PhD Progress

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1st phase: Using distribution data

First paper

First paper

- **Compile** different source of data to make distribution maps of ungulates species in Europe.
- The resulting distribution maps are used to **inform about human-wildlife coexistence**.

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Review

The challenges and opportunities of coexisting with wild ungulates in the human-dominated landscapes of Europe's Anthropocene

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ABSTRACT

The cumulative impact of human activities has driven many species into severe declines across the globe. However, the recent focus on conservation optimism has begun to highlight case studies that go against this trend. Reforestation, agricultural abandonment, reintroduction and legislative change have led to a situation where large mammals have recovered and are now widespread across the European continent. This study summarizes the knowledge about wild ungulate distribution in Europe and reviews the diversity of ways in which they interact with humans. Drawn from a wide range of sources, we built distribution maps of European wild ungulates. Results show that 90% of Europe is home to at least 1 species of wild native ungulate, with roe deer and wild boar occupying 74% and 64% of Europe respectively. In contrast, wild native mountain ungulates only occupy 5% of Europe, and are often associated with protected areas. The wide distribution of most European ungulates combined with the extensive human activity within Europe result in a wide range of interactions between ungulates and humans. These interactions can be classified as services or disservices depending on the value orientation and economic position of the various stakeholders perceiving this relationship. Overall, our survey highlights the success of wildlife management policies in Europe and the potential for continental scale conservation of large mammals in human-dominated landscapes. However, maintaining the success of wild ungulate conservation requires actions from national and European institutions to improve coordinated management across jurisdictional borders and sectorial coordination for the whole landscape.

1. Introduction

There are currently many debates ongoing within conservation science concerning the best models for human – nature interactions. These include the debates about land sparing vs land sharing (Fischer et al., 2014), the role of protected areas vs multi-use landscapes (Soyer, 2009), and sustainable use vs protectionist ideals (Cretois et al., 2019). The science of spared landscapes (i.e. protected areas) is well developed, at least in part due to its robust conceptual foundations in island biogeography and the small population paradigm which were central to the early days of conservation biology (Caughley, 1994). However, critics of this approach note that the conceptual confinement of wildlife into "human-free" areas impedes our capacity to envision conservation strategies that do not include remoteness (López-Bao et al., 2017). In contrast, the science of coexistence, which promotes the presence of wildlife in multi-use landscapes, remains ad hoc and fragmented, and both the strategic utility and practicality of the whole approach are being contested. Despite recent attempts to conceptualise the approach (Carter and Linnell, 2016), there remains a dearth of good studies and analyses within the conservation science literature to illuminate the ongoing discussions.

The practice of wildlife conservation began many decades, even centuries, before the development of conservation science (Leopold, 1933). The results of these efforts can contribute valuable insights to inform ongoing debates. This is especially evident for species such as large mammals with which humans have a long and complex relationship, and which have been both directly exploited and directly managed. The relationship between Europeans and large ungulates goes

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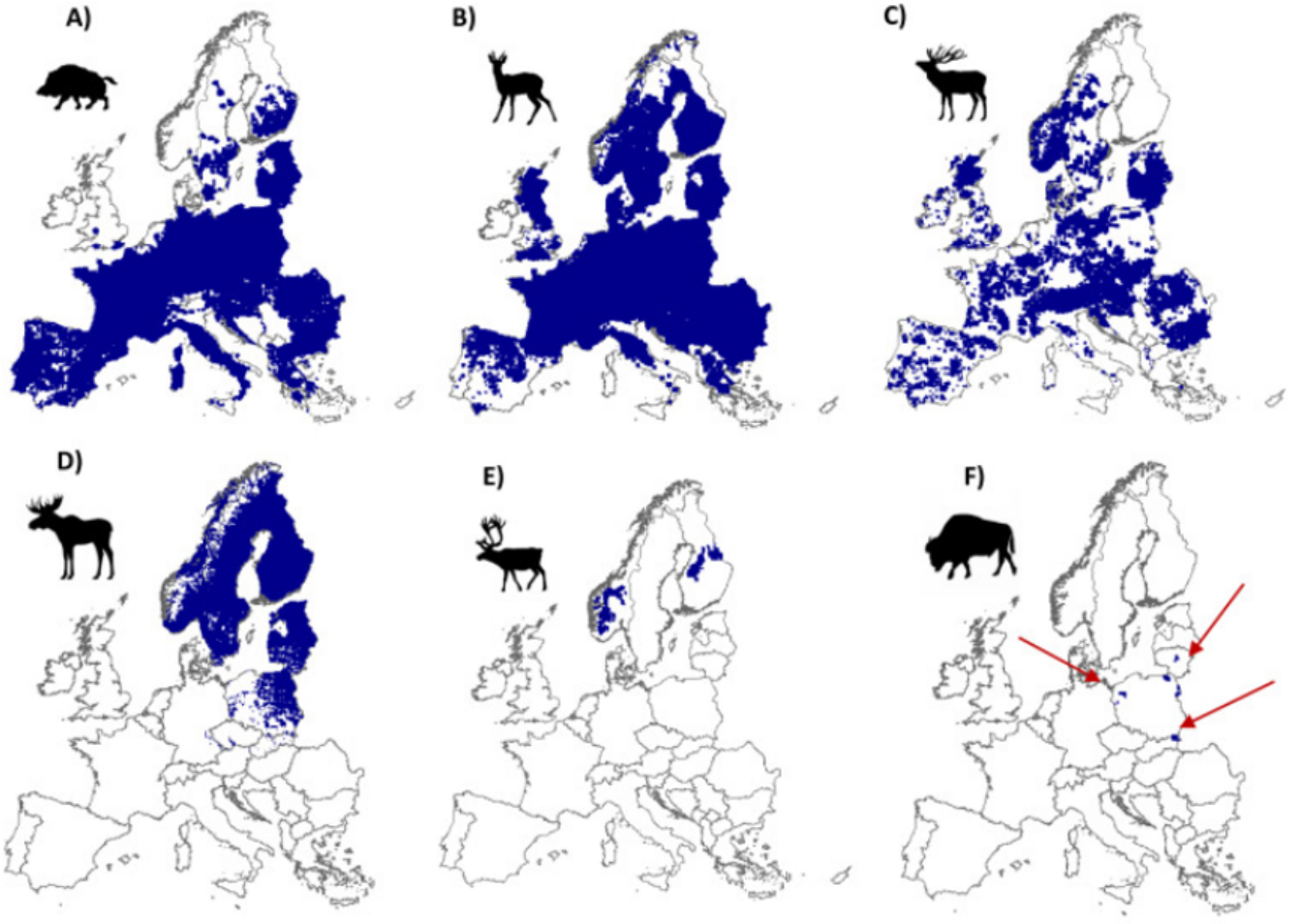
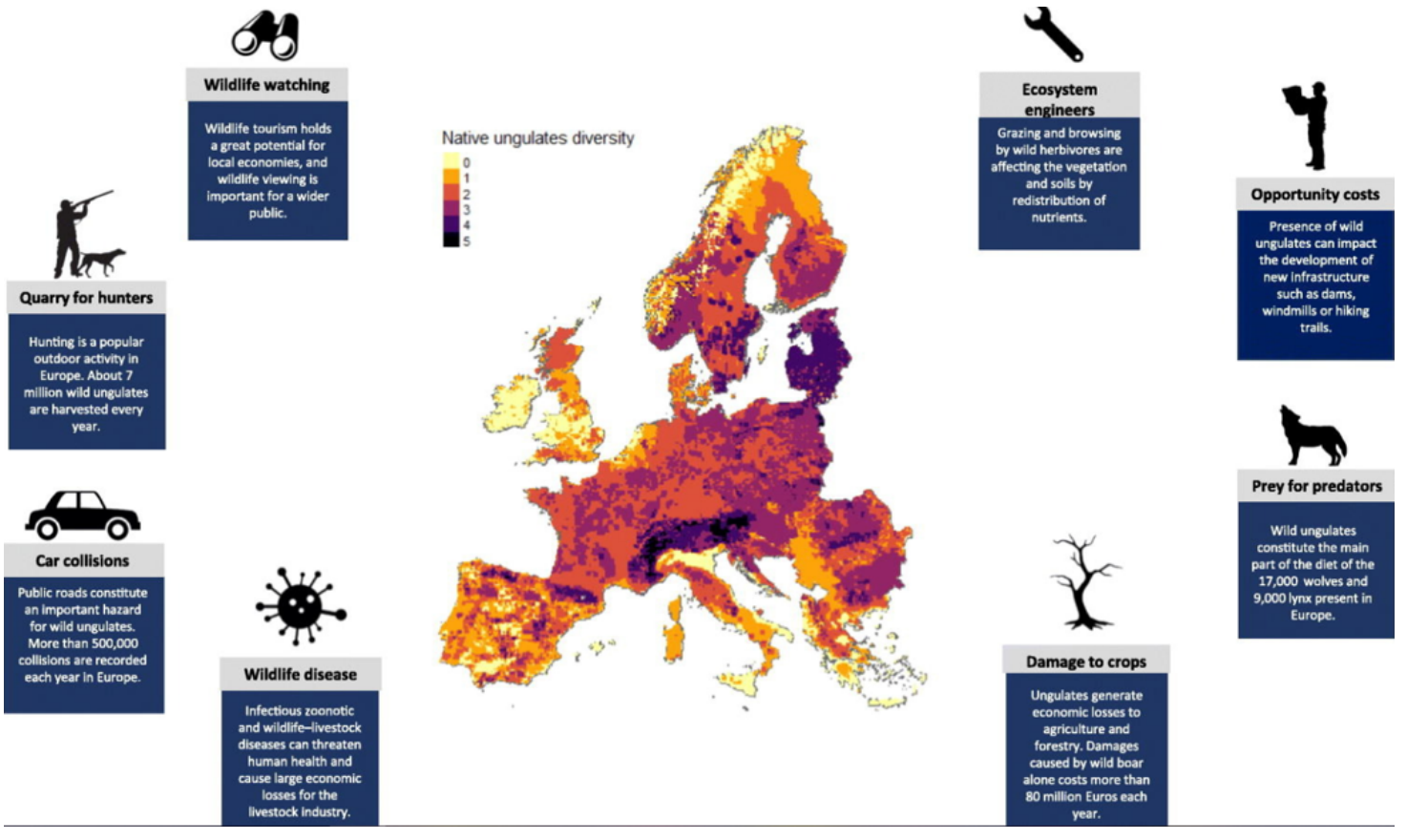
First paper

- **We summarize** knowledge on wild ungulates distribution in Europe.
- About **90%** of Europe is home to at least one species of wild ungulates.
- **75%** of wild ungulate distribution is located outside protected areas
- We explore the interactions between ungulates and humans in Europe's anthropogenic landscape.
- More than **7 million ungulates** are harvested each year in Europe.


A)
B)
C)
D)
E)
F)


Native ungulates diversity
0
1
2
3
4
5
Wildlife watching
Wildlife tourism holds a great potential for local economies, and wildlife viewing is important for a wider public.
Quarry for hunters
Hunting is a popular outdoor activity in Europe. About 7 million wild ungulates are harvested every year.
Car collisions
Public roads constitute an important hazard for wild ungulates. More than 500,000 collisions are recorded each year in Europe.
Wildlife disease
Infectious zoonotic and wildlife–livestock diseases can threaten human health and cause large economic losses for the livestock industry.
Ecosystem engineers
Grazing and browsing by wild herbivores are affecting the vegetation and soils by redistribution of nutrients.
Damage to crops
Ungulates generate economic losses to agriculture and forestry. Damages caused by wild boar alone costs more than 80 million Euros each year.
Opportunity costs
Presence of wild ungulates can impact the development of new infrastructure such as dams, windmills or hiking trails.
Prey for predators
Wild ungulates constitute the main part of the diet of the 17,000 wolves and 9,000 lynx present in Europe.

1st phase: Using distribution data

Second paper

Coexistence of large mammals and humans is possible in Europe's anthropogenic landscapes

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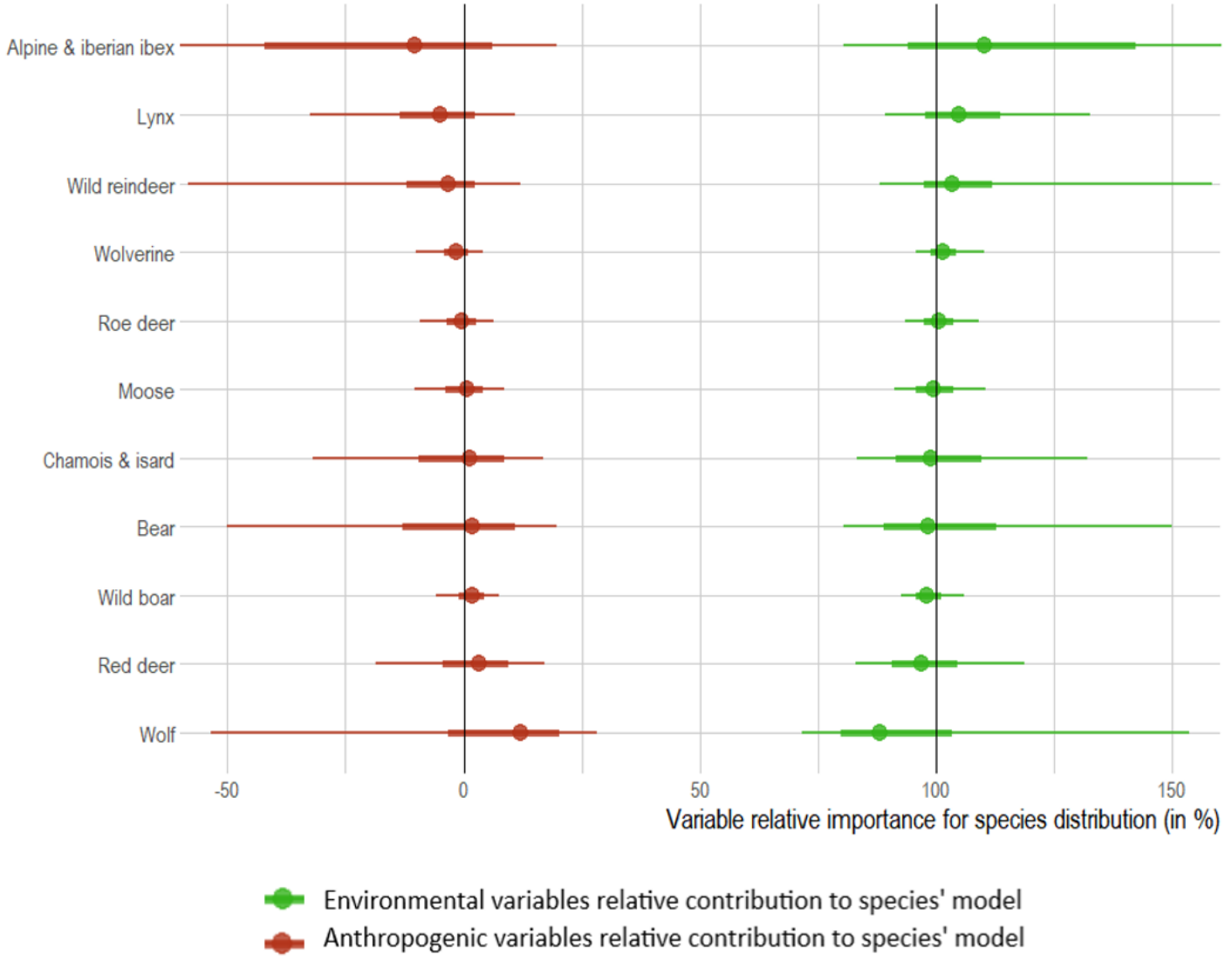
keywords:

adaptation, sustainability, Europe, mammals, human disturbance

2nd paper

- In this paper, **we evaluate the relative effects of both the human footprint and protected areas** on large mammal distribution at a continental scale.
- We found that the broad scale distribution of most large mammals in Europe includes areas of high to very high human disturbance.
- **Their distribution is primarily driven by environmental variables** rather than the human footprint or the presence of protected areas.


Alpine & iberian ibex
Lynx
Wild reindeer
Wolverine
Roe deer
Moose
Chamois & isard
Bear
Wild boar
Red deer
Wolf
-50
0
50
100
150
Variable relative importance for species distribution (in %)
Environmental variables relative contribution to species' model
Anthropogenic variables relative contribution to species' model

1st phase: Using distribution data

3rd paper

3rd paper

- A huge amount of distributional data come from hunting bags. For instance deer maps in Norway from hunting bag data.
- We acknowledge hunters' contribution to biodiversity monitoring in the 3rd paper.

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Original Research Article

Hunters as citizen scientists: Contributions to biodiversity monitoring in Europe

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ABSTRACT

Monitoring biodiversity characteristics at large scales and with adequate resolution requires considerable effort and resources. Overall, there is clearly a huge scope for European hunters, a special and often overlooked group of citizen scientist, to contribute even more to biodiversity monitoring, especially because of their presence across the entire European landscape.

Using the Essential Biodiversity Variables (EBVs) framework we reviewed the published and grey literature and contacted experts to provide a comprehensive overview of hunters' contributions to biodiversity monitoring. We examined the methods used to collect data in hunter-based monitoring, the geographic and taxonomic extent of such contributions and the scientific output stemming from hunter-based monitoring data.

Our study suggests that hunter-based monitoring is widely distributed across Europe and across taxa as 32 out of the 36 European countries included in our analysis involve hunters in the monitoring of at least one species group with ungulates and small game species groups which have the widest hunter-based monitoring coverage. We found that it is possible to infer characteristics on Genetic composition, Species traits and Community composition with data that are being routinely collected by hunters in at least some countries. The main types of data provided are hunting bags data, biological samples including carcasses of shot animals and non-invasive samplings and Observations for counts and indices.

Hunters collect data on biodiversity in its key dimensions. Collaborations between hunters and scientists are fruitful and should be considered a standard partnership for biodiversity conservation. To overcome the challenges in the use of hunters' data, more rigorous protocols for sampling data should be implemented and improvements made in data integration methods.

1. Introduction

Global biodiversity is undergoing severe declines (Díaz et al., 2019). This situation has led the international community to take action to alter this trend by setting policy frameworks and objectives. For example, the Aichi Biodiversity Targets set by

3rd paper

We found that hunters contribute to monitoring biodiversity in all its key characteristics:

- **Distribution** - through carcasses ...
- **Phenology** - through carcasses ...
- **Physiology** - through carcasses ...
- **Migration** - through carcasses too ...

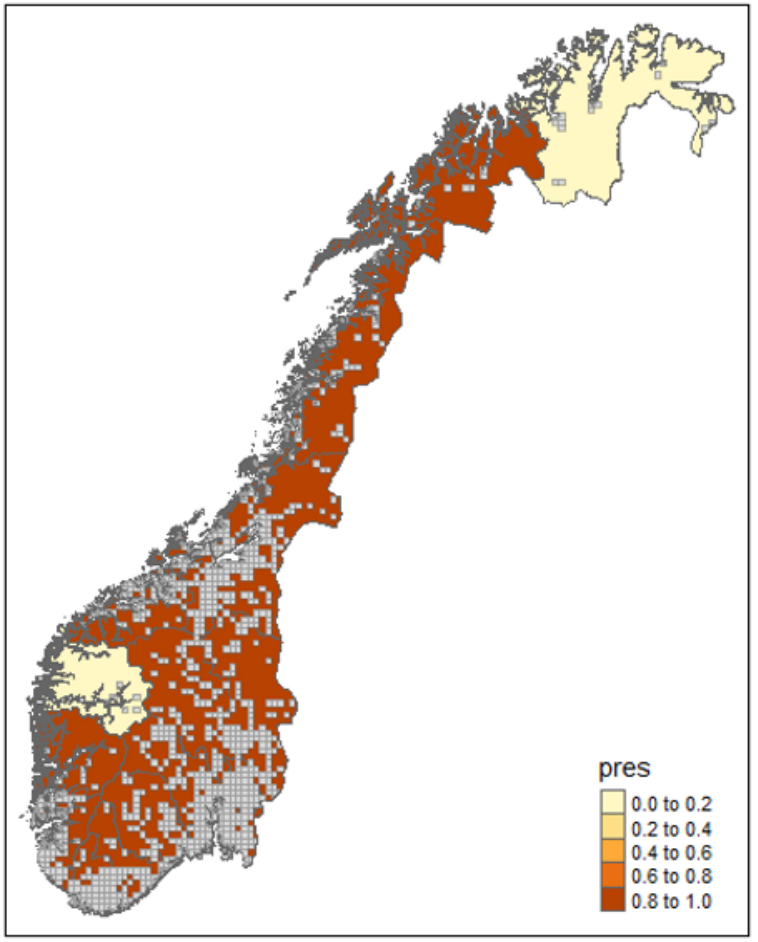
And much more!

2nd phase: Understanding distribution data

Characterizing CS data & account for its biases

2nd phase

- While useful (as shown in phase 1), distribution maps heavily depends on the quality & the amount of data available. This is especially true at lower resolution!
- Because of this, certain areas may be non sampled even though the species of interest is present.
- We need to understand the drivers of citizen science observations.
- Using the understanding to properly integrate the dataset & obtain more accurate prediction maps.

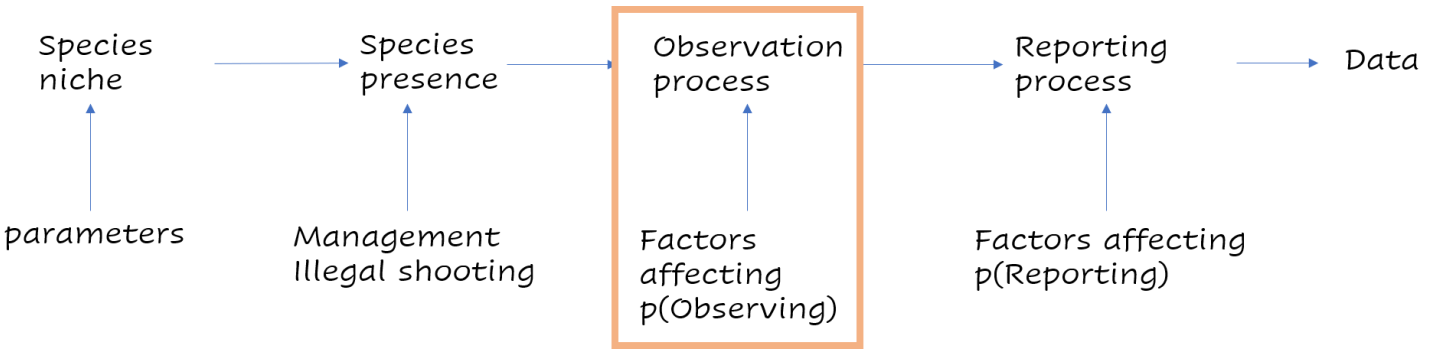


Some areas should host roe deer but are not sampled by CS.

Some areas are non hunted but hosts citizen scientists observations.

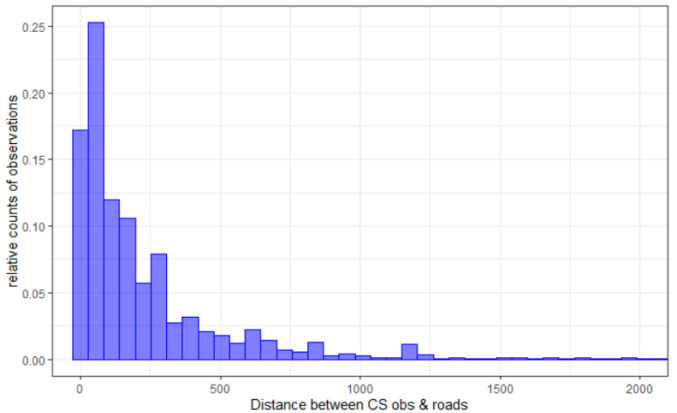
2nd phase

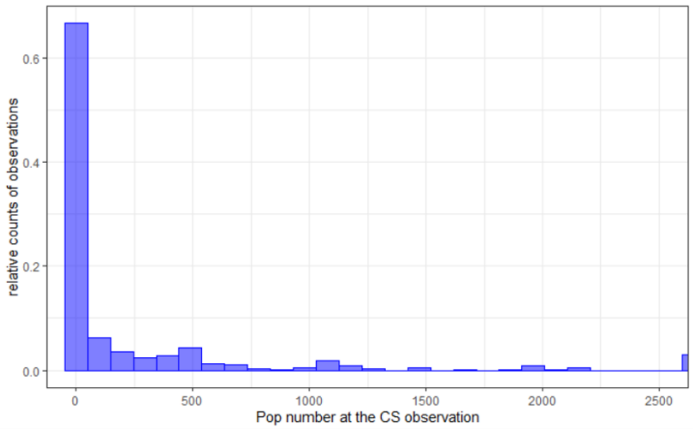
How are data generated?

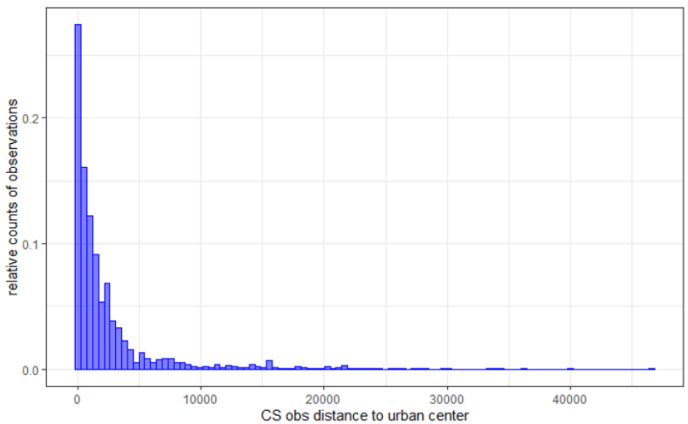


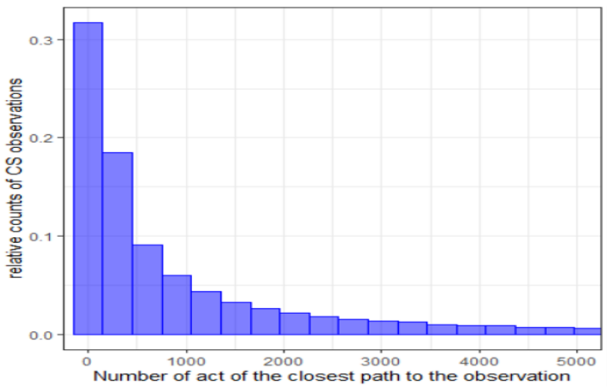
2nd phase

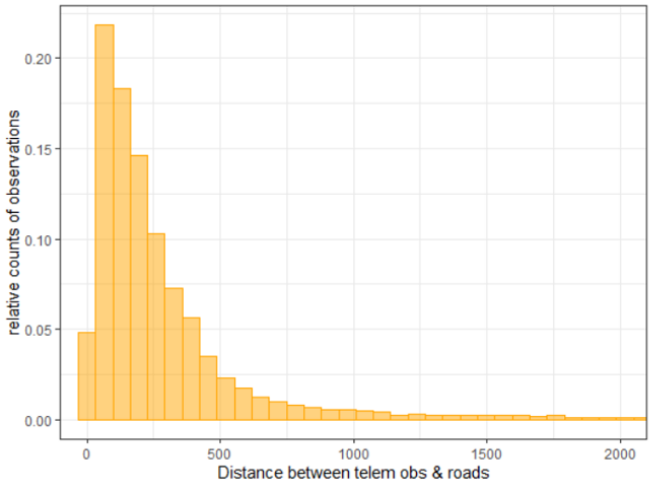
- Case study on the distribution of roe deer (Capreolus capreolus).
- We have telemetry data and we are able to infer the “true” use of the habitat or where the species is in reality
- Is it so different from citizen science?

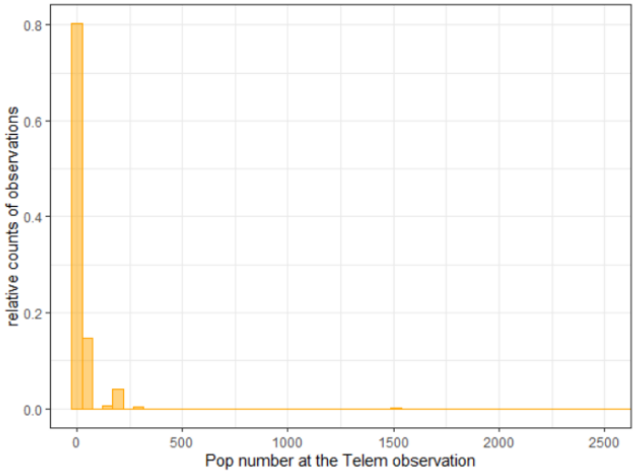

relative counts of observations
0.25
0.20
0.15
0.10
0.05
0.00
0
500
1000
1500
2000
Distance between CS obs & roads

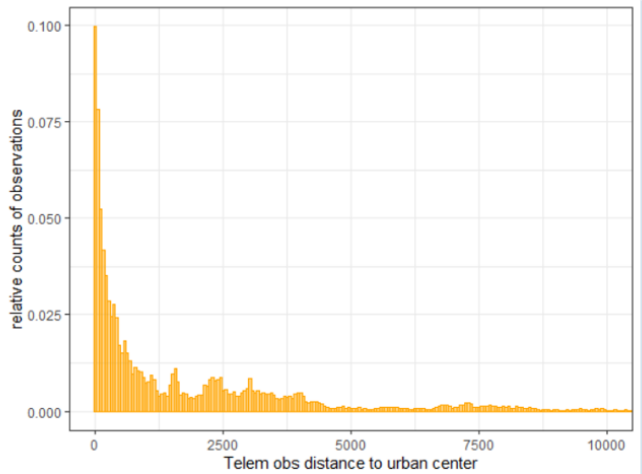

relative counts of observations
0.6
0.4
0.2
0.0
0
500
1000
1500
2000
2500
Pop number at the CS observation

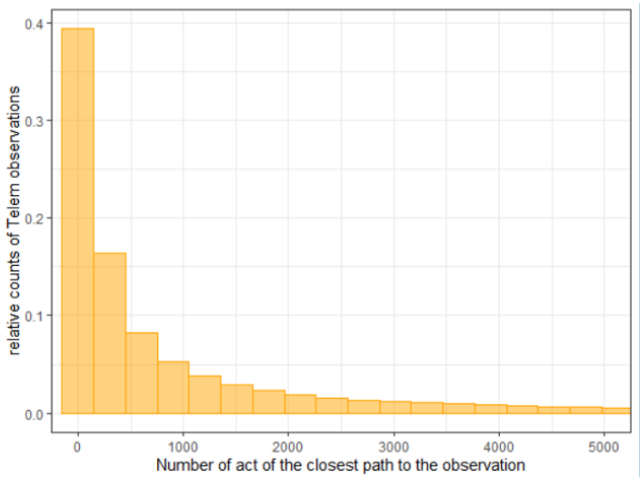

relative counts of observations
0.2
0.1
0.0
0
10000
20000
30000
40000
CS obs distance to urban center


relative counts of CS observations
0.3
0.2
0.1
0.0
0
1000
2000
3000
4000
5000
Number of act of the closest path to the observation


relative counts of observations
0.20
0.15
0.10
0.05
0.00
0
500
1000
1500
2000
Distance between telem obs & roads


relative counts of observations
0.8
0.6
0.4
0.2
0.0
0
500
1000
1500
2000
2500
Pop number at the Telem observation


relative counts of observations
0.100
0.075
0.050
0.025
0.000
0
2500
5000
7500
10000
Telem obs distance to urban center


relative counts of Telem observations
0.4
0.3
0.2
0.1
0.0
0
1000
2000
3000
4000
5000
Number of act of the closest path to the observation

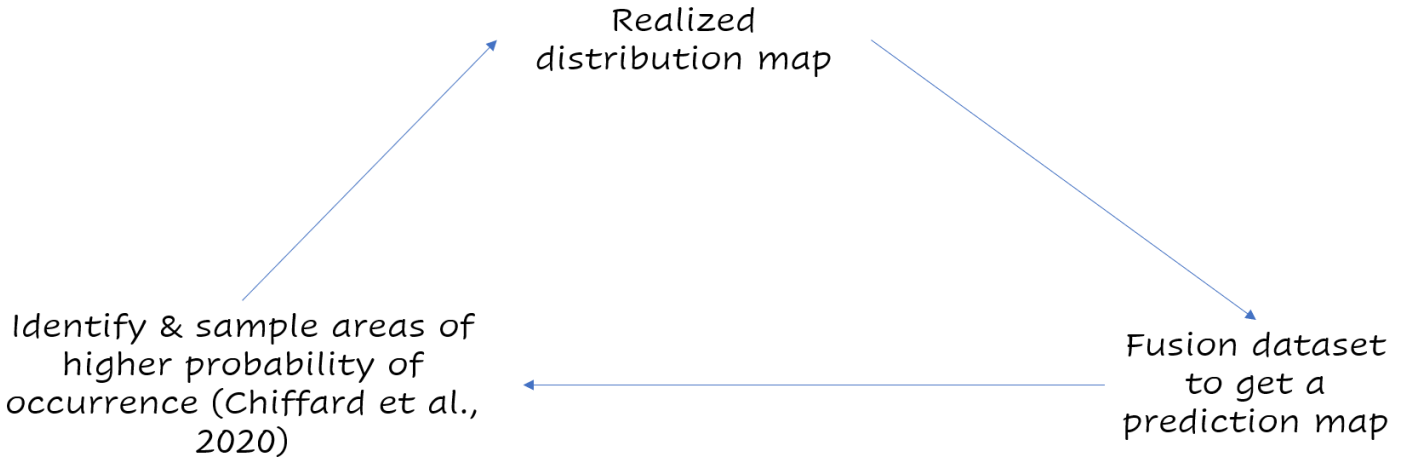
2nd phase

- Why such differences in the distribution of the observations?
- Which areas lack observations? – We hypothesize areas far from urban centers
- Can we tone down these biases by adding other dataset? – We test data fusion

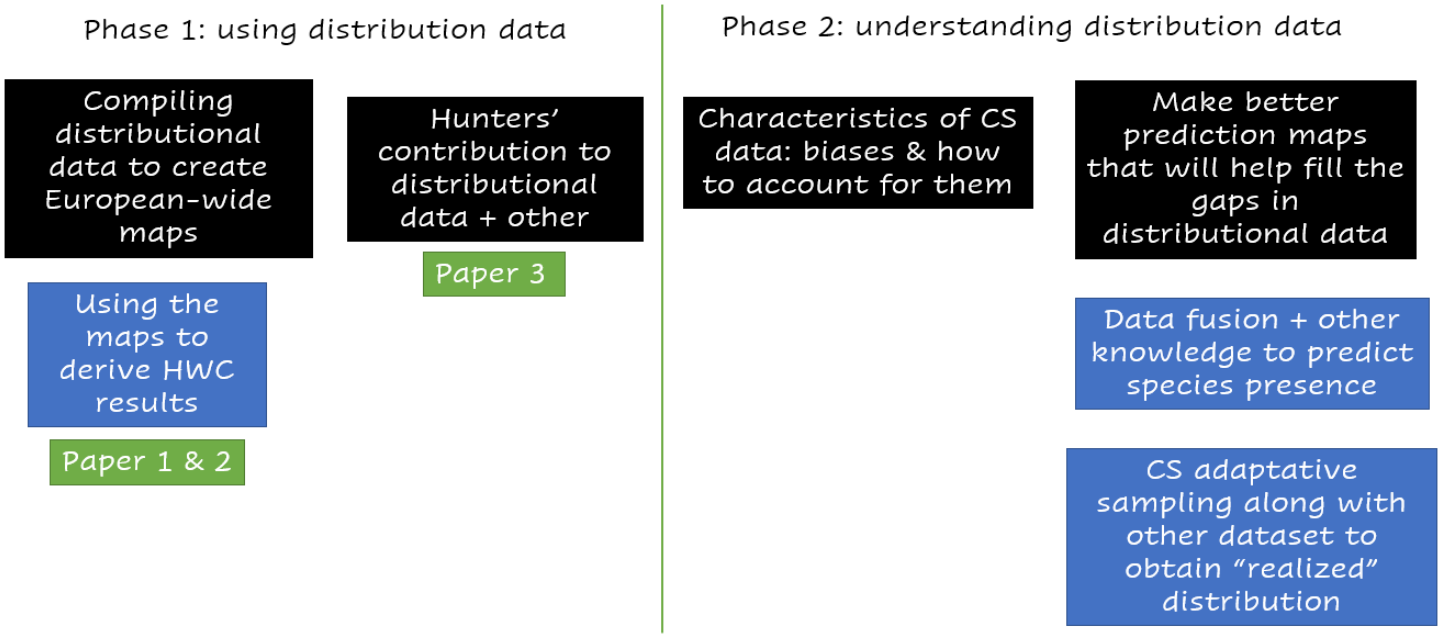
And next ...

Next ...

- Using the part 1 results to fusion properly the dataset & obtain more accurate prediction maps and compare them to the observed distribution.
- These prediction maps can be used to identify areas worth sampling.
- Citizen Scientists could be used to sample these areas.
- Their data could then be used to recompute the prediction maps


Realized distribution map
Fusion dataset to get a prediction map
Identify & sample areas of higher probability of occurrence (Chiffard et al., 2020)

PhD plan in a nutshell:



Thank you for your attention