

# Report about collection of hunting, presence and abundance data of ungulates and carnivores in Europe

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## Abstract

This report provides an overview of abundance data collection on wild boar, wild ruminants, and wild carnivores across Europe, focusing mainly on hunting statistics. It aims to assess the current state of available data, highlighting gaps and challenges in data collection and harmonization across different regions. The data collection activities by *ENETWILD* during the period Sep 2023 to Sep 2024 introduces relevant improvements regarding hunting data. These enhancements are reflected in temporal resolution, spatial resolution, the inclusion of new countries and regions, and the addition of new species. In most of the countries, data obtained in previous years were updated till the hunting season 2022/2023 (2023/2024 in some cases). This important improvement in data collection will allow addressing new and improved spatial distribution models on species distribution and abundance with more, better resolution and new species data in the next future. Still, *ENETWILD* should develop an evaluation with each data provider about issues encountered that can impede the data submission, especially about hunting bag data, in the perspectives of retrieving data without the need of an intermediate role of a data cleaner and of automatizing the data submission.

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**Key words:** ungulates, carnivores, wild boar, wildlife data collection, wildlife management legislation, wildlife monitoring, international coordination, science-based decision-making

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## Summary

**Background:** This report provides an overview of abundance data collection on wild boar, ruminants, and carnivores across Europe, focusing mainly on hunting statistics. It aims to assess the current state of available data, highlighting gaps and challenges in data collection and harmonization across different regions. The primary species of concern include wild boar, due to its role in disease transmission, and various ruminants and carnivores, important for their ecological and economic impacts. The report also outlines the methodologies used for gathering and standardizing data from multiple sources. Furthermore, the report discusses the practical applications of the collected data for wildlife management, disease control, and conservation. Ultimately, it serves as to promote the existence of data which constitute a resource for researchers and policymakers to improve data-driven decision-making in wildlife conservation across Europe.

**Results:** The data collection activities during the first specific contract of *ENETWILD* 2.0 (Sep 2023-Sep 2024) introduces relevant improvements over the previous 2023 report regarding hunting data. These enhancements are reflected in temporal resolution, spatial resolution, the inclusion of new countries, and the addition of new species. In most of the countries, data obtained in previous years were updated till the hunting season 2022/2023 (2023/2024 for some), which will result in better understating in the general trends in hunting statistics across Europe. Some countries present a large delay in data provision, often several years, which may prevent from rapid use of recent data in certain European regions. We manage to collect data from additional countries and spatial and time resolution of data was increased in others, and the temporal range has been extended in others, covering longer period. We were provided new data for species that were either missing or inconsistently reported in the previous 2023 report. The inclusion of these species represents an important improvement in data collection, allowing for more accurate population monitoring and management of a broader range of wildlife across different European regions. All these improvements allowed obtaining the most recent available data which is crucial for accurately predicting population trends and assessing potential risks. Up-to-date data is essential for making informed decisions about wildlife management, conservation efforts, and risk mitigation or disease control, particularly for species that impact agriculture, biodiversity, and disease transmission. The 2024 data collection efforts have resulted in the inclusion of several new species, which were not previously covered in the earlier datasets. This expansion in species coverage significantly enhances the comprehensiveness of wildlife monitoring and provides more detailed insights into species distribution and abundance across Europe.

**Discussion, perspectives, and recommendations:** The improvements on wildlife data collection presented in this report evidence that aspects increasing spatial range, widening the list of species as well as improving resolution of data are priority, and continuously under the focus of *ENETWILD* data collection activities. Based on the advancements and challenges highlighted in this report, several important areas for future data development can be identified.

- First, efforts should focus on expanding both the temporal and spatial coverage and resolution of wildlife data across Europe. Filling gaps in recent data and encouraging countries to provide data at the hunting ground level, which offers the highest spatial resolution, will improve the accuracy of population trend analysis and risk assessments.
- Second, while we present relevant improvement, the inclusion of additional species in future datasets (e.g., lagomorphs) is still necessary to better monitor ecologically and economically significant species that are currently underrepresented. The inclusion of these species represents an important improvement in data collection, allowing for more accurate population monitoring and management of a broader range of wildlife species across different European regions. This will allow addressing new and improved spatial distribution models on species distribution and abundance with more, better resolution and new species data in the future.
- Third, data standardization and harmonization from the source should continue to be a priority. While significant progress has been made, further efforts are needed to ensure all countries adopt consistent reporting formats, such as the Wildlife Data Model (WLDM). This will make it easier to compare and integrate data across regions.
- Fourth, future data collection should leverage technological tools to improve accuracy and efficiency. The use of tools like remote sensing, camera traps, drones, and citizen science platforms can help cover difficult areas and provide real-time data. Artificial intelligence (AI) could also be used for automated species identification and trend analysis, making data processing faster and more reliable.
- Fifth, international collaboration must be strengthened to improve data collection and sharing. Countries with less developed wildlife monitoring systems could benefit from support, both technically and in terms of resources. Greater cooperation between governments, research organizations, and local stakeholders will help ensure that wildlife data is kept up-to-date and accessible.

Future data development should focus on ensuring that wildlife data is used effectively in policymaking and management. Data should be tailored to meet specific objectives, such as risk assessment, mitigating human-wildlife conflicts, controlling invasive species, and conserving biodiversity. Linking data collection directly to management outcomes will enhance its usefulness in shaping sustainable wildlife management policies across Europe. Some countries present a large delay in providing data since, which may impede rapid use of recent data, which often is urgent, such in the case of ASF outbreak in new areas. We encourage hunting services and hunting associations to speed up the data collection and availability process, which will be beneficial to their purposes to develop informed management based on recently collected data. The incorporation of IT tools and a harmonized data model would be helpful, as well as increasing the technical and administrative staff devoted to this issue.

Finally, we remark that focusing on these areas will ensure that future wildlife data collection efforts are more comprehensive and effective, contributing to the long-term health and sustainability of ecosystems in Europe. *ENETWILD* should develop an evaluation with each data provider about issues encountered that can impede the data submission, especially about hunting bag data, in the perspective of retrieving data without the need of an intermediate role of a data cleaner and in the perspective of automatizing the data submission.

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# 1 Introduction

Accurate and comprehensive data collection is critical for effective wildlife management, conservation, and disease control. In Europe ruminant and carnivorous species play vital roles in ecosystems but are also involved in significant human-wildlife conflicts, agricultural damage, and disease transmission. Reliable data on the presence, abundance, and distribution of these species is essential to understanding their population dynamics, managing their impacts, and informing policy decisions. Wildlife data is essential for disease surveillance and control, particularly for species like wild boar, which are known vectors for diseases such as African Swine Fever (ASF) (*ENETWILD*-consortium 2023a). Monitoring populations of these animals provides an early warning system for potential outbreaks, allowing timely interventions to limit disease spread and minimize economic and ecological damage.

Data collection on wildlife serves several key purposes. It is vital for conservation and biodiversity management, as it allows for the monitoring of populations of species like wild boar, deer, and large carnivores. This information helps assess their conservation status and informs strategies for habitat preservation, species recovery, and biodiversity enhancement. In turn, these efforts ensure ecosystems remain balanced and resilient. Data also plays a crucial role in mitigating human-wildlife conflict. For example, wild boar and other ungulates can cause extensive damage to crops, while carnivores may threaten livestock. Detailed information on species abundance and movements enables authorities to develop measures that reduce such conflicts, facilitating coexistence between human activities and wildlife. In addition, data on the distribution of both native and invasive species is critical for managing ecosystems. Tracking species movements helps prevent the spread of invasive animals that can harm native species and disrupt biodiversity. Wildlife data also supports policy and decision-making, as governments and conservation bodies rely on accurate, up-to-date information to create laws, set hunting quotas, and designate protected areas. Without this data, policies may not fully address the needs of wildlife populations or the ecosystems they inhabit.

Despite its importance, wildlife data collection in Europe faces several challenges. National monitoring systems differ, leading to variations in data availability. Additionally, logistical issues such as difficult terrain and geopolitical barriers can limit data collection efforts. Furthermore, the spatial and temporal coverage of the available data is often inconsistent, making it challenging to form a comprehensive understanding of species distribution and abundance across Europe. To overcome these obstacles, initiatives such as the *ENETWILD* consortium aim to standardize and harmonize data from multiple sources across Europe. By centralizing information on species presence, abundance, and density, these efforts provide a foundation for building spatial models (*ENETWILD*-consortium2023b) that predict population changes, identify critical habitats, and assess the risk of disease spread. These models are invaluable tools for conservationists, wildlife managers, and policymakers as they navigate the complexities of wildlife management.

In addition to providing valuable insights, the data collected supports the development of geospatial tools that allow stakeholders, from policymakers to researchers, to visualize and analyse wildlife trends in a user-friendly way. These tools are instrumental in conducting risk

assessments, developing wildlife management strategies, and planning conservation efforts at both regional and national levels.

In conclusion, comprehensive data collection on wildlife presence, abundance, and distribution is essential for managing the animal and public health impacts of key species as well as, economic and ecological impacts. It forms the foundation for effective conservation strategies, helps mitigate human-wildlife conflicts, and supports disease control efforts, ensuring that Europe's biodiversity and ecosystems remain resilient and sustainable.

## 1.1 Background and terms of reference as provided by the requestor

The contract entitled "Wildlife and One Health: wildlife ecology, health surveillance and interaction with livestock, human population, and environment" (framework contract number: OC/EFSA/BIOHAW/2022/01) was awarded to the University of Torino by EFSA. From here, we refer to this framework contract as to the *ENETWILD* project. The Specific Contract 1 (SC1) of the framework contract refers to "Wildlife ecology, health surveillance and interaction with livestock, human population and environment".

Within SC1, Work Package 2 (WP2 – Data collection) refers to the collection of existing hunting, occurrence and abundance data from official statistics and other resources from different countries across Europe. Specifically, task 2.4. of WP2 aims to continue data collection for wild ungulates and wild carnivores, to upload new data in the online platform (web app) with newly collected data up to hunting season 22-23. The deliverables of this Task are: Report on data collection activities to be stored in a dedicated Sharepoint provided by EFSA and updated data in the online platform, which is due by September 30th 2024.

## 1.2 Scope of the report

This report provides an overview of data collection, mainly hunting statistics, on wild boar, ruminants, and carnivores across Europe, focusing on their presence, abundance, and density. It aims to assess the current state of available data, highlighting more relevant progress, gaps and challenges in data collection and harmonization across different regions. The primary species of concern include wild boar, due to its role in disease transmission, and various ruminants and carnivores, important for their ecological and economic impacts. The report also outlines the methodologies used for gathering and standardizing data from multiple sources. Furthermore, the report discusses the practical applications of the collected data for wildlife management, disease control, and conservation. Ultimately, it serves as a resource for researchers and policymakers to improve data-driven decision-making in wildlife conservation across Europe.

# 2 Species data availability and collection status

## 2.1 Wild boar data

Collecting wild boar data is one of the most crucial tasks in wildlife monitoring and management, particularly in light of the spread of African Swine Fever (ASF) across Europe. ASF poses a significant threat not only to the socio-economic landscape, due to its potential to devastate pig farming industries, but also to the environment by severely impacting native wild boar populations. This highly virulent disease causes high mortality rates in wild boar, leading to rapid declines in population densities and slow recovery due to the species' biological constraints. Monitoring wild boar populations is essential for understanding the scale of the disease's impact and developing strategies for disease control and population recovery. Accurate data collection is critical for implementing effective measures, such as biosecurity protocols and hunting regulations, which can help manage ASF outbreaks. However, a significant challenge remains: some countries still lack clear policies for systematically collecting and reporting wild boar statistics. This gap in data hinders the ability to develop a coordinated response to ASF, underlining the urgent need for more standardized data collection practices across all affected regions.

The Table 1 summarizes the up-to-date status of hunting data collected over European countries for wild boar, indicating the time period, resolution, and main progress respect to the previous report (2023).

Table 1. Up-to-date status of hunting data collected by *ENETWILD* over European countries for wild boar, indicating the time period, resolution, and main progress respect to the previous report (2023).

Country (code)	Previous report (end <i>ENETWILD</i> 1)		Present report (SC1 <i>ENETWILD</i> 2)		Progress SC1 <i>ENETWILD</i> 2
	Data period	Resolution	Data period	Resolution	
AD	2016-2022	administrative unit	2016-2023	administrative unit	Updated data
AT	2011-2016; 2020	administrative unit			
BE	2014-2022	administrative unit	2018; 2021-2023	administrative unit	Updated data and expanded geographical extension
	2015	administrative unit			
BG	2014-2020	administrative unit			
BY	2002-2021	administrative unit			
CH	2013-2017	administrative unit	2019-2022	administrative unit	Updated data
CZ	2016	administrative unit	2017-2021	administrative unit	Updated data
DE	2012-2020	administrative unit			
DK	2011-2019	administrative unit			



EE	2013-2021	hunting ground	2013-2022	hunting ground	Updated data
ES	2008-2020	administrative unit			
	2012-2023	hunting ground	2020-2024	hunting ground	Updated data
			2023	management unit	New data (spp & Country)
FI	2014-2021	management unit	2014-2023	management unit	Updated data
FR	2017-2020	administrative unit	1973-2022	administrative unit	Updated data
GR	2014-2020	administrative unit	2021	administrative unit	Updated data
HR	2015-2018; 2021	administrative unit			
	2018-2020	hunting ground	2022	hunting ground	Updated data
HU	2014-2021	management unit			
IT	2014-2022	administrative unit	2015-2022	administrative unit	Updated data and expanded geographical extension
	2014-2017; 2019-2021	hunting ground	2018-2023	hunting ground	
	2011; 2014-2021	management unit	2014-2023	management unit	
LT	2014-2016	administrative unit	2014-2022	administrative unit	Updated data
	2014-2017	hunting ground			
	2015-2023	hunting ground			
LV	2003; 2013-2017	management unit			
ME			2016-2018	administrative unit	New data (spp & Country)
MK	2014-2021	administrative unit			
PL	2015-2021	hunting ground	2015-2022	hunting ground	Updated data
PT	2012-2020	administrative unit			
	1989-2020	hunting ground			
RO	2016-2020	hunting ground			

			2022	administrative unit	New data (spp & Country)
RS	2021	administrative unit			
RU	2014-2020	administrative unit			
SE	2012-2018	administrative unit			
	2019	hunting ground			
SI	2014-2022	management unit	2010-2024	management unit	Updated data
SK	2010-2020	hunting ground			
TR			2024	administrative unit	New data (spp & Country)
			2023	hunting ground	New data (spp & Country)
UA	2015-2019	administrative unit			

## 2.2 Wild ruminant data

Collecting data on ruminant species is equally critical for wildlife management, as these animals play a key role in both ecosystem health and human activities across Europe. Ruminants such as red deer, roe deer, and moose influence vegetation dynamics, biodiversity, and habitat structure through their grazing patterns, but they can also cause conflicts with agriculture due to crop damage and competition with livestock for resources. Monitoring the presence, abundance, and density of ruminant populations is vital for maintaining a balance between conservation and human land use.

In particular, ruminant data is essential for developing effective hunting quotas and conservation strategies. Overpopulation can lead to habitat degradation, while underpopulation might indicate environmental stress or disease outbreaks. Additionally, many ruminants are important for biodiversity conservation as they serve as prey for large carnivores and contribute to the overall structure of ecosystems.

Unfortunately, the collection of ruminant data varies greatly across countries, with some lacking systematic approaches to gathering and analysing this information. Inconsistent data collection can hinder efforts to understand the spatial distribution and population dynamics of these species, making it more difficult to address conservation challenges or mitigate their impacts on agriculture. To effectively manage ruminant populations and ensure sustainable ecosystems, it is essential to implement standardized data collection practices across Europe. This will enable better decision-making regarding wildlife management, habitat protection, and agricultural conflict resolution.

The Table 2 summarizes the up-to-date status of hunting data collected over European countries for wild ruminants, indicating the time period, resolution, and main progress respect to the previous report (2023).

Table 2. Up-to-date status of hunting data collected by *ENETWILD* over European countries for wild ruminants, indicating the time period, resolution, and main progress respect to the previous report (2023).

Species	Country (code)	Previous report (end <i>ENETWILD</i> 1)		Present report (SC1 <i>ENETWILD</i> 2)		Progress SC1 <i>ENETWILD</i> 2
		Data period	Resolution	Data period	Resolution	
<i>Alces alces</i>	EE	2013-2019	hunting ground	2013-2022	hunting ground	Updated data
	FI	2000-2021	management unit	2000-2023	management unit	Updated data
	LT			2014-2022	administrative unit	New data (spp & Country)

	LV			2003; 2005; 2014-2022	hunting ground	New data (spp & Country)
	PL			2015-2022	hunting ground	New data (spp & Country)
	SE	2012-2020	administrativ e unit			
<i>Ammotragu s lervia</i>	ES	2012-2021	hunting ground	2021-2022	hunting ground	Updated data
<i>Capra ibex</i>	AT	2020	administrativ e unit			
	SI	2014-2021	administrativ e unit	2010-2023	administrativ e unit	Updated data
<i>Capra pyrenaica</i>	ES	2012-2021	hunting ground	2021-2022	hunting ground	Updated data
<i>Capreolus capreolus</i>	AD	2014-2022	administrativ e unit	2015-2023	administrativ e unit	Updated data
	AT	2020	administrativ e unit			
	BE	2018-2022	administrativ e unit	2018-2023	administrativ e unit	Updated data and expanded geographica l extension
	BG	2020	administrativ e unit			
	BY	2000-2021	administrativ e unit			
	CH			2016-2022	administrativ e unit	New data (spp & Country)
	CZ			2017-2021	administrativ e unit	New data (spp & Country)
	DE	2012-2020	administrativ e unit			
	DK	2006-2019	administrativ e unit			
	EE	2013-2021	hunting ground	2013-2022	hunting ground	Updated data
	ES	2006; 2012-2022	hunting ground	2019-2023	hunting ground	Updated data and expanded geographica l extension

	FI	2000-2021	management unit	2000-2023	management unit	Updated data
	FR			1973-2022	hunting ground	New data (spp & Country)
	HR	2014-2019	hunting ground			Updated data
				2022	hunting ground	
	HU	2014-2021	management unit			
	IT	2014-2020	administrative unit			
		2014-2022	hunting ground			
		2016-2022	management unit	2014-2023	management unit	Updated data
	LT			2014-2022	administrative unit	New data (spp & Country)
	LV	2016-2019	hunting ground	2003; 2005; 2013-2021	hunting ground	Updated data
	LU			2017-2022	hunting ground	New data (spp & Country)
	MK	2014-2019	administrative unit			
	PL			2015-2022	hunting ground	New data (spp & Country)
	PT	1993; 1994;1996;1997;1999; 2010-2020	hunting ground			
	RO	2014; 2015; 2017-2021	administrative unit			
	RS	2015; 2017	administrative unit			
	SE	2012-2018	administrative unit			
		2019	hunting ground			
	SI	2014-2021	administrative unit	2010-2024	administrative unit	Updated data
	SK	2010-2020	hunting ground			
<i>Cervus elaphus</i>	AD	2015; 2017; 2018; 2020-2022	administrative unit	2015-2023	administrative unit	Updated data

AT	2020	administrative unit			
BE	2018-2022	administrative unit	2022-2023	administrative unit	Updated data and expanded geographical extension
BG	2020	administrative unit			
BY	2000-2021	administrative unit			
CH			2016-2022	administrative unit	New data (spp & Country)
CZ			2017-2021	administrative unit	New data (spp & Country)
DE	2012-2020	administrative unit			
DK	2006-2019	administrative unit			
EE	2013-2021	hunting ground	2013-2023	hunting ground	Updated data
ES	2015-2019	administrative unit			
	2012-2021	hunting ground	2019-2023	hunting ground	Updated data
FR			1973-2022	hunting ground	New data (spp & Country)
HR	2015-2019	administrative unit			
			2022	hunting ground	New data (spp & Country)
HU	2014-2021	management unit			
IT	2014-2020	administrative unit			
	2014-2022	hunting ground			
	2016-2022	management unit	2014-2023	management unit	Updated data
LT			2014-2022	administrative unit	New data (spp & Country)

	LU			2017-2022	hunting ground	New data (spp & Country)
	LV	2016-2019	hunting ground	2003; 2013-2023	hunting ground	Updated data
	MK	2014; 2016; 2017; 2019	administrative unit			
	PL			2015-2022	hunting ground	New data (spp & Country)
	RO	2014-2021	administrative unit			
	RS	2017	administrative unit			
	SE	2012-2018	administrative unit			
		2019	hunting ground			
	SI	2015-2021	administrative unit			
				2010-2024	management unit	New data (spp & Country)
	SK	2010-2020	hunting ground			
<i>Dama dama</i>	AT	2020	administrative unit			
	BE	2018-2022	administrative unit	2022-2023	administrative unit	Updated data and expanded geographical extension
	BG	2020	administrative unit			
	CZ			2017-2021	administrative unit	New data (spp & Country)
	DE	2012-2020	administrative unit			
	DK	2006-2019	administrative unit			
	ES	2015-2019	administrative unit			
2012-2021		hunting ground		2020-2023	hunting ground	Updated data

				2023	management unit	New data (spp & Country)
	FI			2000-2023	management unit	New data (spp & Country)
	FR			1983-2022	hunting ground	New data (spp & Country)
	HU	2014-2021	management unit			
	IT	2014-2019	administrative unit			
		2014-2021	hunting ground			
		2016-2021	management unit			
	LT			2014-2022	administrative unit	New data (spp & Country)
	LU			2017-2022	hunting ground	New data (spp & Country)
	PL	2015-2021	hunting ground	2015-2022	hunting ground	Updated data
	PT	1989; 1990; 1992-2001; 2006-2020	hunting ground			
	RO	2014-2021	administrative unit			
	RS	2015; 2017	administrative unit			
	SE	2012-2018	administrative unit			
		2019	hunting ground			
	SI	2014-2021	administrative unit	2010-2024	administrative unit	Updated data
	SK	2010-2020	hunting ground			
<i>Muntiacus reevesi</i>	DK	2018-2019	administrative unit			
<i>Odocoileus virginianus</i>	FI			2000-2023	management unit	New data (spp & Country)
<i>Ovis aries</i>	AD	2014-2022	administrative unit	2014-2024	administrative unit	Updated data



AT	2020	administrative unit			
BE			2018; 2021; 2022	administrative unit	New data (spp & Country)
BG	2020	administrative unit			
CZ			2017-2021	administrative unit	New data (spp & Country)
DE	2012-2020	administrative unit			
DK	2012-2019	administrative unit			
ES	2012-2021	hunting ground	2021-2022	hunting ground	Updated data
FI			2014-2023	management unit	New data (spp & Country)
FR			1973-2022	hunting ground	New data (spp & Country)
HU	2014-2021	management unit			
IT	2014-2020	administrative unit			
	2014-2020	hunting ground			
LU			2017-2022	hunting ground	New data (spp & Country)
MK	2014-2019	administrative unit			
PL			2021-2022	hunting ground	New data (spp & Country)
PT	1990; 1993; 1997; 1999; 2000; 2005; 2006; 2009-2014; 2016-2019	hunting ground			
RS	2015; 2017	administrative unit			
SI	2014-2021	administrative unit	2010-2024	administrative unit	Updated data
SK	2010-2020	hunting ground			

<i>Rangifer tarandus</i>	FI	2000-2021	management unit	2000-2023	management unit	Updated data	
<i>Rupicapra pyrenaica</i>	AD	2014-2022	administrative unit	2014-2023	administrative unit	Updated data	
	FR			1973-2022	hunting ground	New data (spp & Country)	
	ES	2015-2019	administrative unit				
		2013-2021	hunting ground				
<i>Rupicapra rupicapra</i>	AT	2020	administrative unit				
	BG	2020	administrative unit				
	CH			2016-2022	administrative unit	New data (spp & Country)	
	ES				2021-2023	hunting ground	New data (spp & Country)
					2023	management unit	New data (spp & Country)
	FR			1973-2022	hunting ground	New data (spp & Country)	
	IT		2014-2020	administrative unit			
			2014-2022	hunting ground			
			2016-2022	management unit	2014-2023	management unit	Updated data
	MK	2014-2019	administrative unit				
	RO	2014-2021	administrative unit				
	RS	2015; 2017	administrative unit				
	SI		2014-2021	administrative unit			
				2010-2024	management unit	New data (spp & Country)	



## 2.3 Wild carnivore data

Collecting data on large and mesocarnivore species is crucial for understanding their role in ecosystems and managing their often complex often-complex relationship with human activities. Large carnivores like wolves, bears, and lynx are key apex predators that help regulate prey populations and maintain biodiversity, while mesocarnivores such as red foxes, badgers, and wildcats play significant roles in controlling smaller prey species and scavenging. However, these species also frequently come into conflict with humans, particularly in rural areas where livestock predation and competition with hunters are ongoing concerns.

Accurate data on the distribution, abundance, and behaviour of carnivores is essential for developing strategies to promote coexistence between these species and human communities. For example, monitoring predator populations helps to assess the effectiveness of conservation measures, such as habitat protection and legal protection statuses, as many carnivores are protected by national and European regulations. In addition, carnivore data is vital for understanding ecosystem health, as their presence or absence can indicate broader environmental changes. Some species, such as foxes, are also relevant to shared and zoonotic diseases, such as rabies or echinococcosis.

Despite their ecological importance, the collection of carnivore data is often challenging due to the elusive nature of these animals and the legal and regulatory complexities surrounding their protection. In many regions, carnivores are protected species, making it difficult to obtain accurate population data without infringing on strict conservation laws. Moreover, some countries lack comprehensive monitoring systems for these species, which can lead to data gaps that impede coordinated conservation efforts.

For mesocarnivores, the situation can be even more complex, as they are often not as closely monitored as their larger counterparts, despite their impact on small game species and agricultural areas. To effectively manage both large and mesocarnivores, it is essential to establish standardized data collection protocols across Europe. This will ensure that wildlife managers and conservationists have the necessary information to make informed decisions about species protection, conflict mitigation, and ecosystem management.

The Table 3 summarizes the Up-to-date status of hunting data collected by *ENETWILD* over European countries for wild carnivores, indicating the time period, resolution, and main progress respect to the previous report (2023).

Table 3. Up-to-date status of hunting data collected by *ENETWILD* over European countries for wild carnivores, indicating the time period, resolution, and main progress respect to the previous report (2023).

Species	Country (code)	Previous report (end ENETWILD 1)		Present report (SC1 ENETWILD 2)		Progress SC1 ENETWILD 2
		Data period	Resolution	Data period	Resolution	
<i>Canis aureus</i>	BG	2020	administrative unit			
	EE	2015-2021	hunting ground	2015-2022	hunting ground	Updated data
	HR	2018-2021	hunting ground			Updated data
				2022	hunting ground	
	PL			2015-2022	hunting ground	New data (spp & Country)
	RO	2014-2021	administrative unit			
	RS	2015; 2017	administrative unit			
	SI	2015-2022	management unit	2010-2024	management unit	Updated data
<i>Canis lupus</i>	BG	2020	administrative unit			
	EE	2014-2021	hunting ground	2014-2022	hunting ground	Updated data
	ES	2019	administrative unit			
		2010-2013; 2015; 2017	hunting ground			
	FI	2014-2021	management unit	2014-2023	management unit	Updated data
	LV	2017-2019	administrative unit	2017-2023	administrative unit	Updated data
	MK	2014-2019	administrative unit			
	RS	2017	administrative unit			
	SE	2014-2017; 2020	administrative unit			
	SI			2010-2024	management unit	New data (spp & Country)
<i>Lynx lynx</i>	EE	2014-2015	hunting ground			New data (spp & Country)
				2014-2022	management unit	
	FI	2014-2021	management unit	2014-2023	management unit	Updated data
	LV			2017-2021	hunting ground	New data (spp & Country)

	SE	2012; 2014; 2015-2020	administrative unit			
<i>Meles meles</i>	AT	2020	administrative unit			
	CH	2019-2021	administrative unit			
	DE	2012-2020	administrative unit			
	EE	2014-2021	hunting ground	2014-2022	hunting ground	Updated data
	FI	1996-2021	management unit	1996-2023	management unit	Updated data
	HU	2014-2021	management unit			
	LV	2013-2015; 2017-2021	management unit			
	PL	2015-2020	hunting ground	2015-2022	hunting ground	Updated data
	RO	2014-2021	administrative unit			
	RS	2015; 2017	administrative unit			
	SE	2012-2018	administrative unit			
2019		hunting ground				
SI	2014-2022	management unit	2010-2024	management unit	Updated data	
<i>Neovison vixon</i>	EE	2021	hunting ground	2014-2022	hunting ground	Updated data
	FI	1996-2021	management unit	1996-2023	management unit	Updated data
	LT	2019	hunting ground			
	PL	2015-2021	hunting ground			
<i>Nyctereutes procyonoides</i>	AT	2020	administrative unit			
	DE	2012-2020	administrative unit			
	DK	2010-2019	administrative unit			
	EE	2014-2015; 2017-2021	hunting ground			
			2014-2022	management unit	New data (spp & Country)	

	FI			1996-2023	management unit	New data (spp & Country)
	LV	2013-2021	management unit			
	PL			2015-2020	hunting ground	New data (spp & Country)
	RO	2015; 2018; 2019	administrative unit			
<i>Procyon lotor</i>	AT	2020	administrative unit			
	BE			2021	administrative unit	New data (spp & Country)
	DE	2012-2020	administrative unit			
	DK	2012-2019	administrative unit			
	PL			2015-2020	hunting ground	New data (spp & Country)
<i>Ursus arctos</i>	EE	2014-2021	hunting ground	2014-2022	hunting ground	Updated data
	FI	2014-2021	management unit	2014-2023	management unit	Updated data
	HR	2019-2021	administrative unit			
	SE	2012-2020	administrative unit			
	SI			2010-2024	management unit	New data (spp & Country)
<i>Vulpes vulpes</i>	AT	2020	administrative unit			
	BE			2021	administrative unit	New data (spp & Country)
	BG	2020	administrative unit			
	BY	2000-2021	administrative unit			
	CH	2019-2021	administrative unit			
	DE	2012-2020	administrative unit			
	DK	2006-2019	administrative unit			
	EE	2014-2021	hunting ground	2014-2022	hunting ground	Updated data
	ES	2008-2021	hunting ground	2019-2023	hunting ground	Updated data

			2022-2023	administrative unit	New data (spp & Country)
FI	1996-2021	management unit	1996-2023	management unit	Updated data
HR	2018-2021	administrative unit			
HU	2014-2021	management unit			
IT	2014-2021	administrative unit			
	2014-2020	hunting ground			
	2016-2022	management unit	2014-2023	management unit	Updated data
LT	2014-2019	hunting ground			
LV	2013-2021	management unit			
LU			2017-2022	hunting ground	New data (spp & Country)
MK	2014-2021	administrative unit			
PL			2015-2022	hunting ground	New data (spp & Country)
PT	1989-2020	hunting ground			
RO	2014-2021	administrative unit			
RS	2015;2017	administrative unit			
SE	2012-2018	administrative unit			
	2019	hunting ground			
SI	2014-2022	management unit	2010-2024	management unit	Updated data



### 3 Improvements in Data Quality: Temporal, Spatial, and Species Coverage Expansion

The present 2024 report (SC1) introduces several improvements over the previous 2023 report regarding hunting data. These enhancements are reflected in temporal resolution, spatial resolution, the inclusion of new countries and regions, and the addition of new species.

The up-to-date maps obtained from *ENETWILD-DET* (*ENETWILD*-consortium 2023c), as well as the summary table of Annex 1 evidence data collection improvement developed under the SC1 of *ENETWILD 2.0*. Efforts in scope of data collection resulted in increasing the number of obtained data from different species. We manage to collect data from bigger number of carnivores like grey seal, otter, grey wolf, European polecat, *Marten* spp or Egyptian mongoose.

In most of the countries, data obtained in previous years were updated till the hunting season 2022/2023, which resulted in better understating in the general trends in hunting statistics across Europe. Some countries present a large delay, often several years, since data are collected from hunters until they are available for sharing in a digitalized form. This may prevent from rapid use of recent data in certain European regions. In these cases, we encourage hunting services and hunting associations to speed up the data collection and availability process, which will be beneficial to their purposes to develop informed management based on recently collected data. The incorporation of IT tools and a harmonized data model (for which we suggest using a simplification of *ENETWILD* WLDM) would be helpful. This may also require increasing the technical and administrative staff devoted to this issue.

We manage to collect data from additional countries like Bosnia and Herzegovina and spatial and time resolution of data was increased countries such as Belgium, Slovenia. In the **2024 report**, Bosnia and Herzegovina is newly included, showing significant improvements in hunting data collection. The hunting data for **European badger**, **golden jackal**, and **European polecat** are now reported from **Republika Srpska** in Bosnia and Herzegovina. The temporal resolution has been extended, covering the period from **2011 to 2023**, and the data is organized at the **NUTS1** spatial resolution. These species were either missing or inconsistently reported in the previous 2023 report, which did not include Bosnia and Herzegovina. Both aspects (increasing spatial range as well as improving resolution of data) are priority, and continuously under the focus of our data collection activities.

Since obtaining the most recent data is crucial for accurately predicting population trends and assessing potential risks, we prioritized filling the gaps in **temporal resolution** in our latest data collection efforts. Up-to-date data is essential for making informed decisions about wildlife management, conservation efforts, and risk mitigation or disease control, particularly for species that impact agriculture, biodiversity, and disease transmission. In this regard, we have successfully updated hunting data to include the **2023 hunting season** in the following countries:

1. **Belgium** (Flanders and Wallonie):
  - Species: **Wild Boar, Red Deer, Roe Deer**
  - Temporal Resolution: 2014-2023
  - Spatial Resolution: **Municipality** for Flanders and **other administrative unit** for Wallonie.
2. **Poland**:
  - Species: **Wild Boar, Red Deer, Roe Deer, Moose, Mouflon, Fallow Deer**
  - Temporal Resolution: 2015-2023
  - Spatial Resolution: **Hunting Grounds**
3. **Estonia**:
  - Species: **Wild Boar, Moose, Red Deer, Roe Deer**
  - Temporal Resolution: 2014-2023
  - Spatial Resolution: **Hunting Grounds**
4. **Italy (Trentino, Friuli Venezia Giulia, Piemonte)**:
  - Species: **Wild Boar, Red Deer, Fallow Deer**
  - Temporal Resolution: 2022-2023
  - Spatial Resolution: **District** or **Municipality**
5. **Latvia**:
  - Species: **Wild Boar, Red Deer, Moose, Roe Deer**
  - Temporal Resolution: 2015-2023
  - Spatial Resolution: **Hunting Grounds**
6. **Spain** (Various Regions):
  - Species: **Wild Boar, Red Deer, Roe Deer, Mouflon, Iberian Ibex**
  - Temporal Resolution: 2014-2023
  - Spatial Resolution: **Hunting Grounds**
7. **Slovenia**:
  - Species: **Wild Boar, Red Deer, Roe Deer**
  - Temporal Resolution: 2010-2024
  - Spatial Resolution: **Other Administrative Unit**
8. **Germany**:
  - Species: **Wild Boar, Red Deer, Sika Deer, Fallow Deer**
  - Temporal Resolution: 2012-2021
  - Spatial Resolution: **District**
9. **Portugal**:
  - Species: **Wild Boar, Red Deer, Mouflon, Fallow Deer**
  - Temporal Resolution: 1989/90 - 2022/23
  - Spatial Resolution: **Hunting Grounds**
10. **Bosnia and Herzegovina (Republika Srpska)**:
  - Species: **Wild Boar**
  - Temporal Resolution: 2011-2023
  - Spatial Resolution: **NUTS1**

The 2024 data collection efforts have resulted in the inclusion of several **new species**, which were not previously covered in the earlier datasets. This expansion in species coverage significantly enhances the comprehensiveness of wildlife monitoring and provides more detailed insights into species distribution and abundance across Europe.

### **Carnivores:**

1. **Grey Seal** (*Halichoerus grypus*)
2. **Otter** (*Lutra lutra*)
3. **Grey Wolf** (*Canis lupus*)
4. **European Polecat** (*Mustela putorius*)
5. **Marten** (*Martes species*)
6. **Egyptian Mongoose** (*Herpestes ichneumon*)

### **Ruminants and Species:**

1. **Barbary sheep** (*Ammotragus lervia*)
  - Reported in Spain, particularly in the regions of **Murcia, Valencia, and Castilla-La Mancha**.
2. **Chamois** (*Rupicapra rupicapra*)
  - Newly added with data from countries including **Bosnia and Herzegovina, Italy, and Spain** (*Rupicapra pyrenaica* in Spain).

The inclusion of these species represents an important improvement in data collection, allowing for more accurate population monitoring and management of a broader range of wildlife species across different European regions.

In Annexes 1 and 2 we present a summary of current data collection status per species and country over time, as well as the improvements in the present report.

## 4 Conclusions

- Data collection activities during the first year of *ENETWILD* 2.0 introduces relevant improvements over the previous 2023 report regarding hunting data. These enhancements are reflected in temporal resolution, spatial resolution, the inclusion of new countries and regions, as well as the addition of new species.
- In most of the countries, data obtained in previous years were updated till the hunting season 2022/2023, which will result in better understating in the general trends in hunting statistics across Europe. Some countries present a large delay in data provision, often several years, which may prevent from rapid use of recent data in certain European regions.
- We manage to collect data from additional countries and spatial and time resolution of data was increased in others, and the temporal range has been extended in others, covering longer period.
- We were provided new data for species that were either missing or inconsistently reported in the previous 2023 report. The inclusion of these species represents an important improvement in data collection, allowing for more accurate population monitoring and management of a broader range of wildlife across different European regions.

All these improvements allowed obtaining the most recent available data which is crucial for accurately predicting population trends and assessing potential risks. Up-to-date data is essential for making informed decisions about wildlife management, conservation efforts, and risk mitigation or disease control, particularly for species that impact agriculture, biodiversity, and disease transmission. Overall, the improvement of data availability has potential to significantly enhance the comprehensiveness of wildlife monitoring, providing more detailed insights into species distribution and abundance across Europe.

## 5 Perspectives for future data development

The improvement on wildlife data collection presented in this report evidence that aspects increasing spatial range, widening the list of species as well as improving resolution of data are priority, and continuously under the focus of *ENETWILD* data collection activities. The continuous improvement and expansion of wildlife data collection are essential to maintaining effective wildlife management strategies across Europe. Based on the advancements and challenges highlighted in this report, several important areas for future data development can be identified.

First, efforts should focus on expanding both the temporal and spatial coverage of wildlife data across Europe. Filling gaps in recent data and encouraging countries to provide data at the hunting ground and/or wildlife management area level, which offers the highest spatial resolution, will improve the accuracy of population trend analysis and risk assessments.

Second, the inclusion of additional species in future datasets is necessary to better monitor ecologically and economically significant species that are currently underrepresented. This could include both invasive species, which can disrupt ecosystems, and native species that play critical roles in biodiversity. The inclusion of these species represents an important improvement in data

collection, allowing for more accurate population monitoring and management of a broader range of wildlife species across different European regions. This will allow addressing new and improved spatial distribution models on specie distribution and abundance with more, better resolution and new species data in the future.

Third, data standardization and harmonization should continue to be a priority. While significant progress has been made, further efforts are needed to ensure all countries adopt consistent reporting formats, such as the Wildlife Data Model (WLDM). This will make it easier to compare and integrate data across regions.

Fourth, future data collection should leverage technological tools to improve accuracy and efficiency. The use of tools like remote sensing, camera traps, drones, and citizen science platforms can help cover difficult areas and provide real-time data. Artificial intelligence (AI) could also be used for automated species identification and trend analysis, making data processing faster and more reliable.

Fifth, international collaboration must be strengthened to improve data collection and sharing. Countries with less developed wildlife monitoring systems could benefit from support, both technically and in terms of resources. Greater cooperation between governments, research organizations, and local stakeholders will help ensure that wildlife data is kept up-to-date and accessible.

Future data development should focus on ensuring that wildlife data are used effectively in policymaking and management. Data should be tailored to meet specific objectives, such as risk assessment and mitigating human-wildlife conflicts, controlling invasive species, and conserving biodiversity. Linking data collection directly to management outcomes will enhance its usefulness in shaping sustainable wildlife management policies across Europe. Some countries present a large delay in providing data since, which may impede rapid use of recent data, which often is urgent, such in the case of ASF outbreak in new areas. We encourage hunting services and hunting associations to speed up the data collection and availability process, which will be beneficial to their purposes to develop informed management based on recently collected data. The incorporation of IT tools and a harmonized data model would be helpful, as well as increasing the technical and administrative staff devoted to this issue.

Finally, we remark that focusing on these areas will ensure that future wildlife data collection efforts are more comprehensive and effective, contributing to the long-term health and sustainability of ecosystems in Europe. *ENETWILD* should develop an evaluation with each data provider about issues encountered that can impede the data submission, especially about hunting bag data, in the perspective of retrieving data without the need of an intermediate role of a data cleaner and in the perspective of automatizing the data submission.

## 6 References

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ENETWILD-consortium, Illanas S, Croft S, Smith GC, Vicente J, Blanco-Aguilar JA, Scandura M, Apollonio M, Ferroglio E, Keuling O, Plis K, Csányi S, Gómez-Molina A, Preite L, Ruiz-Rodríguez C, López-Padilla S, Zanet S, Vada R, Podgorski T, Brivio F, Fernández-López J, Soriguer RC, Acevedo P, 2023b. Wild carnivore occurrence and models of hunting yield abundance at European scale: first models for red fox and badger. EFSA supporting publication 2023:EN-7894. 26 pp. doi: 10.2903/sp.efsa.2023.EN-7894.

ENETWILD-consortium, López-Padilla S, Blanco-Aguilar JA, Acevedo P, Sebastian M, Preite L, Illanas S, Gómez A, Fernández-López J, Vicente J, 2023c. The ENETWILD data exploration tool (*ENETWILD-DET*): a web app to visualize and download wildlife population data EFSA supporting publication 2023.28pp. 10.5281/zenodo.8214252.

## 7 Annexes

Annex 1. Availability of data on different species from European countries. Colour boxes indicate availability of hunting data

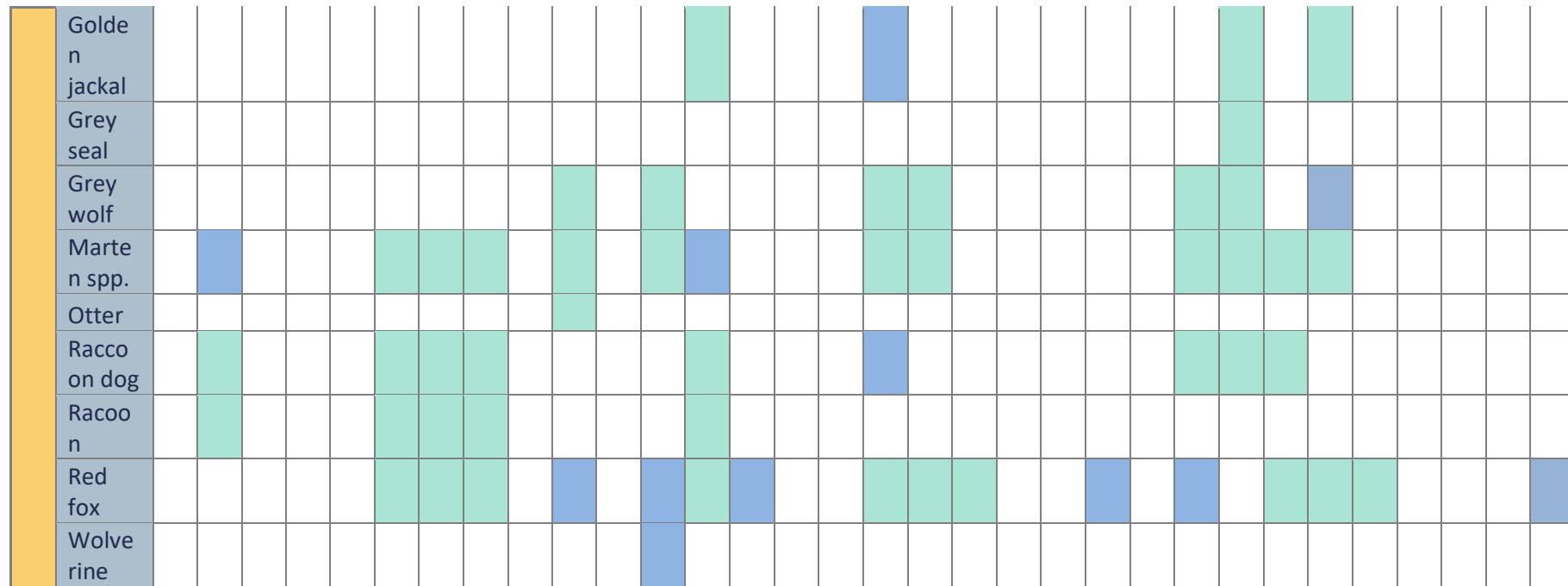
Species	Andora	Austria	Belgium Flanders	Belgium Wallonie	Croatia	Czech Republic	Denmark	Germany	Greece	Macedonia	Netherland	Norway	Poland	Portugal	Romania	Slovakia	Slovenia	Sweden	Switzerland	United Kingdom	France	Hungary	Luxemburg	Latvia	Estonia	Finland	Bosnia and Herzegovina	Spain	Turkiye	Cyprus	Albania	Italy
Wild boar																																
Ungulates	Alpine ibex																															
	Barbar y sheep																															
	Chamo is																															
	Fallow deer																															
	Iberian ibex																															
	Moose																															
	Moufl on																															
	Muntj ac deer																															



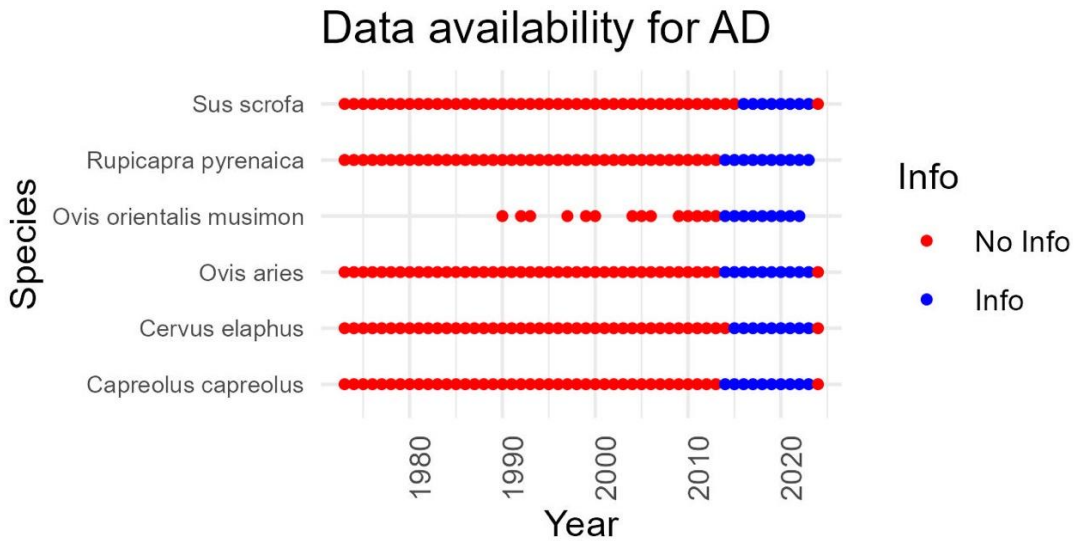
	Species	Geographic Regions																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ungulates	Red deer	1	2	3	4	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
	Reindeer																	18			
	Roe deer	1	2	3	4	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
	Sika deer		1			6	7	8										18			
Carnivores	American mink					6															
	Arctic fox																				
	Brown bear					6						12	13							18	
	Egyptian mongoose																				
	Eurasian lynx					6															
	European badger		1			6															
	European polecat		1			6	7														

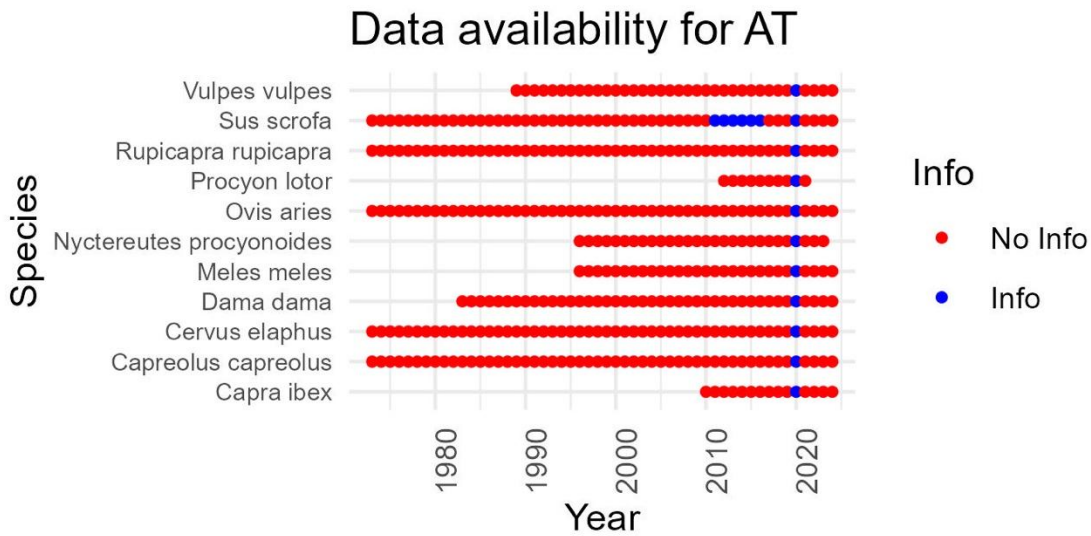


## Data collection report

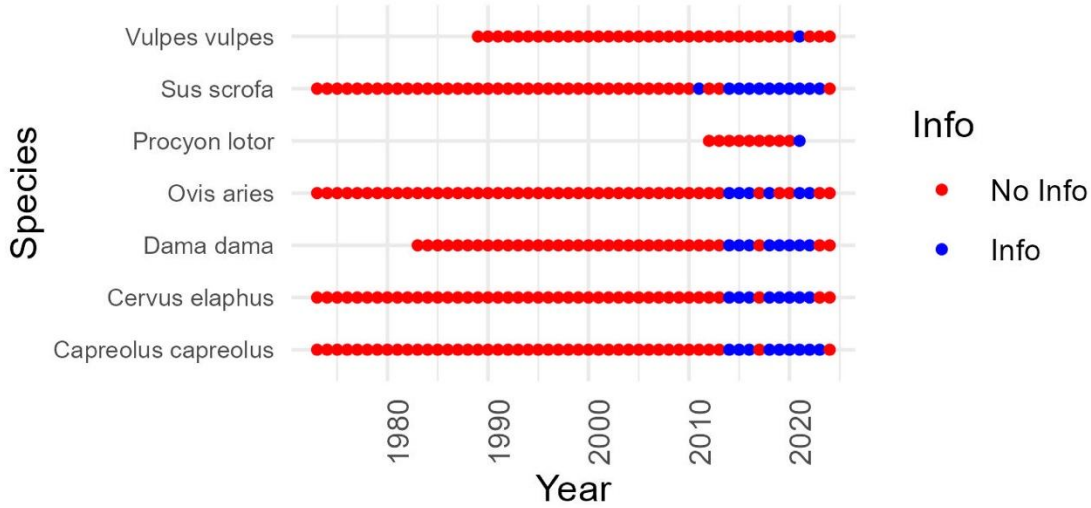


**Annex 2.** Graphical representation of the availability of data on different species from European countries. Colour boxes indicate availability of hunting data

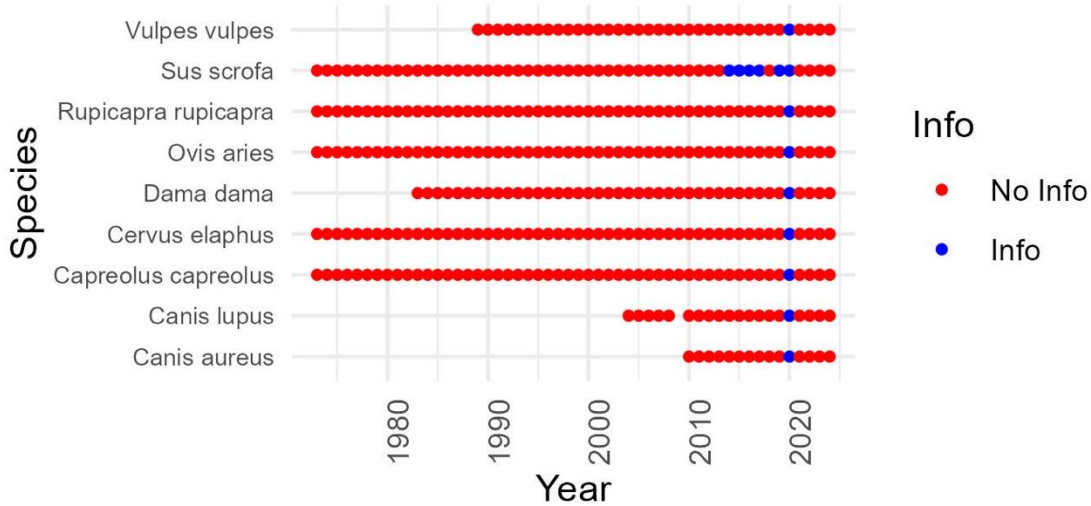




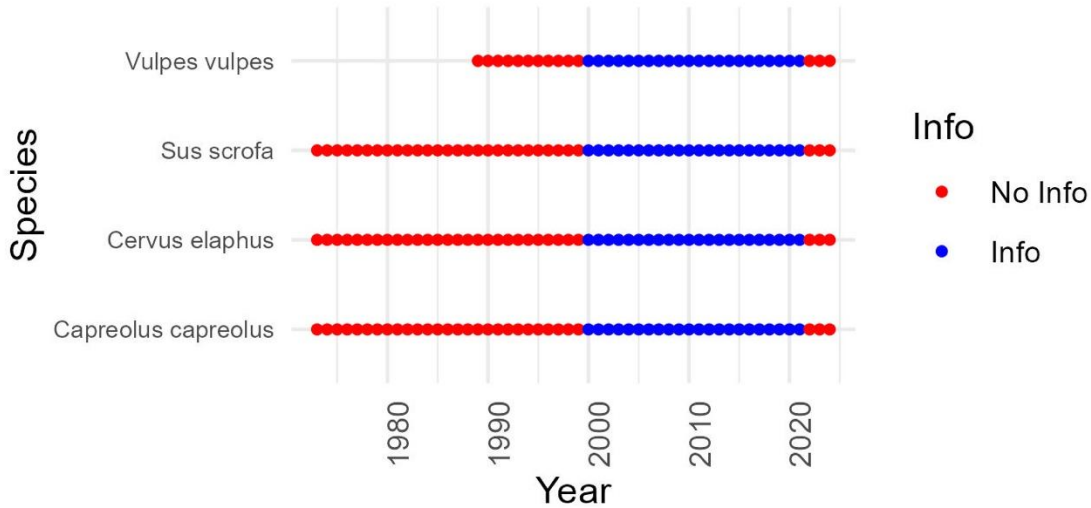
### Data availability for BE



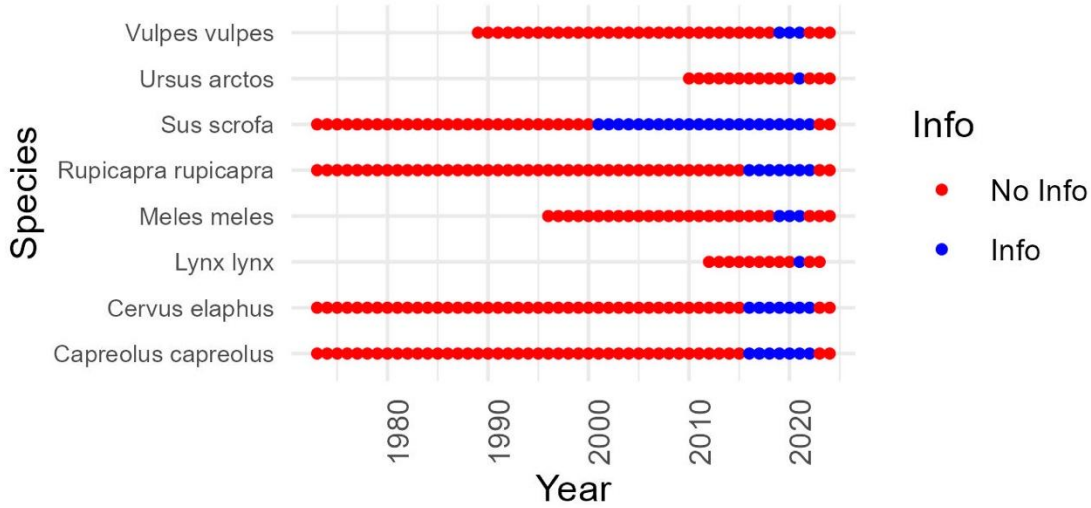
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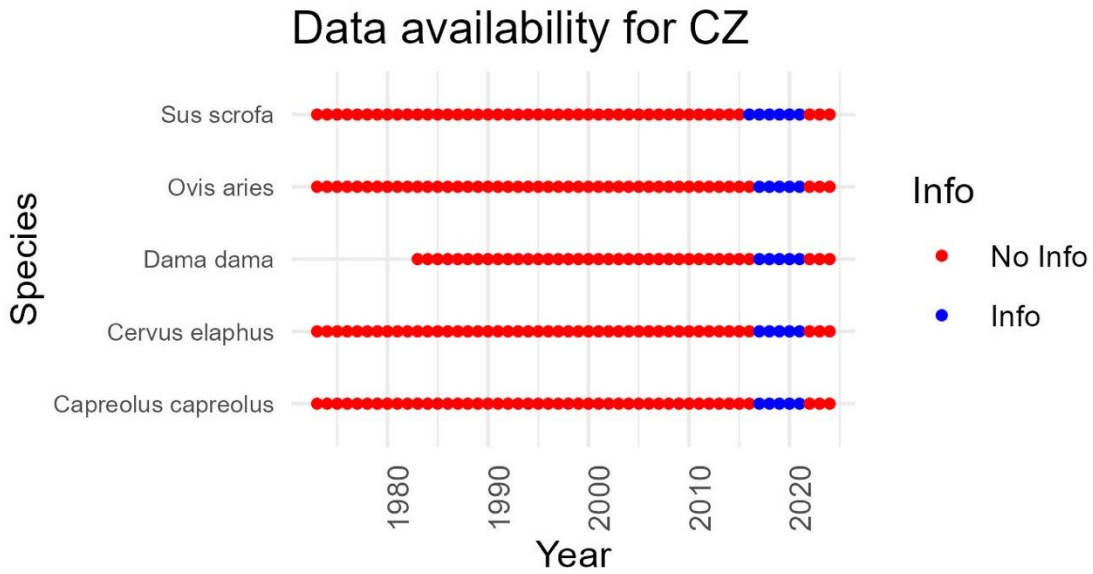


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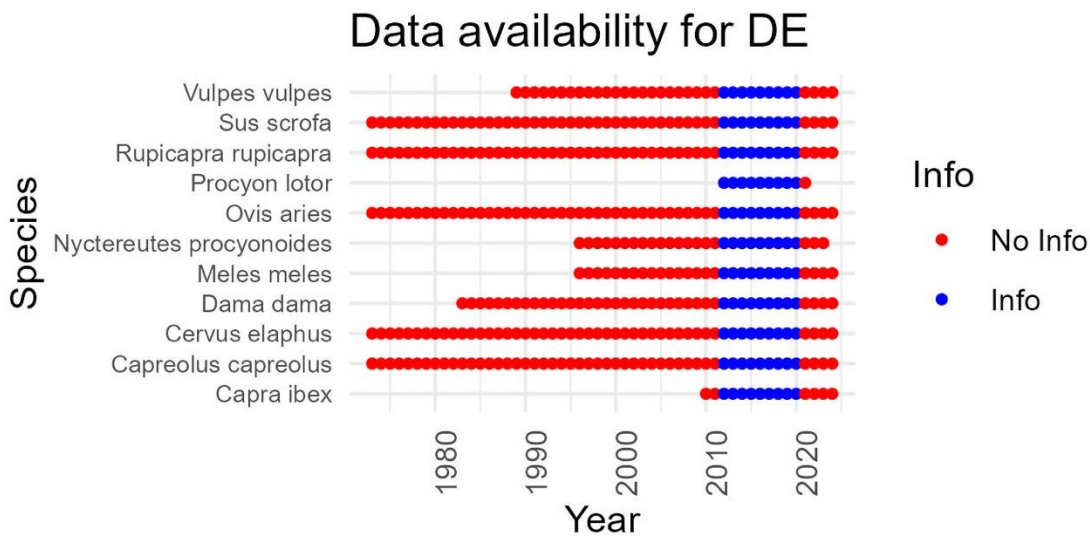


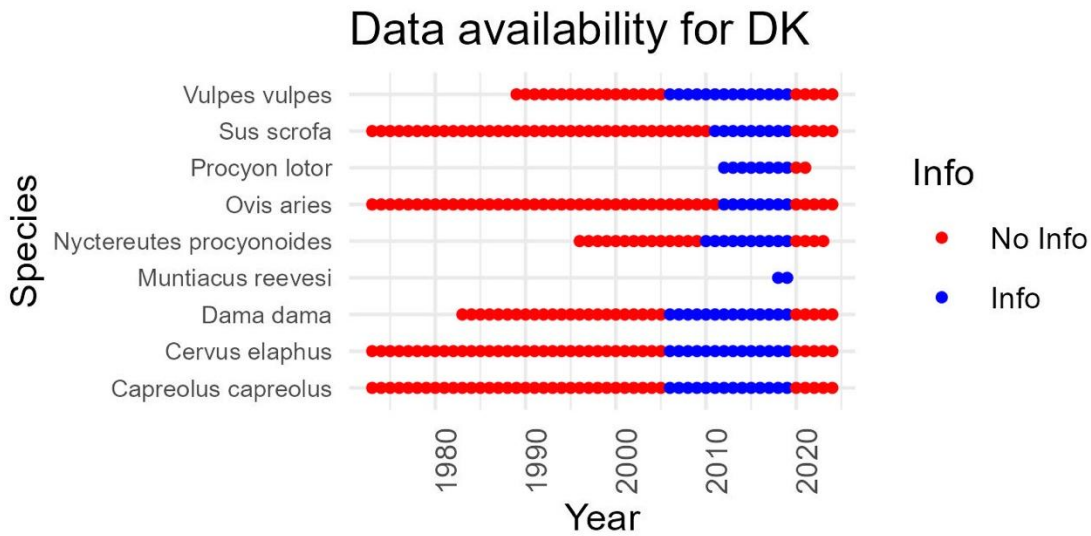
### Data availability for CH

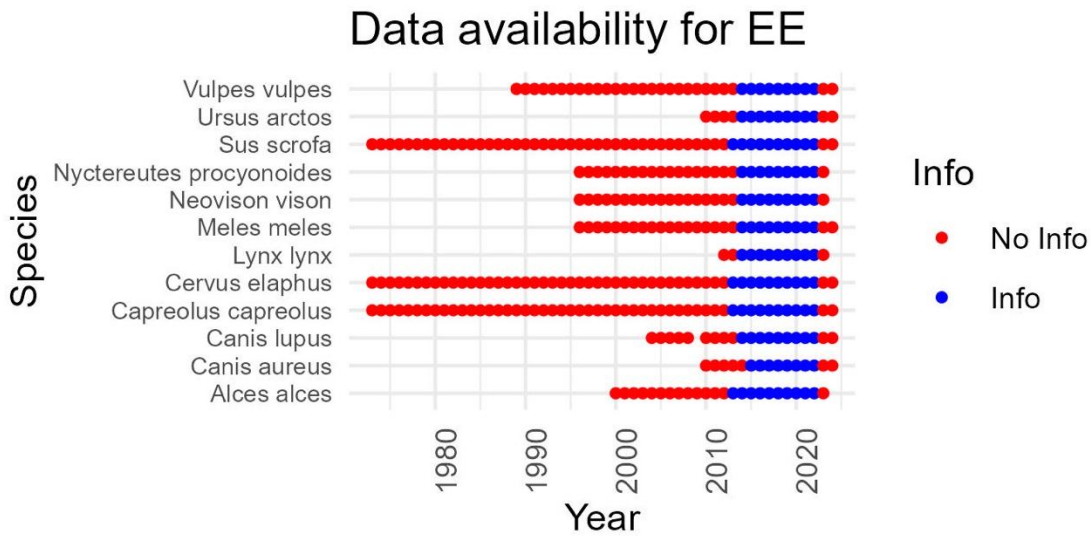


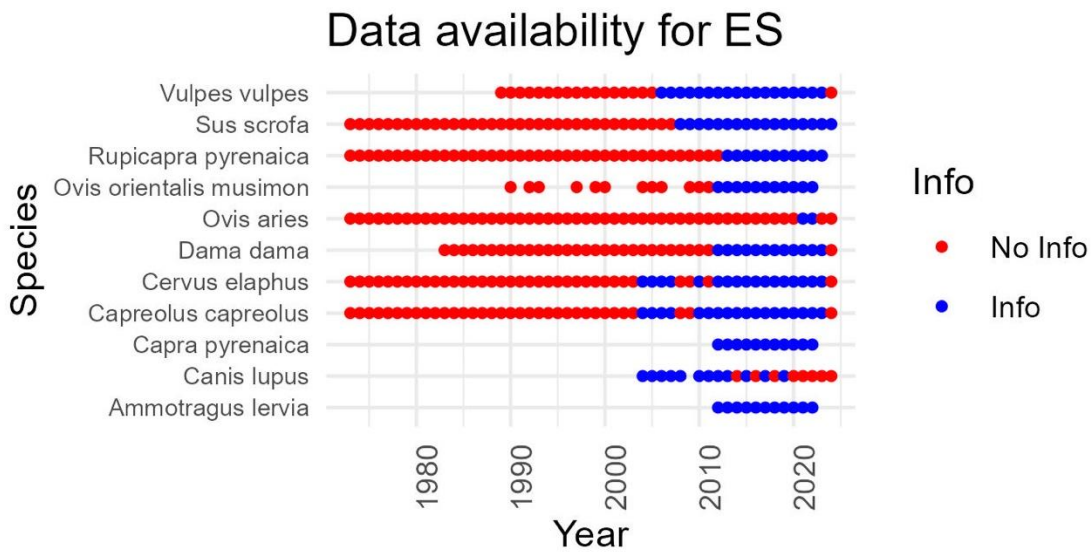






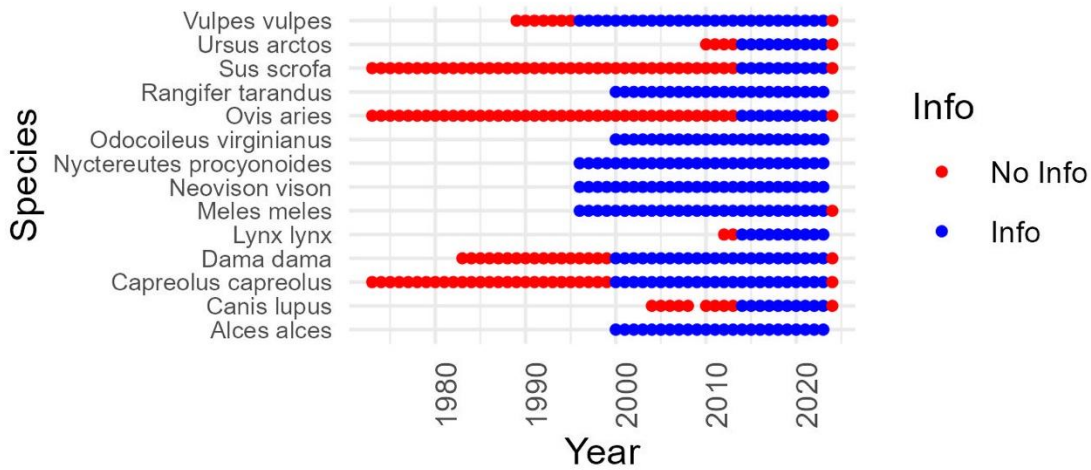


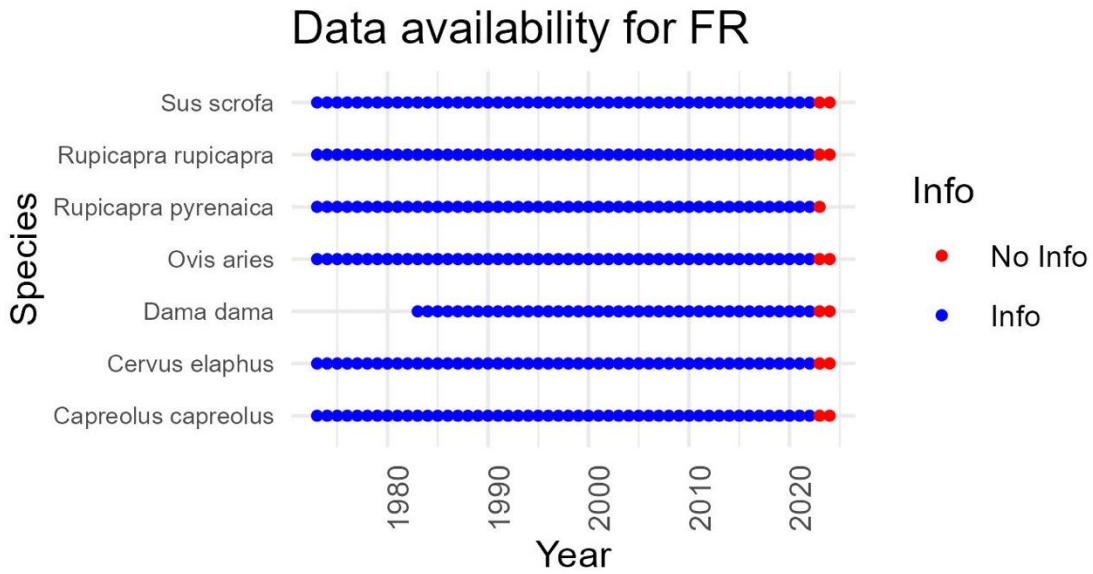




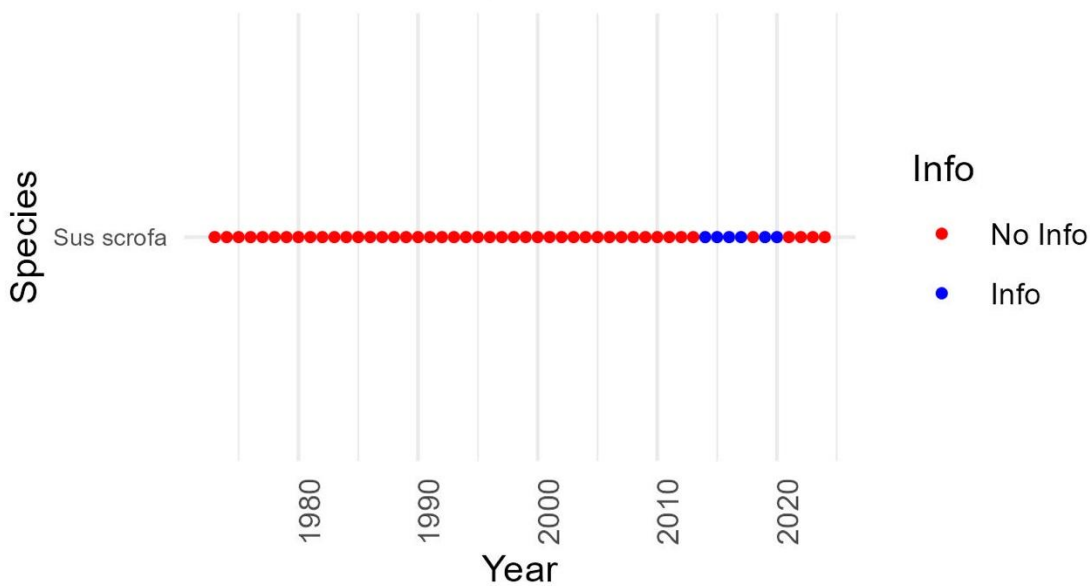


### Data availability for FI

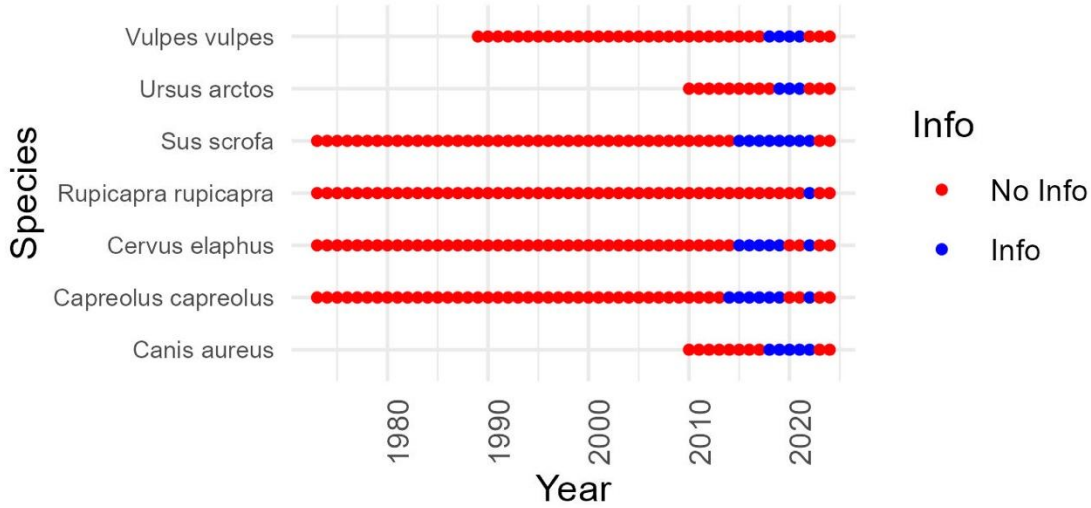




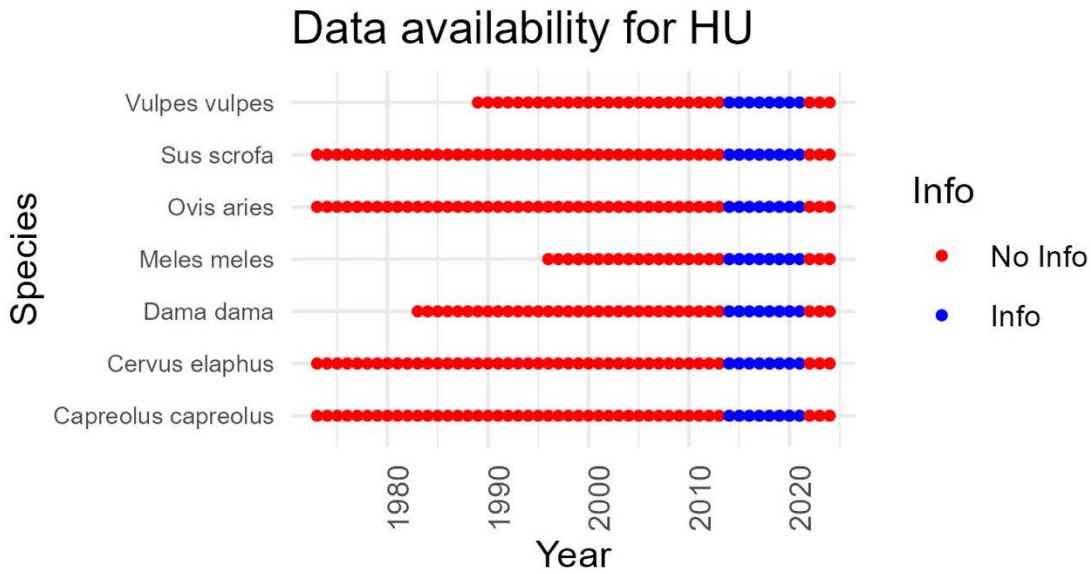
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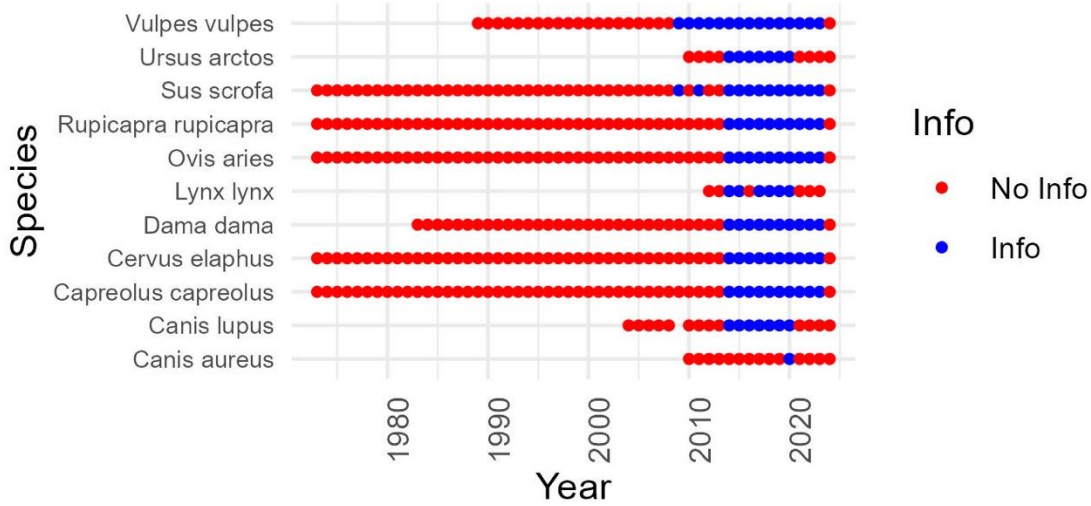
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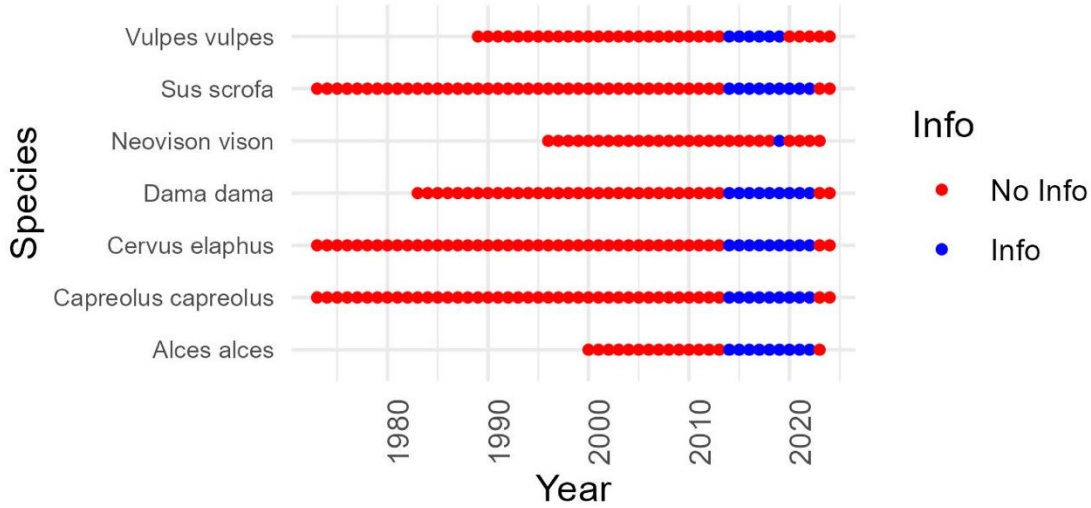


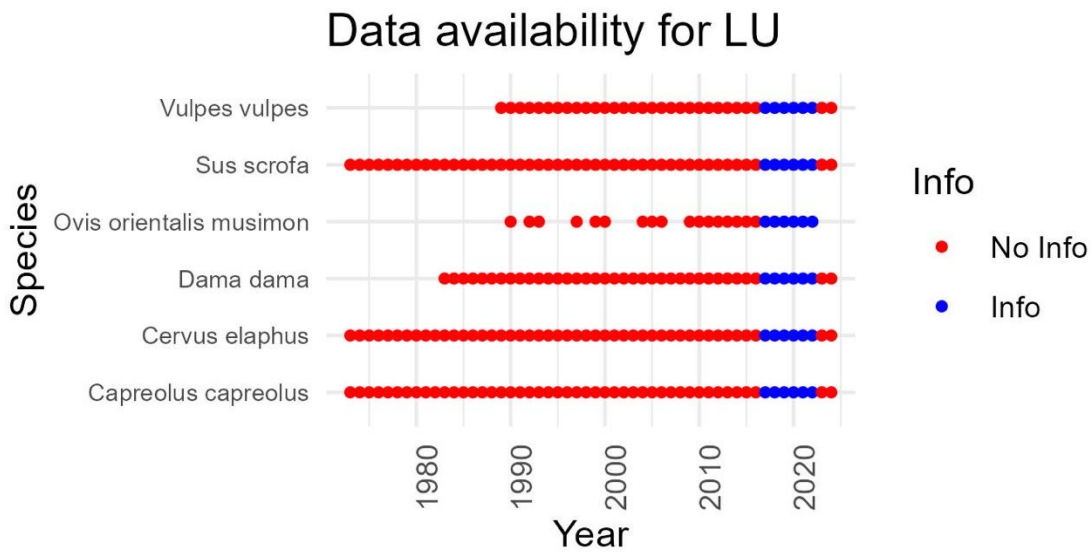


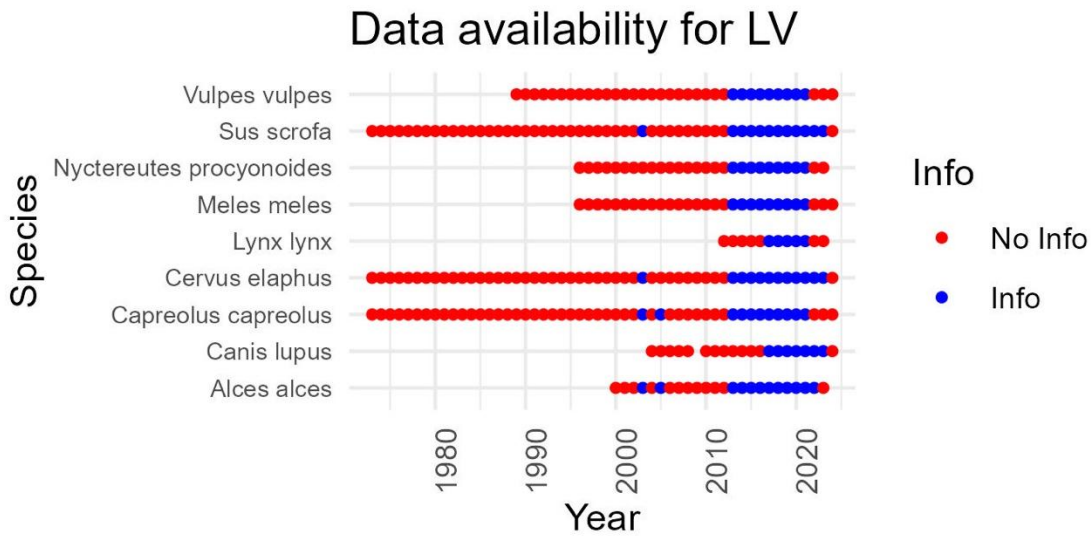
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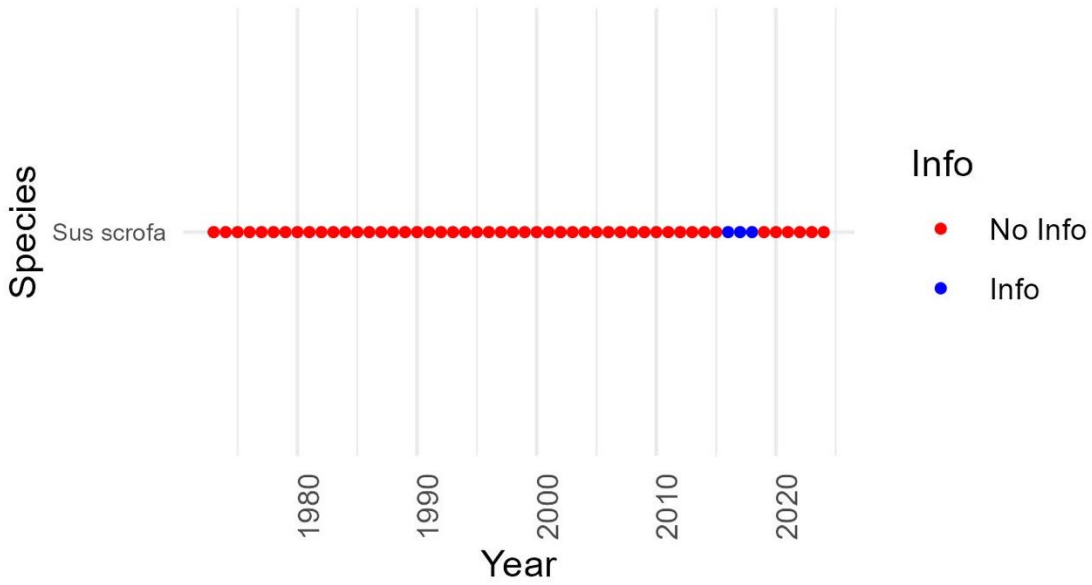
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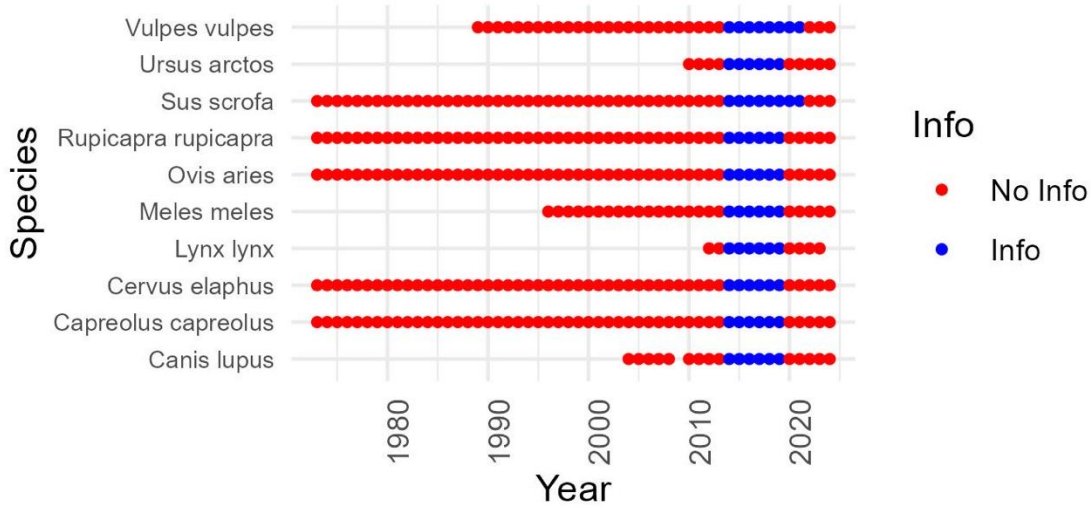


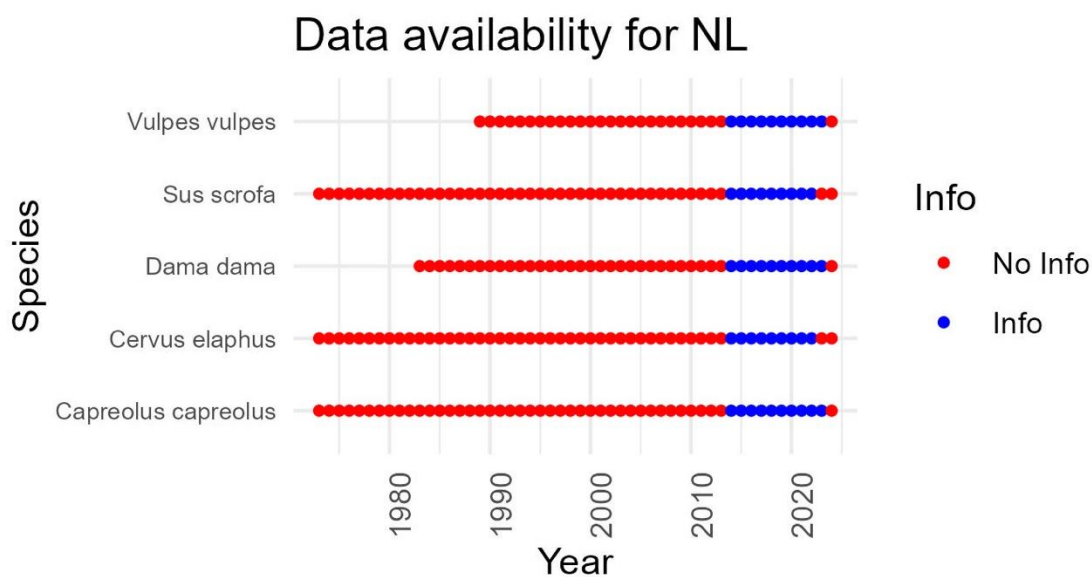


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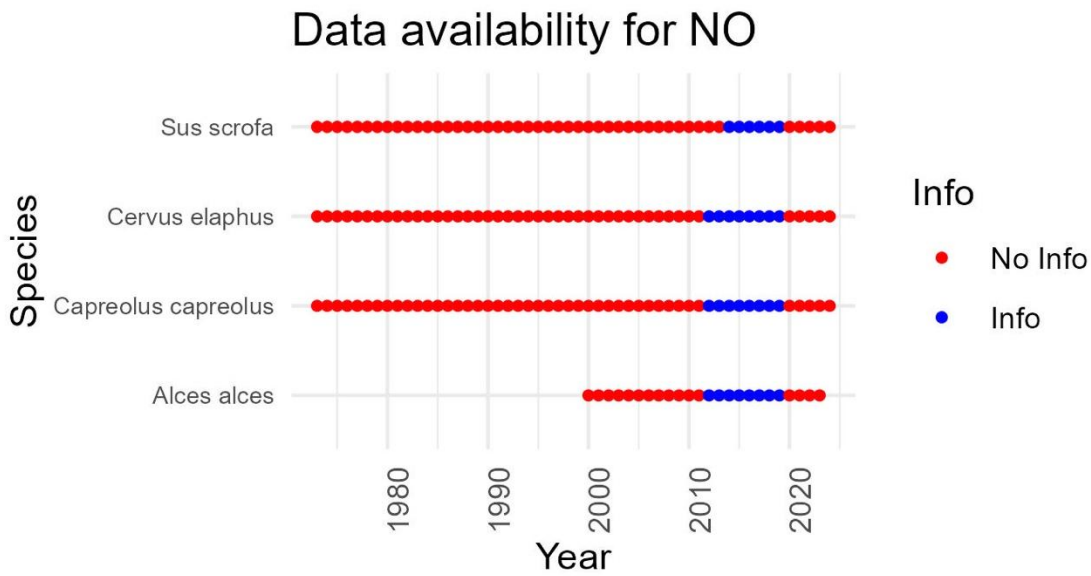


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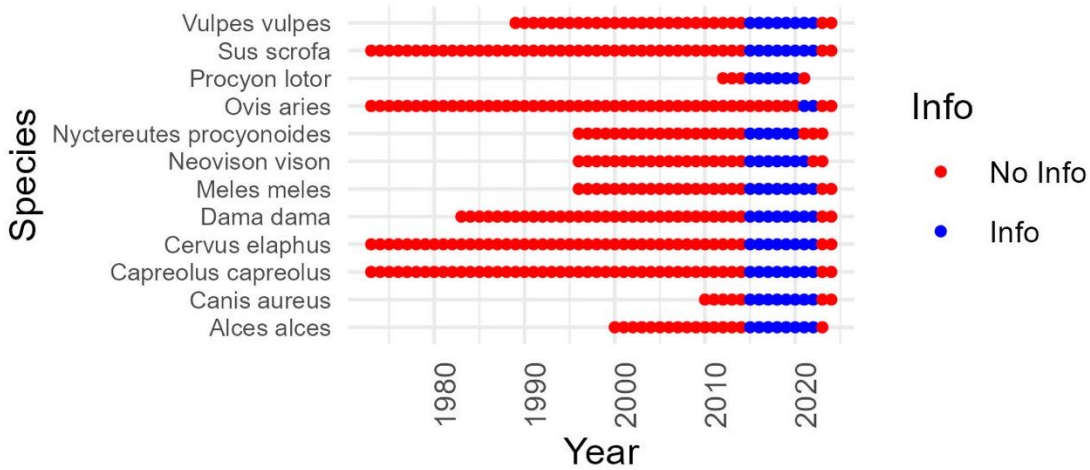


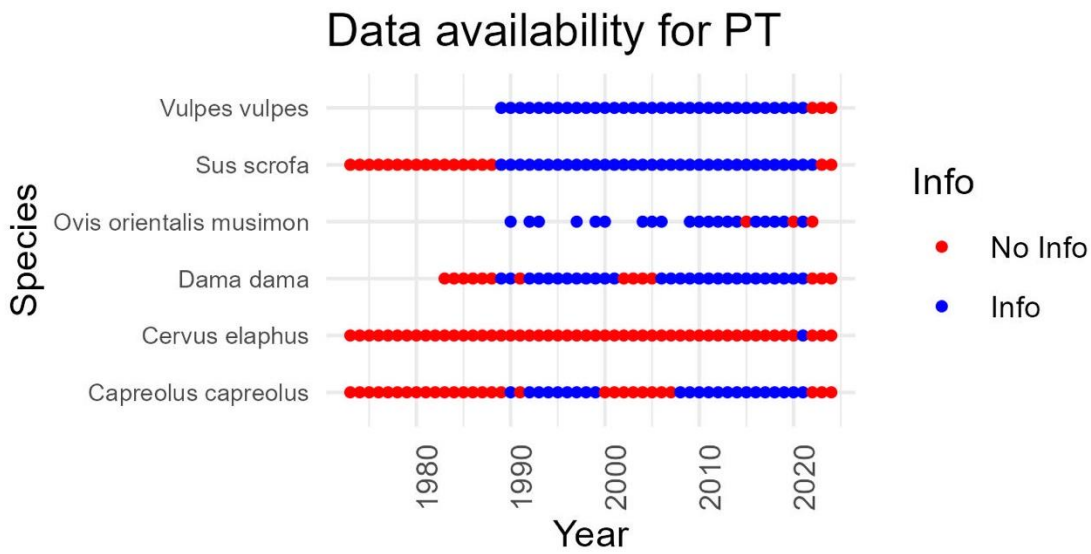




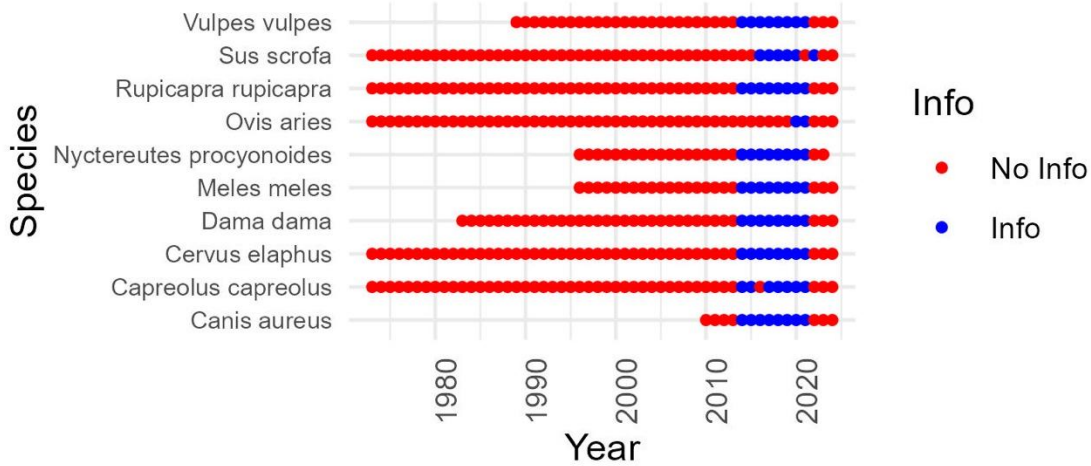


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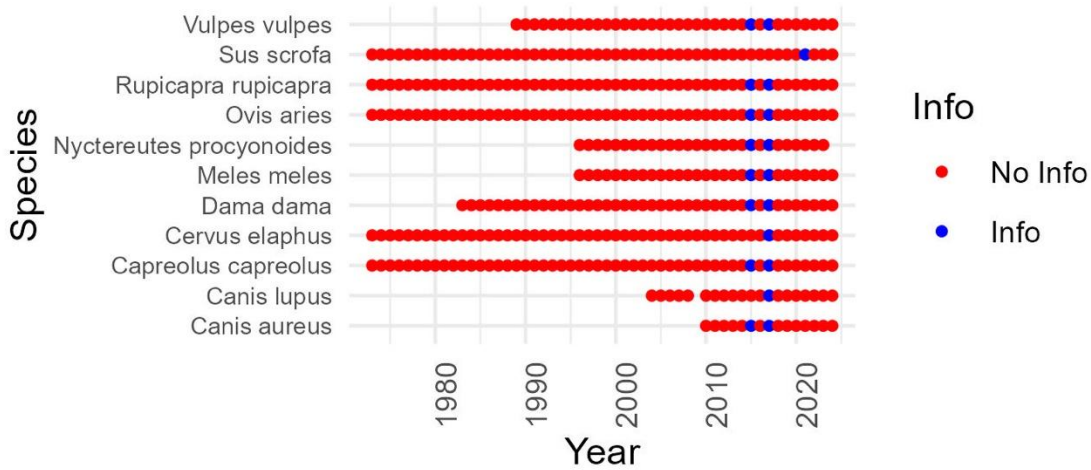


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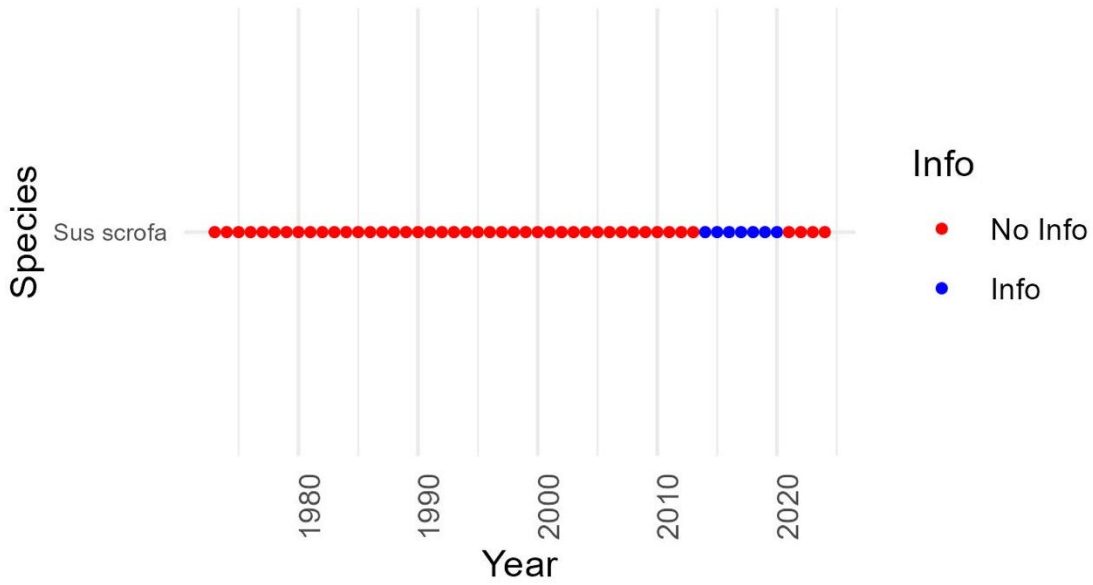




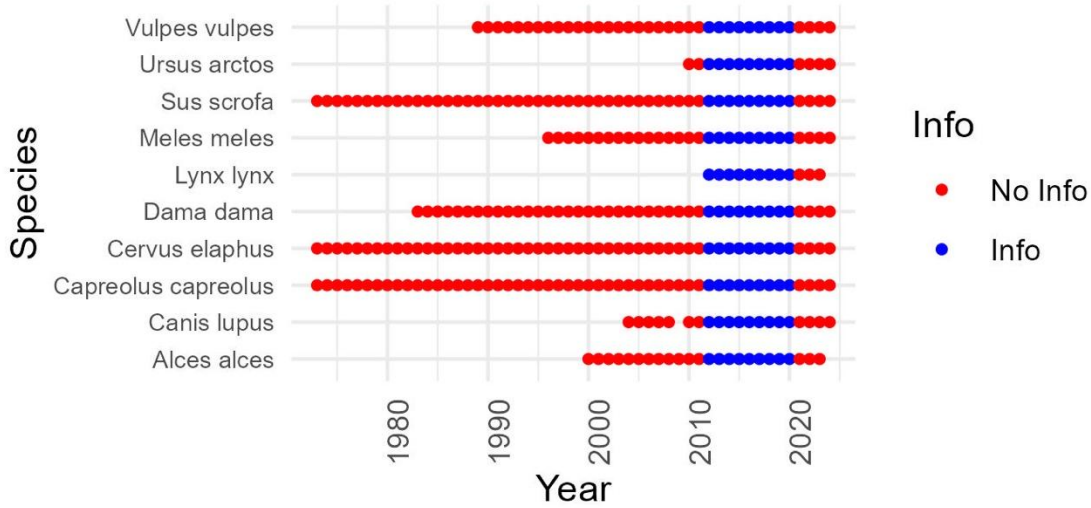
### Data availability for RS



## Data availability for RU

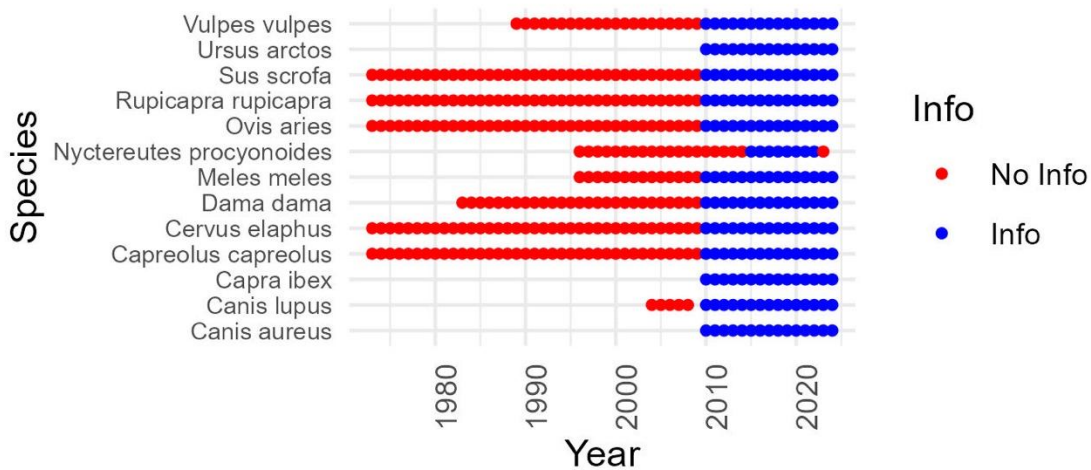


## Data availability for SE



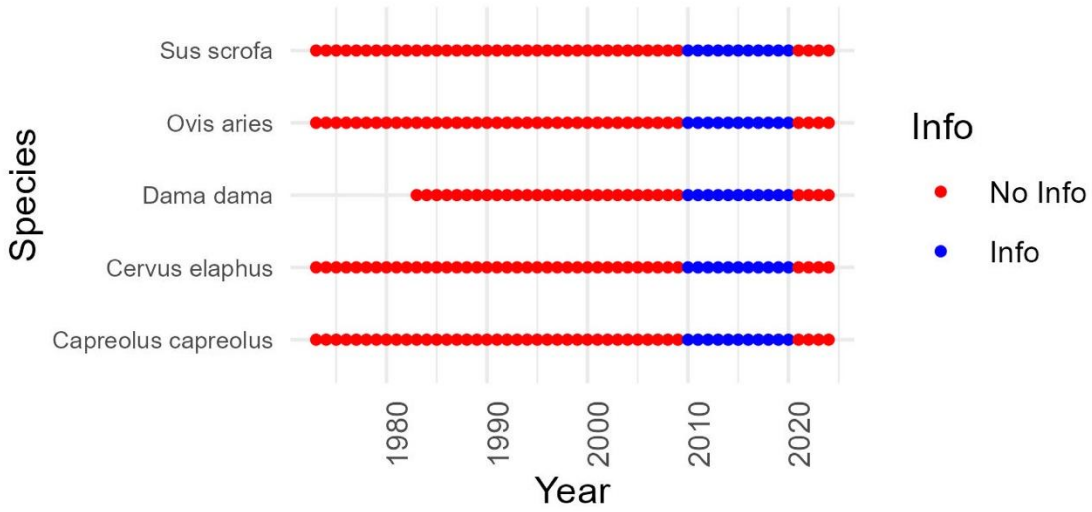


### Data availability for SI

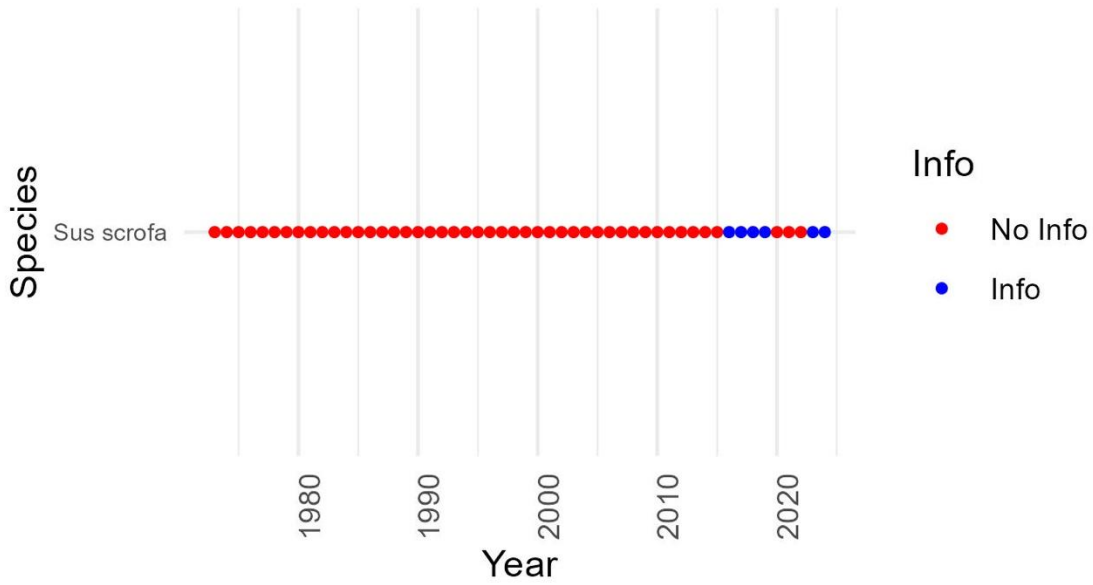




### Data availability for SK



## Data availability for TR



## Data availability for UA

