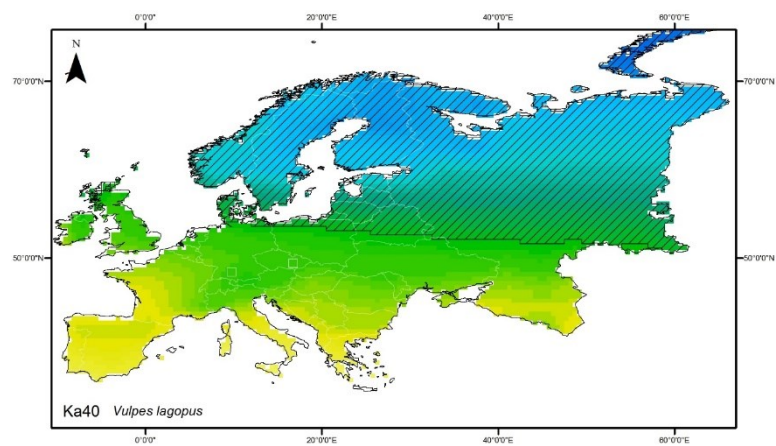
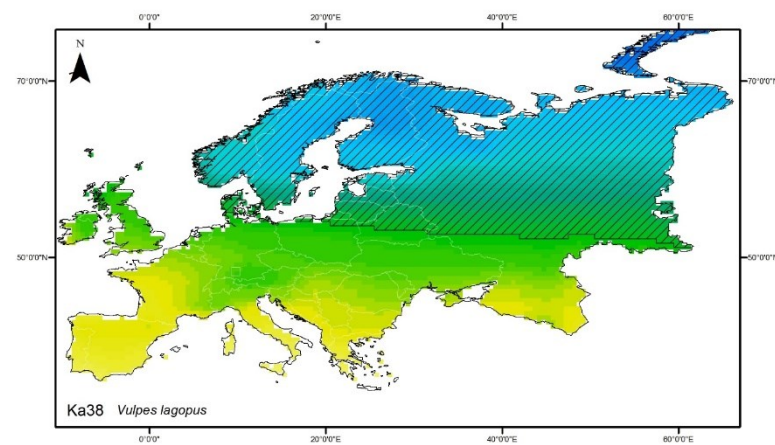
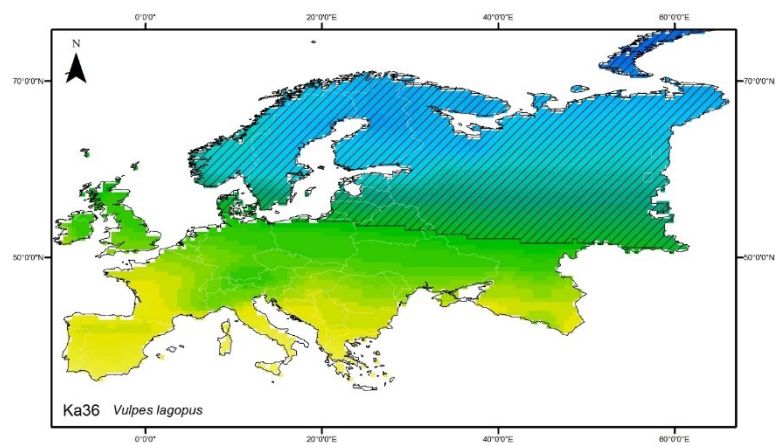
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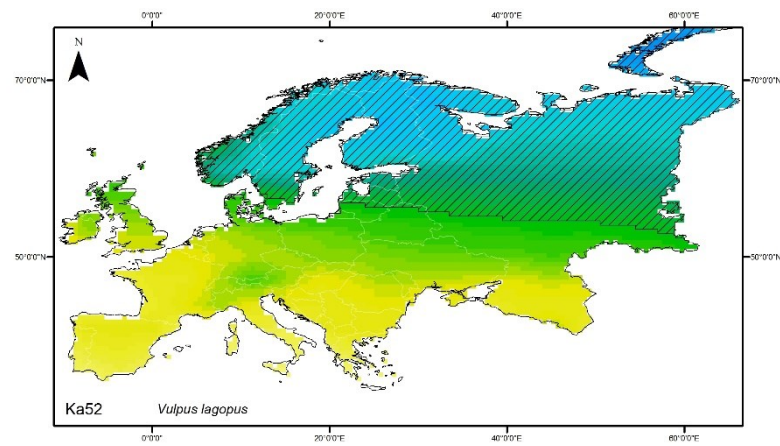
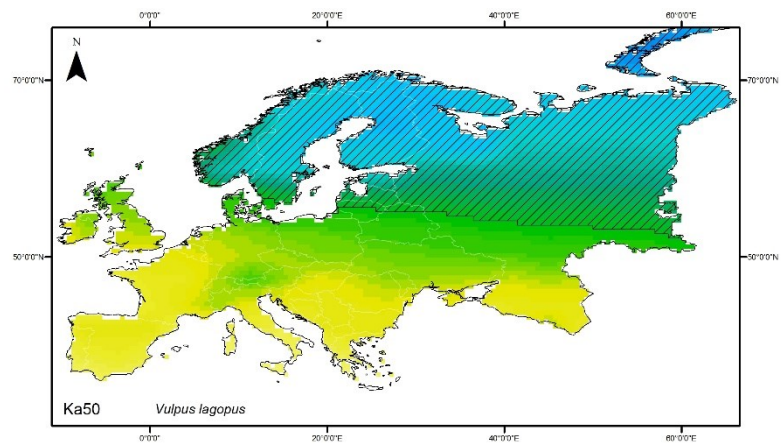
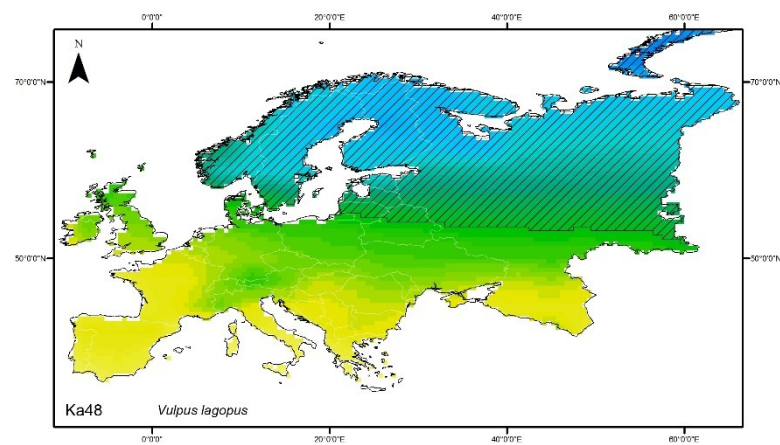
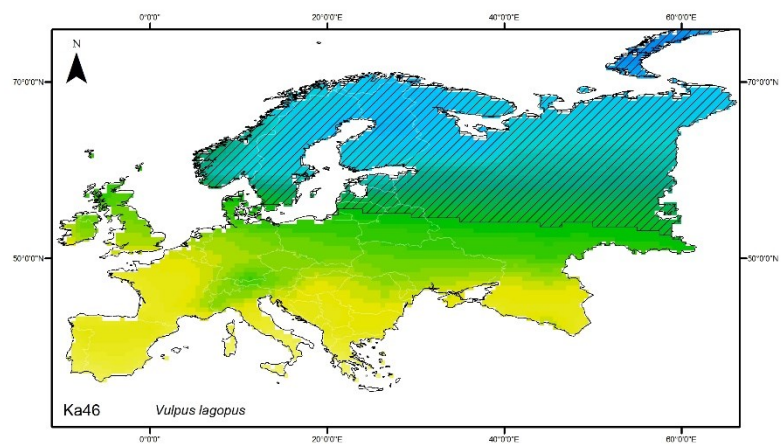


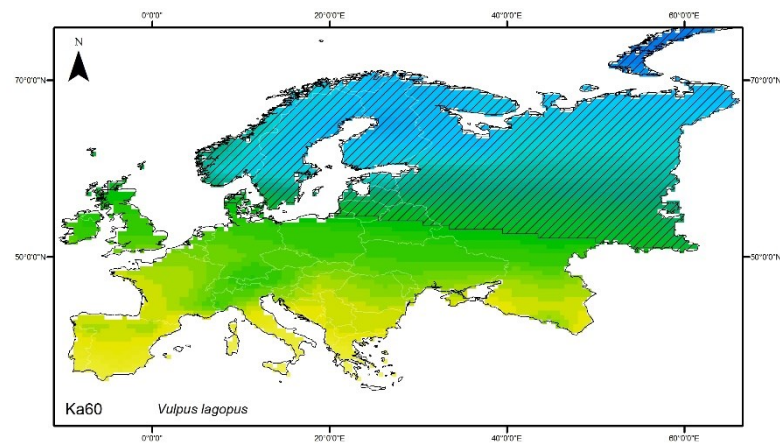
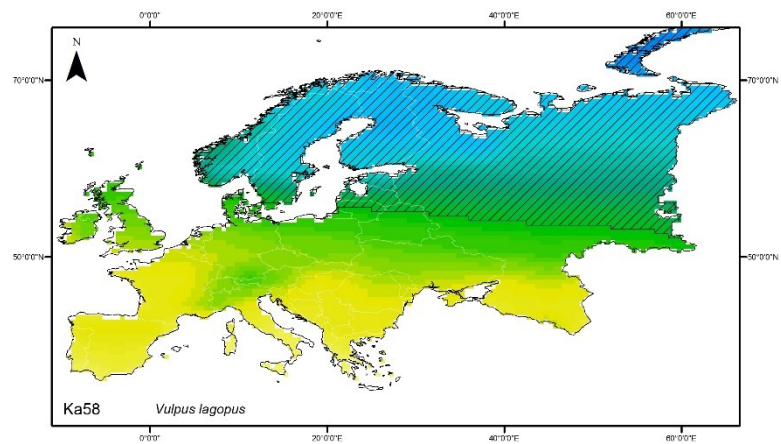
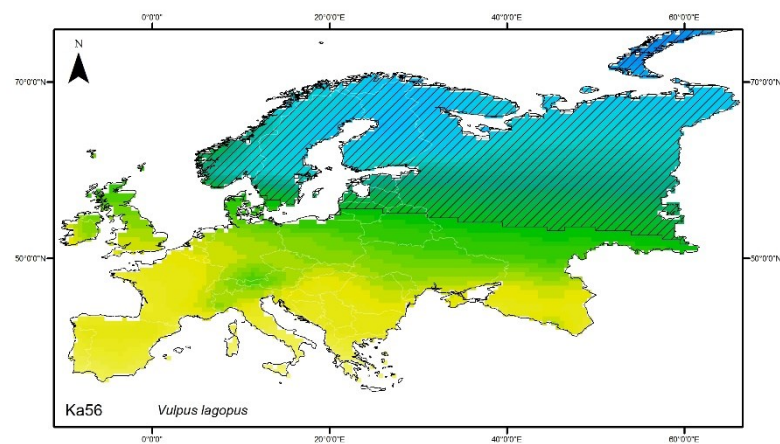
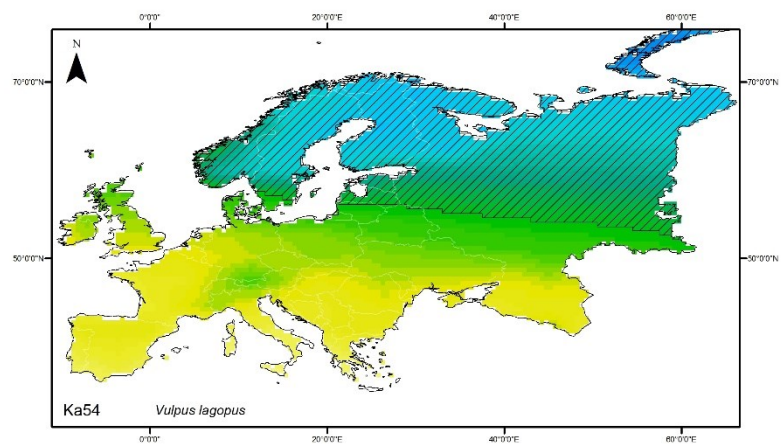












4 Appendix Chapter 5

This appendix presents the correlation matrices used for this chapter. It also shows the predictive models 1-6 for all time periods. The models 1 and 7 to 17 are also shown for all time periods, grouped per timeframe of the training data.

4.0 Model 1 Correlation matrix of variables

Model 1 Bio	1	2	3	4	5	6	7	8	9	12	13	14	15	16	17
1	1.00	0.43	-0.74	0.94	0.58	0.79	-0.52	-0.32	-0.10	-0.28	-0.40	-0.05	0.32	-0.01	-0.23
2	0.43	1.00	-0.19	0.45	0.86	0.87	0.05	0.46	-0.63	0.47	0.11	-0.60	0.35	-0.59	0.48
3	-0.74	-0.19	1.00	-0.75	-0.16	-0.47	0.47	0.51	-0.20	0.48	0.37	-0.26	-0.11	-0.23	0.24
4	0.94	0.45	-0.75	1.00	0.48	0.74	-0.51	-0.26	-0.19	-0.23	-0.41	-0.12	0.44	-0.04	-0.20
5	0.58	0.86	-0.16	0.48	1.00	0.92	-0.05	0.37	-0.57	0.40	0.02	-0.56	0.26	-0.55	0.34
6	0.79	0.87	-0.47	0.74	0.92	1.00	-0.22	0.17	-0.49	0.20	-0.12	-0.45	0.37	-0.43	0.21
7	-0.52	0.05	0.47	-0.51	-0.05	-0.22	1.00	0.70	-0.02	0.66	0.98	-0.02	-0.48	-0.33	0.73
8	-0.32	0.46	0.51	-0.26	0.37	0.17	0.70	1.00	-0.72	0.99	0.66	-0.73	0.03	-0.80	0.82
9	-0.10	-0.63	-0.20	-0.19	-0.57	-0.49	-0.02	-0.72	1.00	-0.75	0.00	0.99	-0.53	0.80	-0.46
12	-0.28	0.47	0.48	-0.23	0.40	0.20	0.66	0.99	-0.75	1.00	0.63	-0.75	0.03	-0.82	0.80
13	-0.40	0.11	0.37	-0.41	0.02	-0.12	0.98	0.66	0.00	0.63	1.00	0.00	-0.45	-0.32	0.74
14	-0.05	-0.60	-0.26	-0.12	-0.56	-0.45	-0.02	-0.73	0.99	-0.75	0.00	1.00	-0.50	0.80	-0.46
15	0.32	0.35	-0.11	0.44	0.26	0.37	-0.48	0.03	-0.53	0.03	-0.45	-0.50	1.00	-0.13	-0.22
16	-0.01	-0.59	-0.23	-0.04	-0.55	-0.43	-0.33	-0.80	0.80	-0.82	-0.32	0.80	-0.13	1.00	-0.78
17	-0.23	0.48	0.24	-0.20	0.34	0.21	0.73	0.82	-0.46	0.80	0.74	-0.46	-0.22	-0.78	1.00

4.1 Model 2 Correlation matrix of variables

Mod el 2 Bio	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1.00	0.14	0.56	-0.40	0.78	0.88	-0.32	0.12	0.86	0.87	0.92	0.07	0.13	-0.13	0.25	0.08	-0.04	-0.43	0.38
2	0.14	1.00	-0.02	0.57	0.58	-0.20	0.66	0.10	0.06	0.47	-0.13	-0.56	-0.44	-0.55	0.51	-0.47	-0.58	-0.34	-0.40
3	0.56	-0.02	1.00	-0.79	0.10	0.78	-0.74	-0.09	0.67	0.18	0.76	0.31	0.34	0.14	0.08	0.32	0.24	-0.23	0.55
4	-0.40	0.57	-0.79	1.00	0.24	-0.75	0.98	0.05	-0.52	0.10	-0.72	-0.58	-0.55	-0.46	0.23	-0.53	-0.55	-0.06	-0.64
5	0.78	0.58	0.10	0.24	1.00	0.44	0.32	0.11	0.60	0.98	0.50	-0.32	-0.23	-0.46	0.44	-0.28	-0.42	-0.55	-0.01
6	0.88	-0.20	0.78	-0.75	0.44	1.00	-0.71	-0.02	0.88	0.56	0.99	0.33	0.35	0.12	0.07	0.30	0.23	-0.33	0.61
7	-0.32	0.66	-0.74	0.98	0.32	-0.71	1.00	0.11	-0.47	0.18	-0.65	-0.59	-0.55	-0.49	0.27	-0.54	-0.58	-0.08	-0.65
8	0.12	0.10	-0.09	0.05	0.11	-0.02	0.11	1.00	-0.19	0.13	0.05	-0.07	-0.03	-0.07	0.09	-0.04	-0.09	0.35	-0.30
9	0.86	0.06	0.67	-0.52	0.60	0.88	-0.47	-0.19	1.00	0.67	0.88	0.17	0.23	-0.06	0.23	0.18	0.06	-0.54	0.58
10	0.87	0.47	0.18	0.10	0.98	0.56	0.18	0.13	0.67	1.00	0.62	-0.24	-0.16	-0.40	0.41	-0.21	-0.34	-0.53	0.08
11	0.92	-0.13	0.76	-0.72	0.50	0.99	-0.65	0.05	0.88	0.62	1.00	0.29	0.32	0.08	0.10	0.27	0.19	-0.32	0.57
12	0.07	-0.56	0.31	-0.58	-0.32	0.33	-0.59	-0.07	0.17	-0.24	0.29	1.00	0.92	0.80	-0.37	0.94	0.86	0.57	0.81
13	0.13	-0.44	0.34	-0.55	-0.23	0.35	-0.55	-0.03	0.23	-0.16	0.32	0.92	1.00	0.59	-0.07	0.98	0.66	0.44	0.83
14	-0.13	-0.55	0.14	-0.46	-0.46	0.12	-0.49	-0.07	-0.06	-0.40	0.08	0.80	0.59	1.00	-0.71	0.61	0.97	0.67	0.48
15	0.25	0.51	0.08	0.23	0.44	0.07	0.27	0.09	0.23	0.41	0.10	-0.37	-0.07	-0.71	1.00	-0.10	-0.67	-0.43	-0.09
16	0.08	-0.47	0.32	-0.53	-0.28	0.30	-0.54	-0.04	0.18	-0.21	0.27	0.94	0.98	0.61	-0.10	1.00	0.68	0.49	0.81
17	-0.04	-0.58	0.24	-0.55	-0.42	0.23	-0.58	-0.09	0.06	-0.34	0.19	0.86	0.66	0.97	-0.67	0.68	1.00	0.61	0.59
18	-0.43	-0.34	-0.23	-0.06	-0.55	-0.33	-0.08	0.35	-0.54	-0.53	-0.32	0.57	0.44	0.67	-0.43	0.49	0.61	1.00	0.01
19	0.38	-0.40	0.55	-0.64	-0.01	0.61	-0.65	-0.30	0.58	0.08	0.57	0.81	0.83	0.48	-0.09	0.81	0.59	0.01	1.00

4.2 Model 4: Correlation matrix of variables

Model 4	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Aspect	Slope	DEM
01	1.00	0.14	0.56	-0.40	0.78	0.88	-0.32	0.12	0.86	0.87	0.92	0.07	0.13	-0.13	0.25	0.08	-0.04	-0.43	0.38	-0.01	0.05	0.05
02	0.14	1.00	-0.02	0.57	0.58	-0.20	0.66	0.10	0.06	0.47	-0.13	-0.56	-0.44	-0.55	0.51	-0.47	-0.58	-0.34	-0.40	-0.01	-0.19	0.02
03	0.56	-0.02	1.00	-0.79	0.10	0.78	-0.74	-0.09	0.67	0.18	0.76	0.31	0.34	0.14	0.08	0.32	0.24	-0.23	0.55	0.02	0.21	0.24
04	-0.40	0.57	-0.79	1.00	0.24	-0.75	0.98	0.05	-0.52	0.10	-0.72	-0.58	-0.55	-0.46	0.23	-0.53	-0.55	-0.06	-0.64	-0.02	-0.33	-0.27
05	0.78	0.58	0.10	0.24	1.00	0.44	0.32	0.11	0.60	0.98	0.50	-0.32	-0.23	-0.46	0.44	-0.28	-0.42	-0.55	-0.01	-0.02	-0.14	-0.06
06	0.88	-0.20	0.78	-0.75	0.44	1.00	-0.71	-0.02	0.88	0.56	0.99	0.33	0.35	0.12	0.07	0.30	0.23	-0.33	0.61	0.00	0.19	0.15
07	-0.32	0.66	-0.74	0.98	0.32	-0.71	1.00	0.11	-0.47	0.18	-0.65	-0.59	-0.55	-0.49	0.27	-0.54	-0.58	-0.08	-0.65	-0.02	-0.30	-0.20
08	0.12	0.10	-0.09	0.05	0.11	-0.02	0.11	1.00	-0.19	0.13	0.05	-0.07	-0.03	-0.07	0.09	-0.04	-0.09	0.35	-0.30	-0.04	-0.15	-0.21
09	0.86	0.06	0.67	-0.52	0.60	0.88	-0.47	-0.19	1.00	0.67	0.88	0.17	0.23	-0.06	0.23	0.18	0.06	-0.54	0.58	0.00	0.20	0.27
10	0.87	0.47	0.18	0.10	0.98	0.56	0.18	0.13	0.67	1.00	0.62	-0.24	-0.16	-0.40	0.41	-0.21	-0.34	-0.53	0.08	-0.02	-0.12	-0.08
11	0.92	-0.13	0.76	-0.72	0.50	0.99	-0.65	0.05	0.88	0.62	1.00	0.29	0.32	0.08	0.10	0.27	0.19	-0.32	0.57	0.00	0.17	0.15
12	0.07	-0.56	0.31	-0.58	-0.32	0.33	-0.59	-0.07	0.17	-0.24	0.29	1.00	0.92	0.80	-0.37	0.94	0.86	0.57	0.81	0.05	0.46	0.32
13	0.13	-0.44	0.34	-0.55	-0.23	0.35	-0.55	-0.03	0.23	-0.16	0.32	0.92	1.00	0.59	-0.07	0.98	0.66	0.44	0.83	0.04	0.46	0.34
14	-0.13	-0.55	0.14	-0.46	-0.46	0.12	-0.49	-0.07	-0.06	-0.40	0.08	0.80	0.59	1.00	-0.71	0.61	0.97	0.67	0.48	0.04	0.35	0.23
15	0.25	0.51	0.08	0.23	0.44	0.07	0.27	0.09	0.23	0.41	0.10	-0.37	-0.07	-0.71	1.00	-0.10	-0.67	-0.43	-0.09	-0.02	-0.09	0.02
16	0.08	-0.47	0.32	-0.53	-0.28	0.30	-0.54	-0.04	0.18	-0.21	0.27	0.94	0.98	0.61	-0.10	1.00	0.68	0.49	0.81	0.05	0.45	0.32
17	-0.04	-0.58	0.24	-0.55	-0.42	0.23	-0.58	-0.09	0.06	-0.34	0.19	0.86	0.66	0.97	-0.67	0.68	1.00	0.61	0.59	0.04	0.39	0.28
18	-0.43	-0.34	-0.23	-0.06	-0.55	-0.33	-0.08	0.35	-0.54	-0.53	-0.32	0.57	0.44	0.67	-0.43	0.49	0.61	1.00	0.01	0.02	0.18	0.07
19	0.38	-0.40	0.55	-0.64	-0.01	0.61	-0.65	-0.30	0.58	0.08	0.57	0.81	0.83	0.48	-0.09	0.81	0.59	0.01	1.00	0.05	0.43	0.33
Aspect	-0.01	-0.01	0.02	-0.02	-0.02	0.00	-0.02	-0.04	0.00	-0.02	0.00	0.05	0.04	0.04	-0.02	0.05	0.04	0.02	0.05	1.00	0.04	0.04
Slope	0.05	-0.19	0.21	-0.33	-0.14	0.19	-0.30	-0.15	0.20	-0.12	0.17	0.46	0.46	0.35	-0.09	0.45	0.39	0.18	0.43	0.04	1.00	0.62
DEM	0.05	0.02	0.24	-0.27	-0.06	0.15	-0.20	-0.21	0.27	-0.08	0.15	0.32	0.34	0.23	0.02	0.32	0.28	0.07	0.33	0.04	0.62	1.00

4.3 Model 5: Correlation matrix of variables

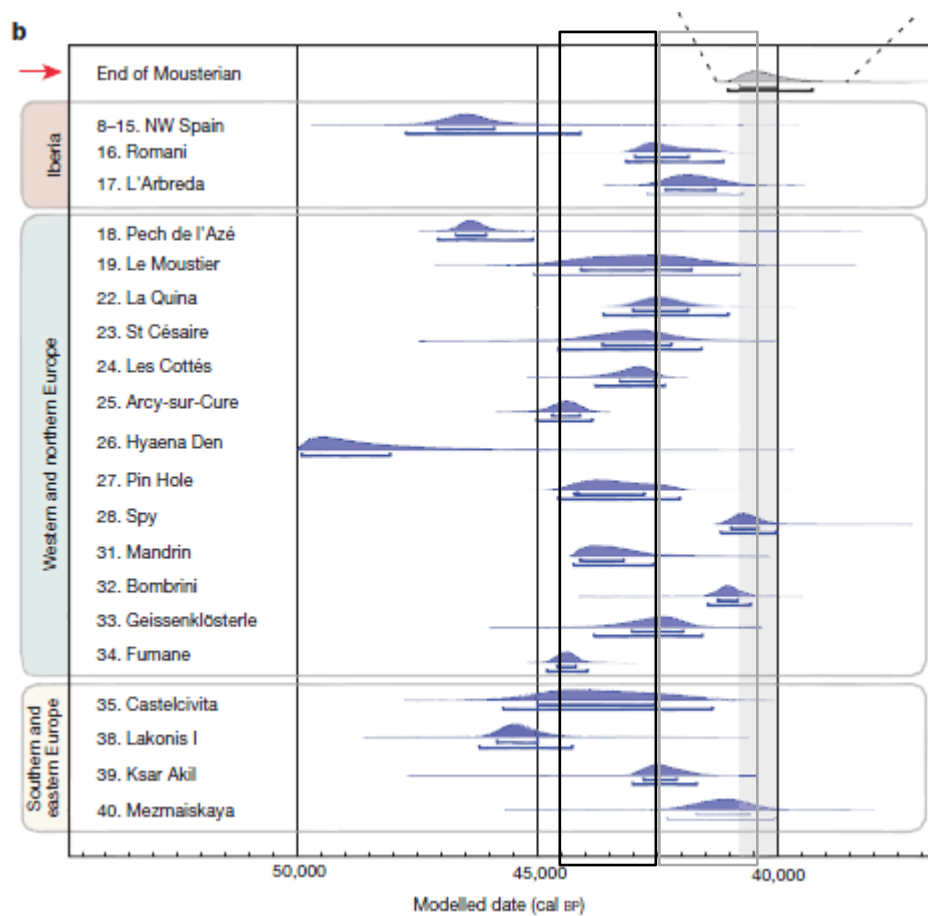
Layer	1	2	3	4	5	6	7	8	9	12	13	14	15	16	17	Aspect	Slope	DEM
01	1.00	-0.81	-0.43	-0.48	0.85	0.93	-0.47	0.95	0.88	-0.02	0.19	-0.42	0.56	0.29	-0.46	-0.02	0.15	0.21
02	-0.81	1.00	0.20	0.81	-0.43	-0.94	0.79	-0.91	-0.48	-0.20	-0.42	0.22	-0.53	-0.43	0.25	0.02	-0.26	-0.32
03	-0.43	0.20	1.00	-0.38	-0.61	-0.19	-0.42	-0.19	-0.67	0.50	0.30	0.63	-0.46	0.42	0.52	0.02	0.01	-0.18
04	-0.48	0.81	-0.38	1.00	0.00	-0.75	0.99	-0.73	-0.02	-0.45	-0.56	-0.12	-0.26	-0.60	-0.05	0.01	-0.27	-0.23
05	0.85	-0.43	-0.61	0.00	1.00	0.63	0.00	0.66	0.98	-0.12	0.02	-0.41	0.37	0.11	-0.40	-0.01	0.04	0.13
06	0.93	-0.94	-0.19	-0.75	0.63	1.00	-0.75	0.99	0.66	0.20	0.40	-0.23	0.48	0.47	-0.28	-0.02	0.22	0.26
07	-0.47	0.79	-0.42	0.99	0.00	-0.75	1.00	-0.72	-0.02	-0.49	-0.57	-0.19	-0.20	-0.63	-0.10	0.01	-0.25	-0.21
08	0.95	-0.91	-0.19	-0.73	0.66	0.99	-0.72	1.00	0.70	0.17	0.37	-0.26	0.51	0.46	-0.32	-0.02	0.22	0.25
09	0.88	-0.48	-0.67	-0.02	0.98	0.66	-0.02	0.70	1.00	-0.22	-0.05	-0.51	0.47	0.05	-0.52	-0.02	0.04	0.12
12	-0.02	-0.20	0.50	-0.45	-0.12	0.20	-0.49	0.17	-0.22	1.00	0.92	0.74	-0.47	0.87	0.79	0.06	0.34	0.30
13	0.19	-0.42	0.30	-0.56	0.02	0.40	-0.57	0.37	-0.05	0.92	1.00	0.48	-0.16	0.86	0.58	0.05	0.45	0.45
14	-0.42	0.22	0.63	-0.12	-0.41	-0.23	-0.19	-0.26	-0.51	0.74	0.48	1.00	-0.75	0.45	0.94	0.05	0.07	-0.04
15	0.56	-0.53	-0.46	-0.26	0.37	0.48	-0.20	0.51	0.47	-0.47	-0.16	-0.75	1.00	-0.19	-0.74	-0.05	0.08	0.17
16	0.29	-0.43	0.42	-0.60	0.11	0.47	-0.63	0.46	0.05	0.87	0.86	0.45	-0.19	1.00	0.43	0.05	0.31	0.25
17	-0.46	0.25	0.52	-0.05	-0.40	-0.28	-0.10	-0.32	-0.52	0.79	0.58	0.94	-0.74	0.43	1.00	0.06	0.15	0.11
Aspect	-0.02	0.02	0.02	0.01	-0.01	-0.02	0.01	-0.02	-0.02	0.06	0.05	0.05	-0.05	0.05	0.06	1.00	0.04	0.02
Slope	0.15	-0.26	0.01	-0.27	0.04	0.22	-0.25	0.22	0.04	0.34	0.45	0.07	0.08	0.31	0.15	0.04	1.00	0.63
DEM	0.21	-0.32	-0.18	-0.23	0.13	0.26	-0.21	0.25	0.12	0.30	0.45	-0.04	0.17	0.25	0.11	0.02	0.63	1.00

4.4 Model 6: Correlation matrix of variables

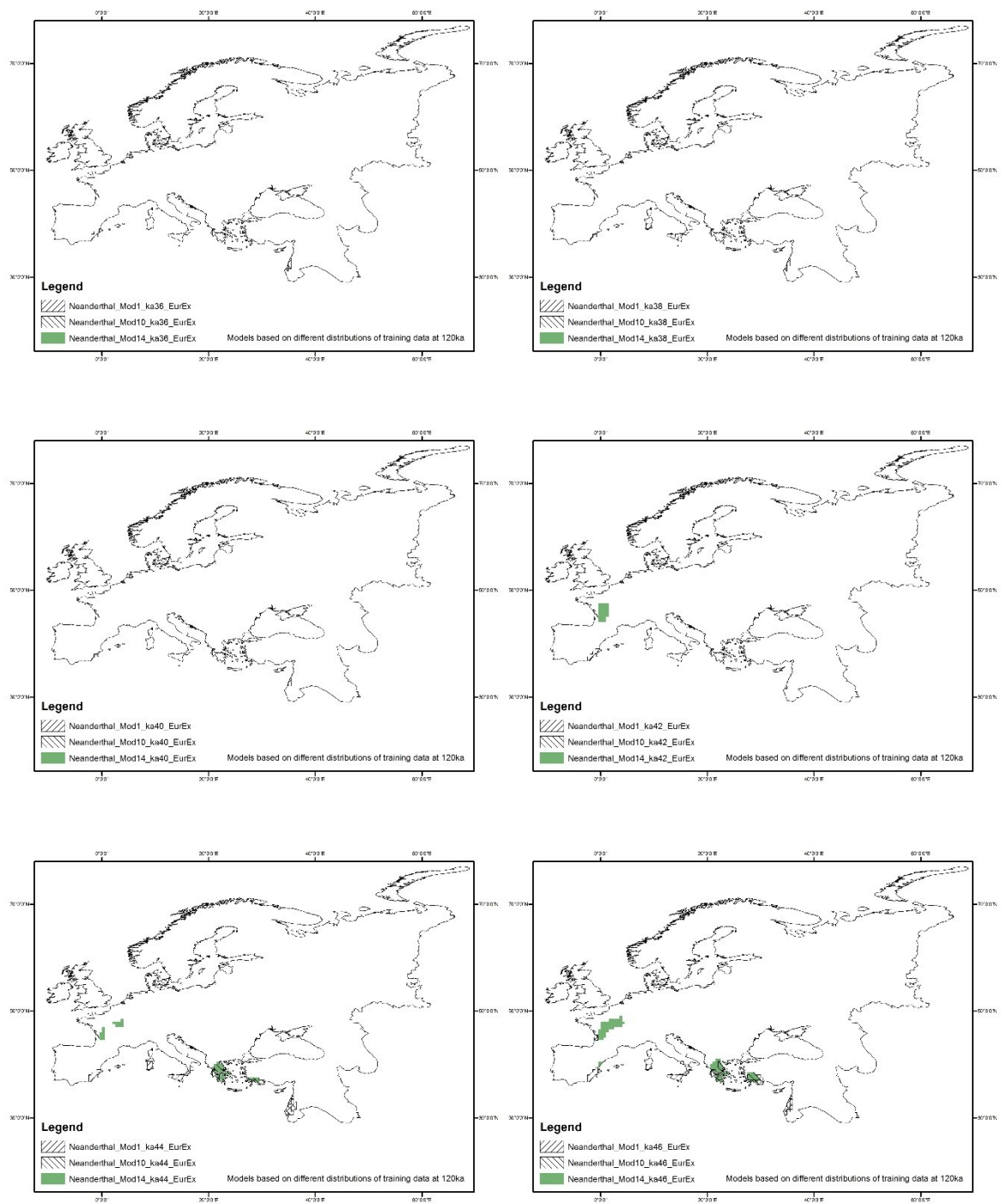
Layer	1	2	3	4	5	6	7	8	9	12	13	14	15	16	17	dem	aspect	slope	albedoS	Wchill	Koppen	NPP	GDD5C	GDDoC
01	1.00	-0.81	-0.43	-0.48	0.85	0.93	-0.47	0.95	0.88	-0.02	0.19	-0.42	0.56	0.29	-0.46	0.21	0.00	0.16	-0.53	1.00	-0.60	0.28	0.87	0.87
02	-0.81	1.00	0.20	0.81	-0.43	-0.94	0.79	-0.91	-0.48	-0.20	-0.42	0.22	-0.53	-0.43	0.25	-0.31	0.01	-0.26	0.44	-0.80	0.74	-0.26	-0.66	-0.68
03	-0.43	0.20	1.00	-0.38	-0.61	-0.19	-0.42	-0.19	-0.67	0.50	0.30	0.63	-0.46	0.42	0.52	-0.19	-0.02	-0.01	-0.08	-0.43	0.16	0.12	-0.54	-0.53
04	-0.48	0.81	-0.38	1.00	0.00	-0.75	0.99	-0.73	-0.02	-0.45	-0.56	-0.12	-0.26	-0.60	-0.05	-0.21	0.02	-0.25	0.41	-0.48	0.64	-0.31	-0.29	-0.32
05	0.85	-0.43	-0.61	0.00	1.00	0.63	0.00	0.66	0.98	-0.12	0.02	-0.41	0.37	0.11	-0.40	0.13	0.02	0.06	-0.46	0.85	-0.23	0.25	0.75	0.75
06	0.93	-0.94	-0.19	-0.75	0.63	1.00	-0.75	0.99	0.66	0.20	0.40	-0.23	0.48	0.47	-0.28	0.25	0.00	0.23	-0.58	0.92	-0.68	0.36	0.74	0.76
07	-0.47	0.79	-0.42	0.99	0.00	-0.75	1.00	-0.72	-0.02	-0.49	-0.57	-0.19	-0.20	-0.63	-0.10	-0.18	0.02	-0.24	0.45	-0.47	0.58	-0.32	-0.26	-0.29
08	0.95	-0.91	-0.19	-0.73	0.66	0.99	-0.72	1.00	0.70	0.17	0.37	-0.26	0.51	0.46	-0.32	0.24	-0.01	0.22	-0.58	0.95	-0.68	0.34	0.77	0.78
09	0.88	-0.48	-0.67	-0.02	0.98	0.66	-0.02	0.70	1.00	-0.22	-0.05	-0.51	0.47	0.05	-0.52	0.13	0.01	0.05	-0.42	0.89	-0.32	0.18	0.82	0.81
12	-0.02	-0.20	0.50	-0.45	-0.12	0.20	-0.49	0.17	-0.22	1.00	0.92	0.74	-0.47	0.87	0.79	0.29	0.03	0.33	-0.47	-0.02	0.17	0.54	-0.28	-0.25
13	0.19	-0.42	0.30	-0.56	0.02	0.40	-0.57	0.37	-0.05	0.92	1.00	0.48	-0.16	0.86	0.58	0.44	0.03	0.44	-0.51	0.19	-0.08	0.50	-0.08	-0.05
14	-0.42	0.22	0.63	-0.12	-0.41	-0.23	-0.19	-0.26	-0.51	0.74	0.48	1.00	-0.75	0.45	0.94	-0.04	0.01	0.05	-0.16	-0.42	0.53	0.30	-0.57	-0.56
15	0.56	-0.53	-0.46	-0.26	0.37	0.48	-0.20	0.51	0.47	-0.47	-0.16	-0.75	1.00	-0.19	-0.74	0.16	-0.02	0.08	0.14	0.56	-0.73	-0.43	0.63	0.62
16	0.29	-0.43	0.42	-0.60	0.11	0.47	-0.63	0.46	0.05	0.87	0.86	0.45	-0.19	1.00	0.43	0.24	0.02	0.29	-0.65	0.29	-0.12	0.54	0.00	0.02
17	-0.46	0.25	0.52	-0.05	-0.40	-0.28	-0.10	-0.32	-0.52	0.79	0.58	0.94	-0.74	0.43	1.00	0.11	0.03	0.15	-0.10	-0.46	0.55	0.32	-0.59	-0.57
dem	0.21	-0.31	-0.19	-0.21	0.13	0.25	-0.18	0.24	0.13	0.29	0.44	-0.04	0.16	0.24	0.11	1.00	0.06	0.64	-0.08	0.20	-0.15	0.07	0.16	0.17
aspect	0.00	0.01	-0.02	0.02	0.02	0.00	0.02	-0.01	0.01	0.03	0.03	0.01	-0.02	0.02	0.03	0.06	1.00	0.07	-0.01	0.00	0.03	0.03	0.01	0.01
slope	0.16	-0.26	-0.01	-0.25	0.06	0.23	-0.24	0.22	0.05	0.33	0.44	0.05	0.08	0.29	0.15	0.64	0.07	1.00	-0.13	0.15	-0.15	0.12	0.08	0.09
albedo	-0.53	0.44	-0.08	0.41	-0.46	-0.58	0.45	-0.58	-0.42	-0.47	-0.51	-0.16	0.14	-0.65	-0.10	-0.08	-0.01	-0.13	1.00	-0.54	0.03	-0.66	-0.16	-0.18
wchill	1.00	-0.80	-0.43	-0.48	0.85	0.92	-0.47	0.95	0.89	-0.02	0.19	-0.42	0.56	0.29	-0.46	0.20	0.00	0.15	-0.54	1.00	-0.60	0.28	0.87	0.87
koppen	-0.60	0.74	0.16	0.64	-0.23	-0.68	0.58	-0.68	-0.32	0.17	-0.08	0.53	-0.73	-0.12	0.55	-0.15	0.03	-0.15	0.03	-0.60	1.00	0.02	-0.67	-0.68
npp	0.28	-0.26	0.12	-0.31	0.25	0.36	-0.32	0.34	0.18	0.54	0.50	0.30	-0.43	0.54	0.32	0.07	0.03	0.12	-0.66	0.28	0.02	1.00	0.13	0.15
gdd5	0.87	-0.66	-0.54	-0.29	0.75	0.74	-0.26	0.77	0.82	-0.28	-0.08	-0.57	0.63	0.00	-0.59	0.16	0.01	0.08	-0.16	0.87	-0.67	0.13	1.00	1.00
gddo	0.87	-0.68	-0.53	-0.32	0.75	0.76	-0.29	0.78	0.81	-0.25	-0.05	-0.56	0.62	0.02	-0.57	0.17	0.01	0.09	-0.18	0.87	-0.68	0.15	1.00	1.00

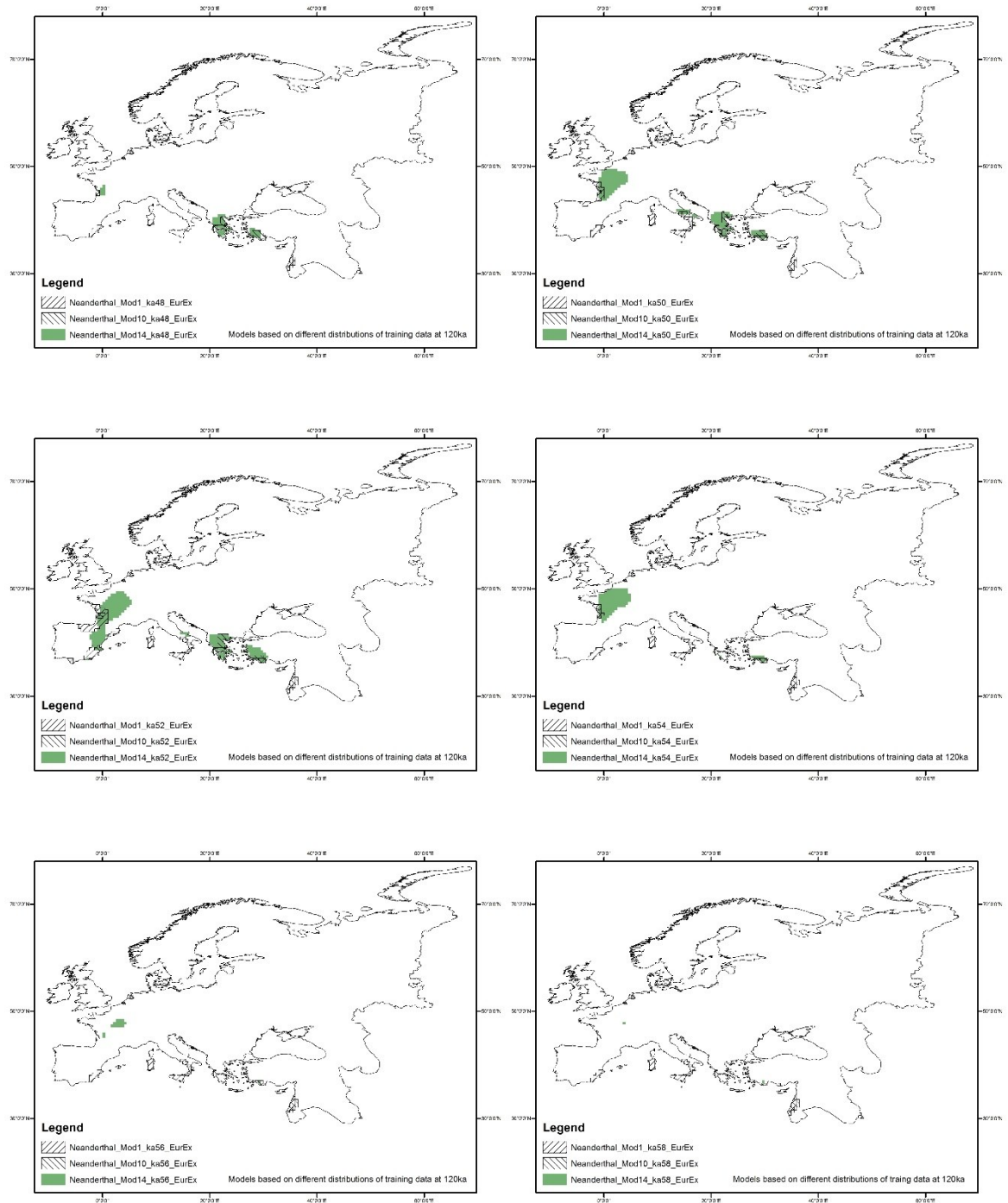
4.5 Site selection for 44 and 42ka.

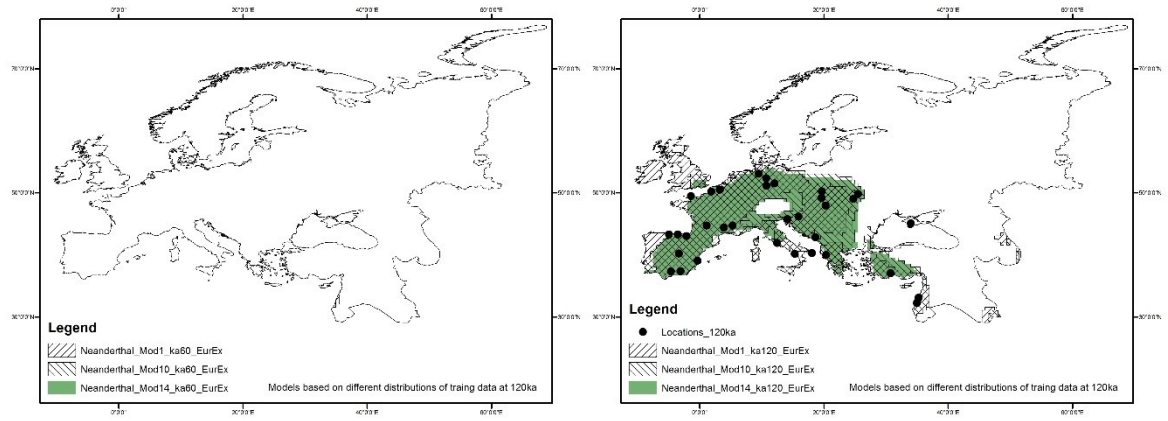
Selection of sites from Higham et al. (2014): Those that fall within the Bayesian analysis of 45-43 (black rectangle) and 43-41ka (grey rectangle). These sites are also part of the audited database designed for this thesis.



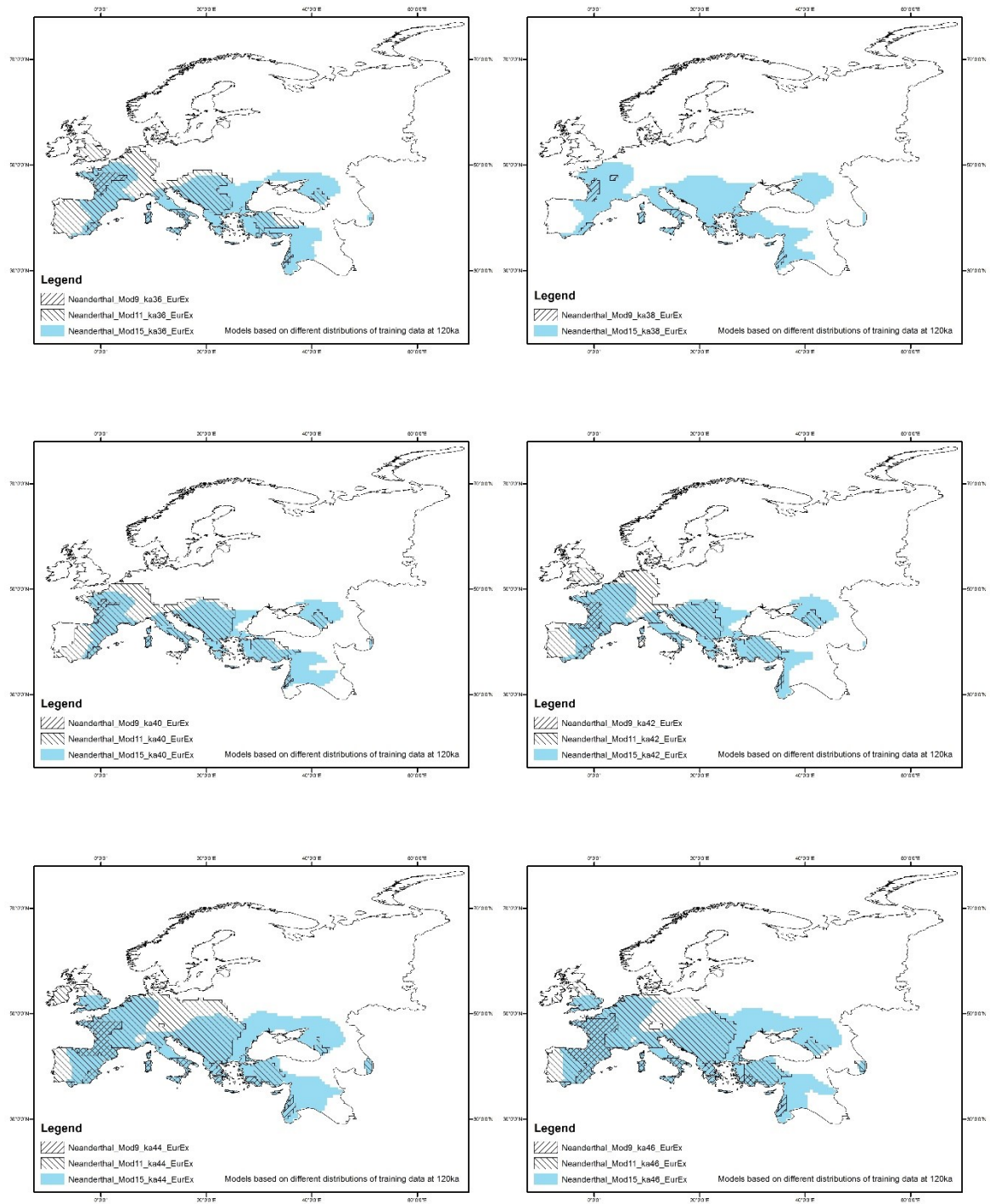
4.6 Models based on Ka120 distribution

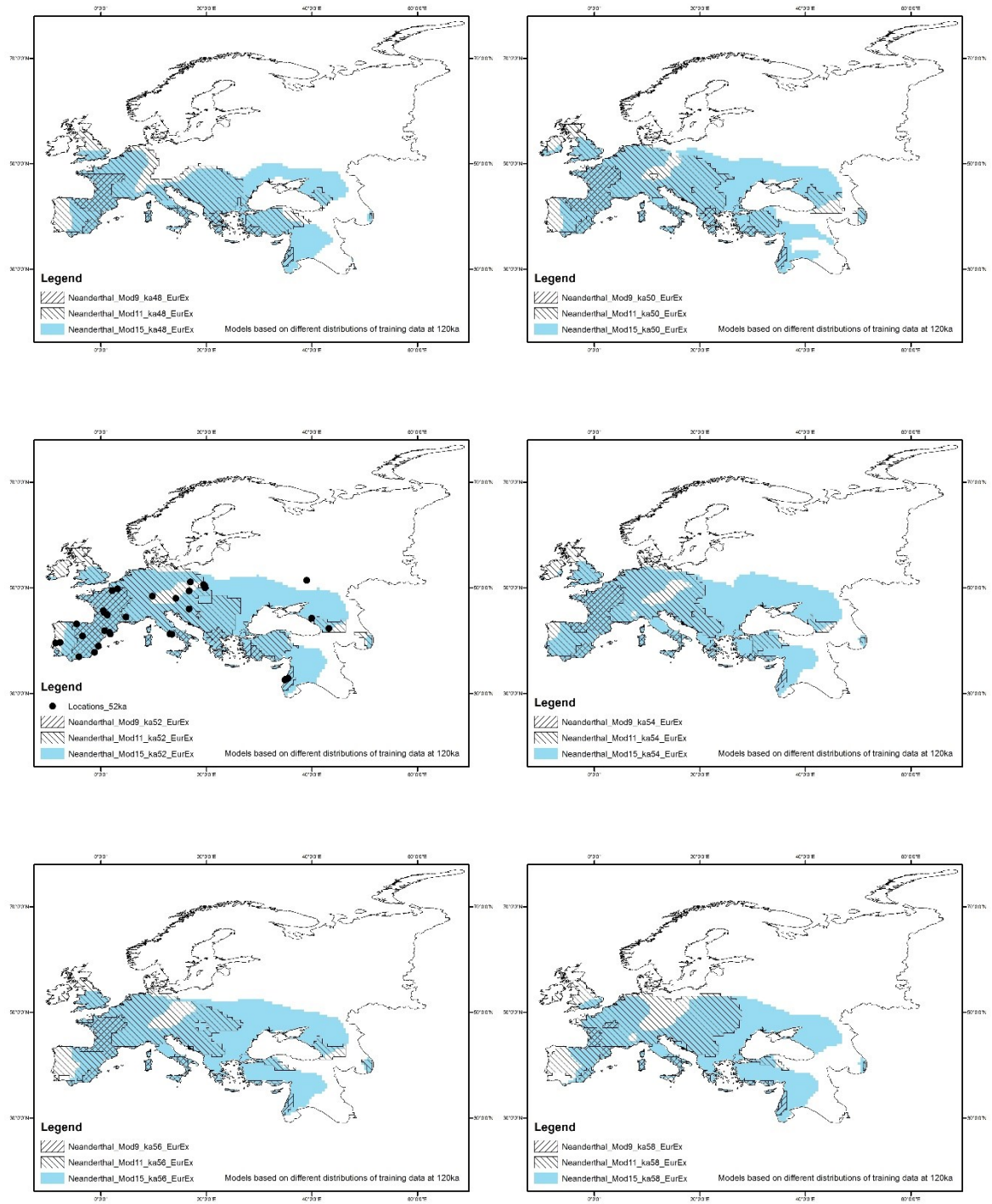


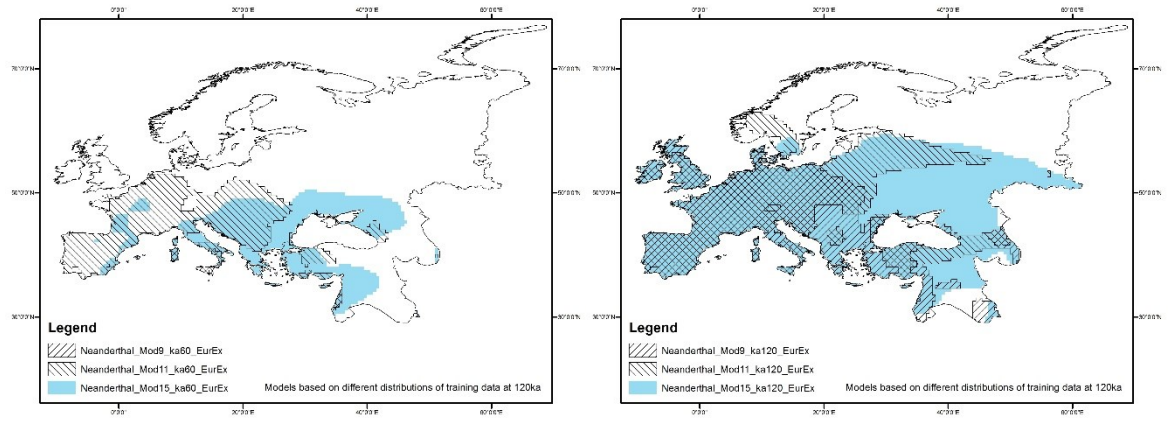




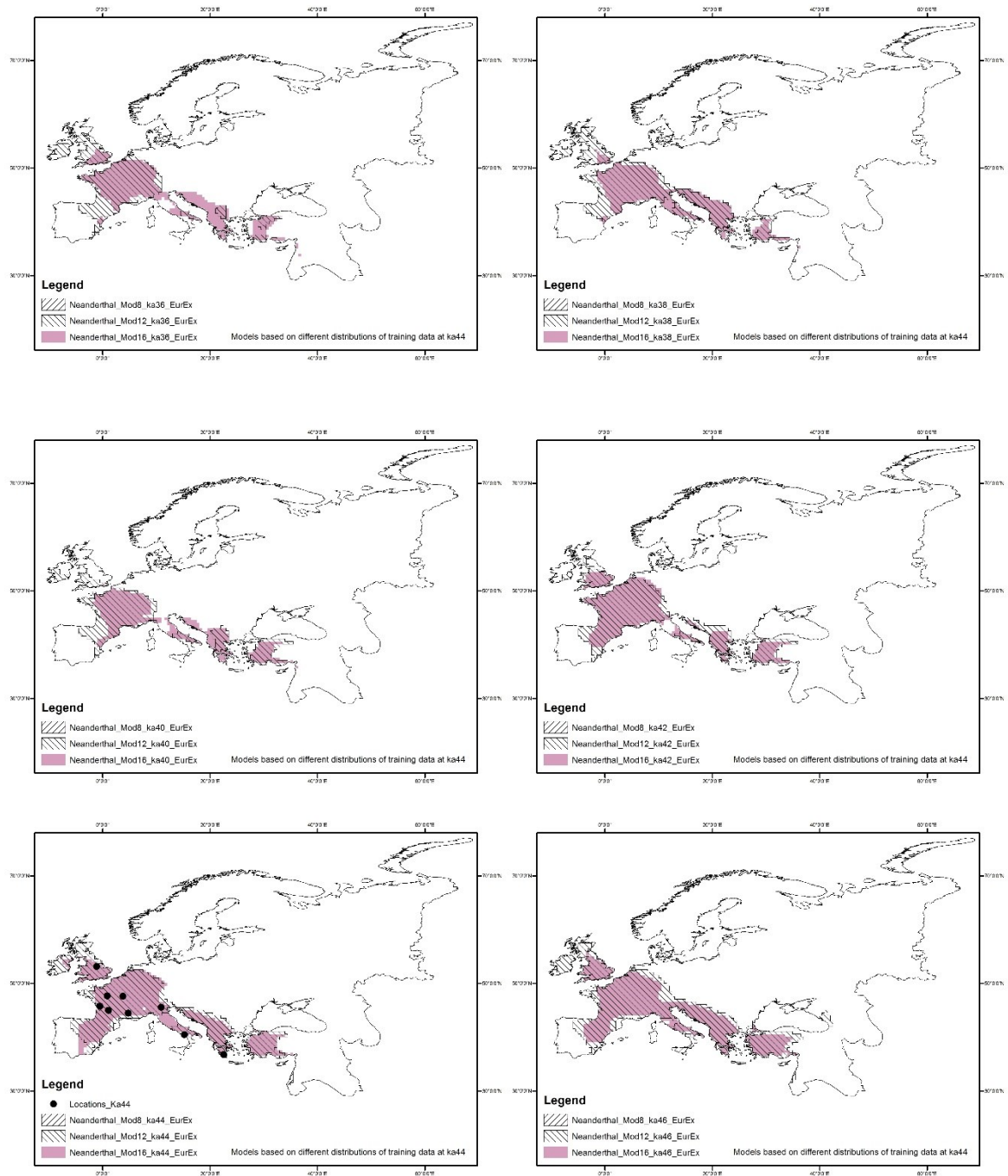
4.7 Models based on Ka52 distribution

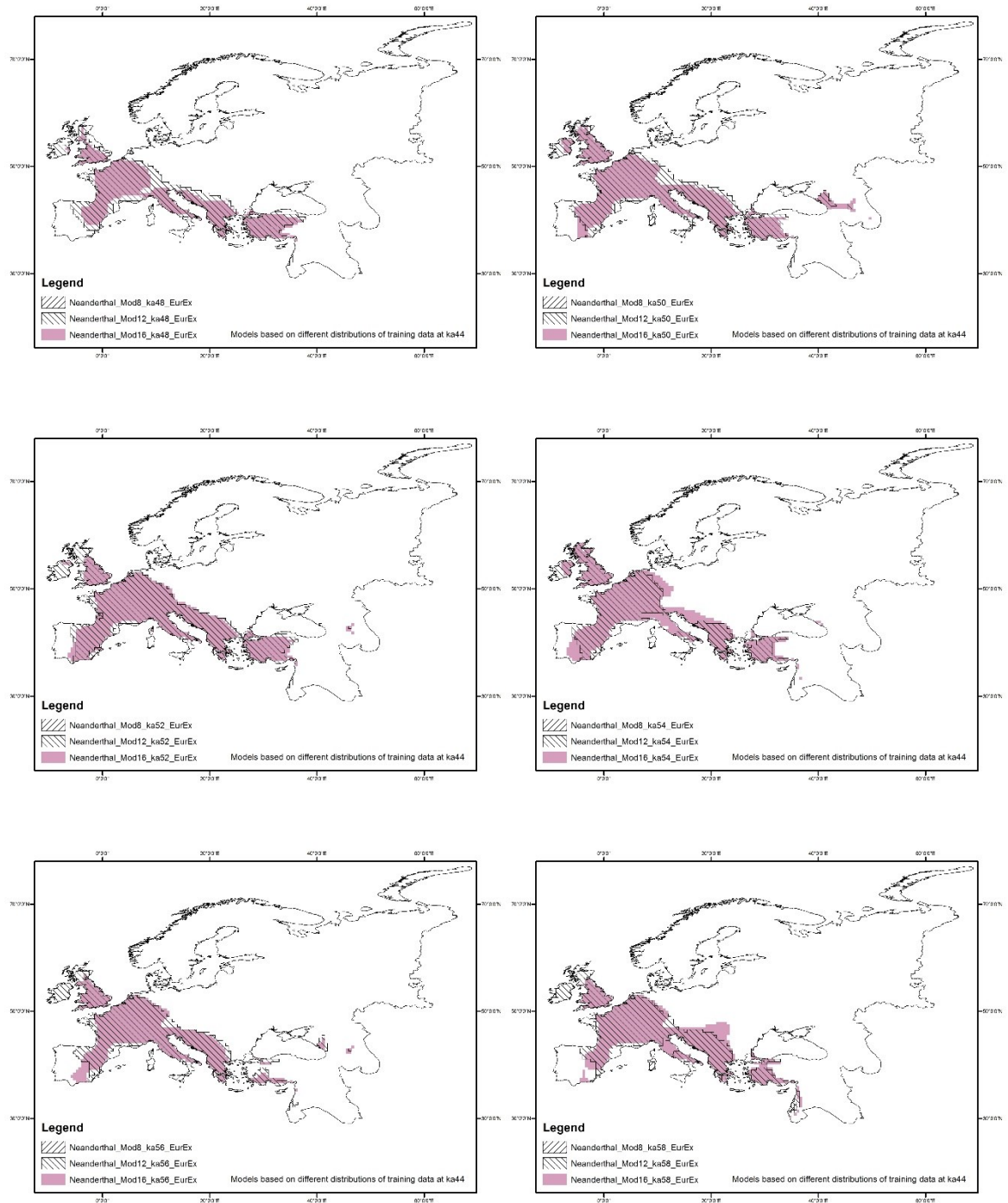


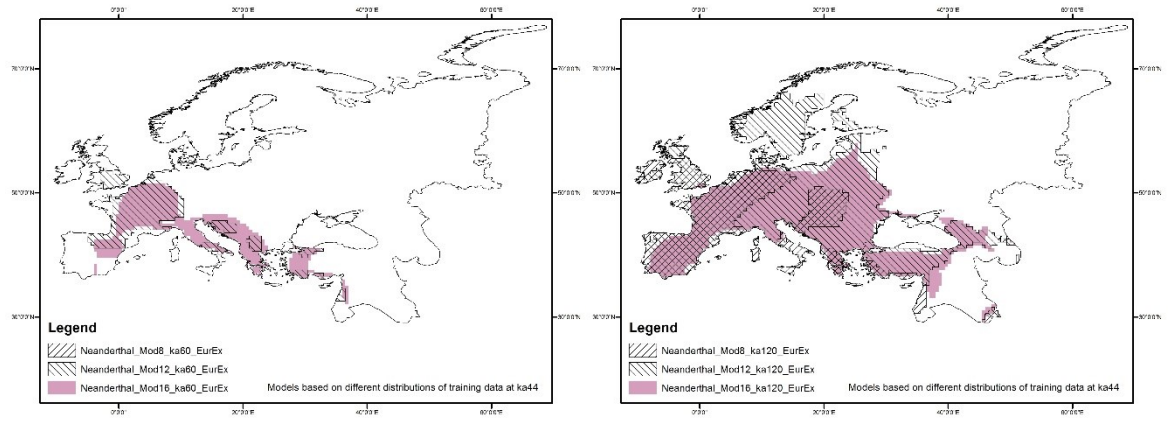




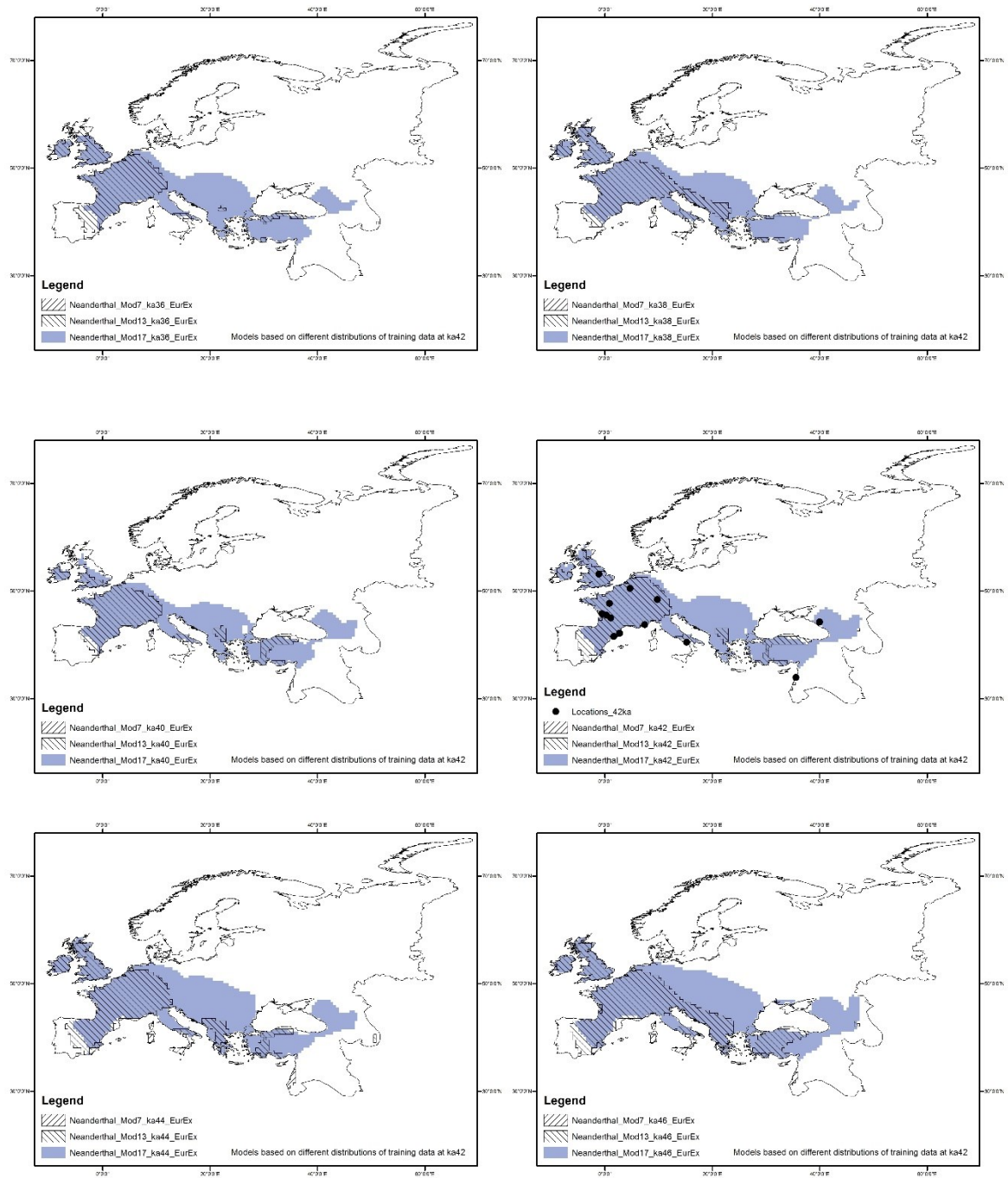
4.8 Models based on Ka44 distribution

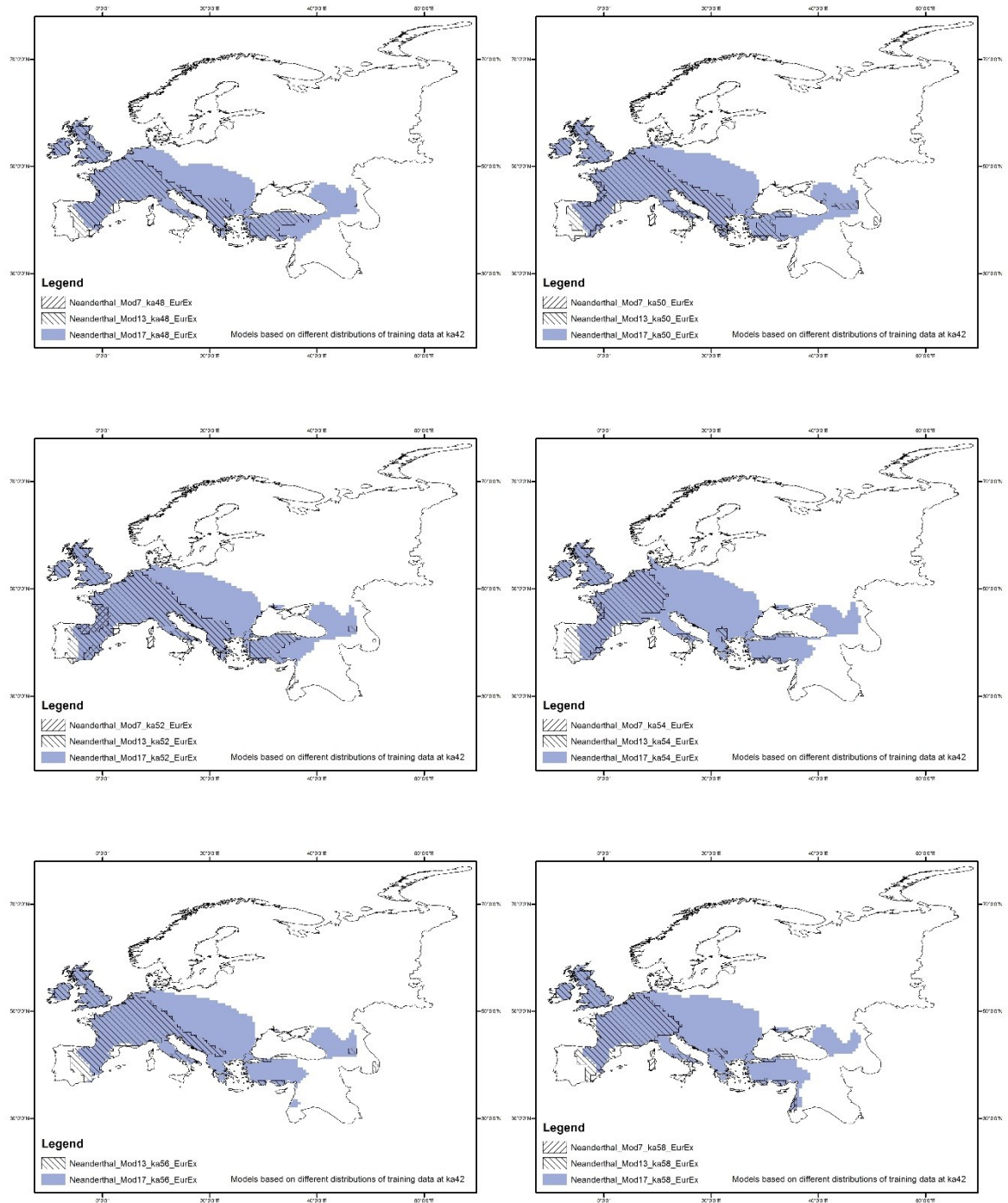


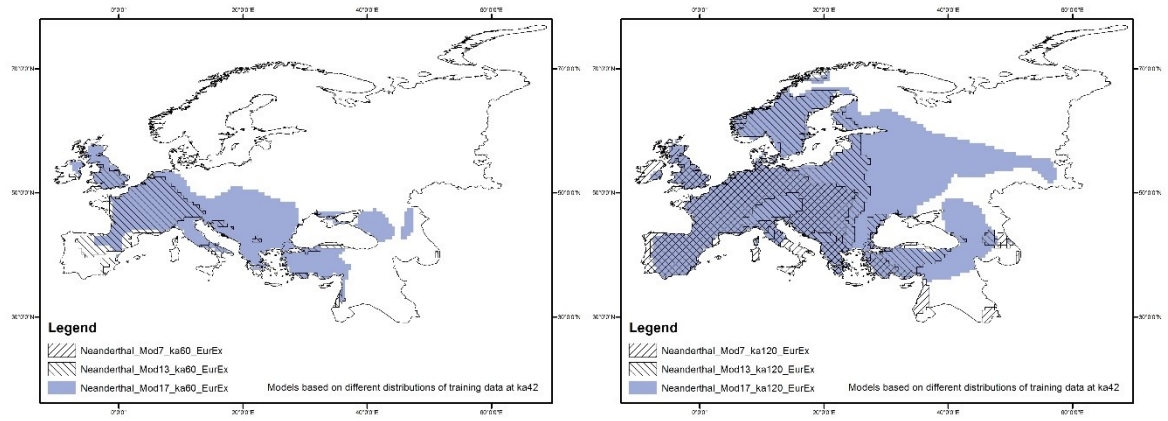




4.9 Models based on Ka42 distribution

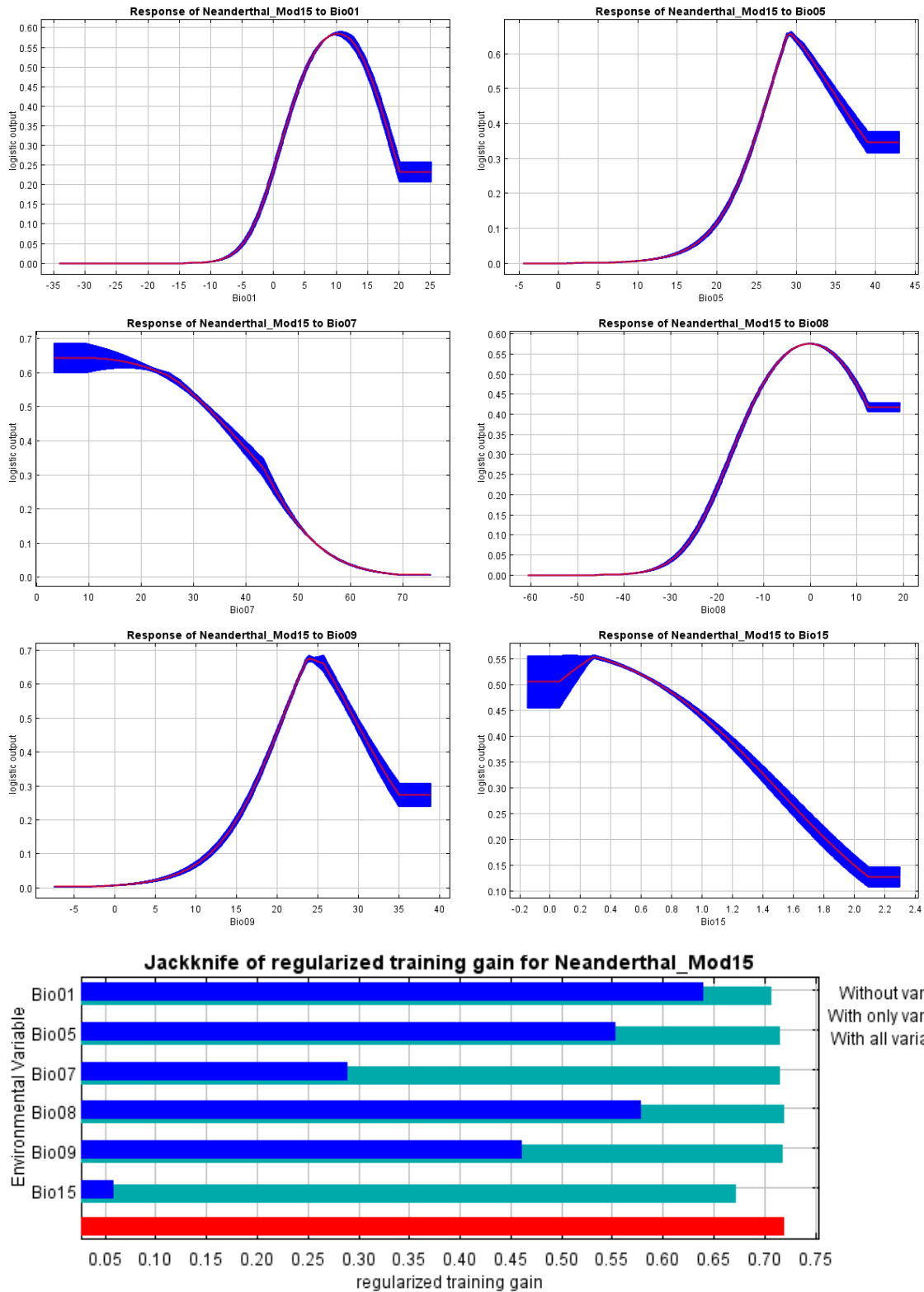






4.10 Appendix: Model 15 Variable importance

Variable	Percent contribution	Permutation importance
Bio01	77	61.7
Bio08	6.9	0.6
Bio05	6.4	13.5
Bio15	5.5	16.5
Bio09	2.2	2.6
Bio07	2	5.1



4.11 Comparison Model 15 bio01 to GI/GS

Ka time frame	GI/GS number	Mean annual temp °C (Bio01) for model 15
60	GS-18	6.61
58	GS-16.2	7.37
56	GS-16	7.24
54	GI-14d	7.59
52	GI-14c	7.64
50	GI-14a	7.49
48	GS-13	7.68
46	GI-12c	7.58
44	GS-12	7.80
42	GS-11	6.99
40	GI-9	7.36
38	GI-8	7.51
36	GS8	7.49