

# Mapping of the functional ecological network of Wallonia

LifeWatch biodiversity day 2023

Habitat mapping

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Thomas Pollet, Axel Bourdouxhe and Thomas Coppée

Dr. Marie Pairon and Pr. Marc Dufrêne



# Context



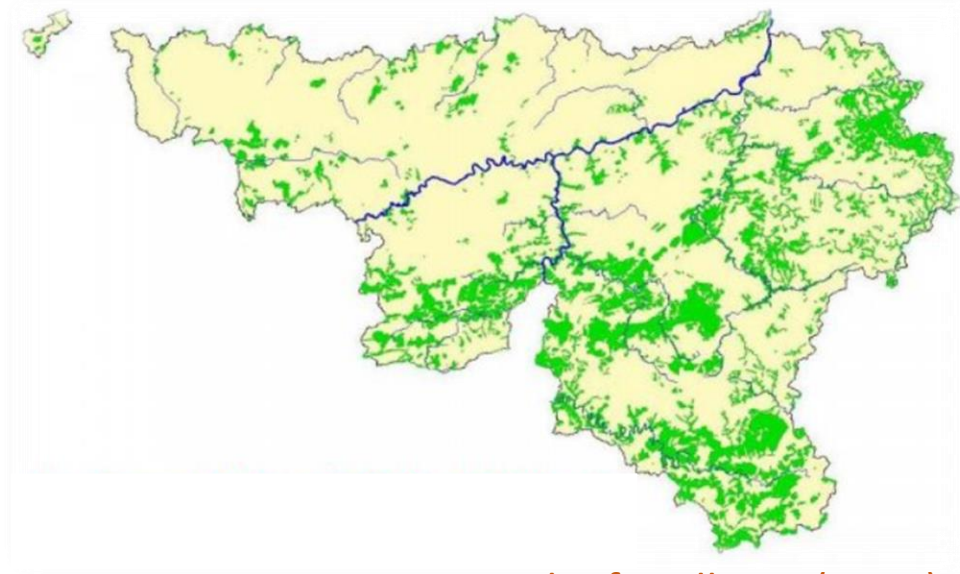
# Context

Ecological network: set of ecosystems connected by the movement of organisms in a spatially cohesive manner and interacting with the surrounding environment

In Wallonia, there is no functional ecological network in place to ensure the connectivity between sites of high biodiversity importance.



Main ecological structure of Wallonia



Natura 2000 network of Wallonia (2005)

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# Objective

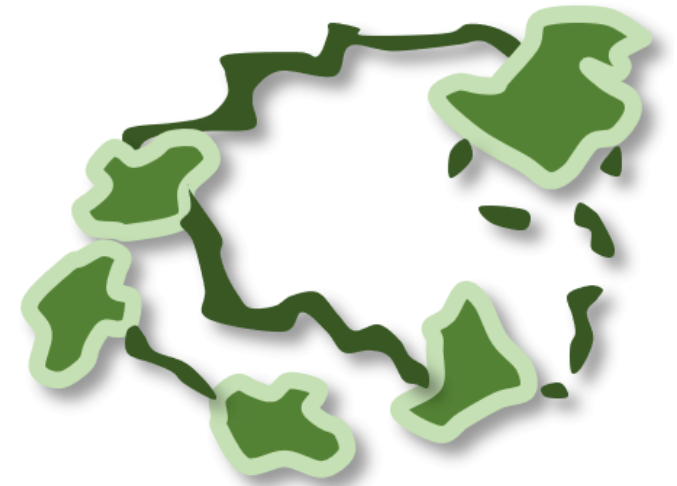
To identify important sites for the conservation of ordinary and extraordinary biodiversity in Wallonia and the connections between these sites

**Cartographic data set:**  
Precise mapping of habitats  
over the entire region

**Biologic data set:** census  
data of fauna and flora

**Connectivity analysis:**  
Connectivity levels between  
core areas

**Functional ecological network at  
Walloon region scale**



Context

**Objective**

Sub-  
networks

Sub-networks  
mapping

Biologic data

Data crossing

Biological  
indicators



# Sub-networks





# Sub-networks

- Sub-network = Subset of similar habitats that meet the ecological requirements of a specific species group and the connection between these habitats
- Hierarchical structure : Open wetlands > Meso-eutrophic wet grasslands > Alluvial wetlands



*Bistorta  
officinalis*



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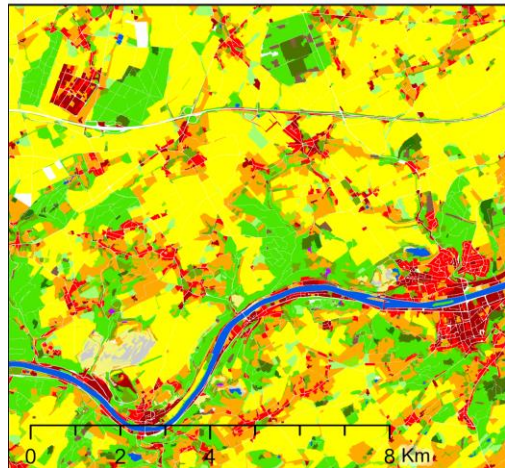
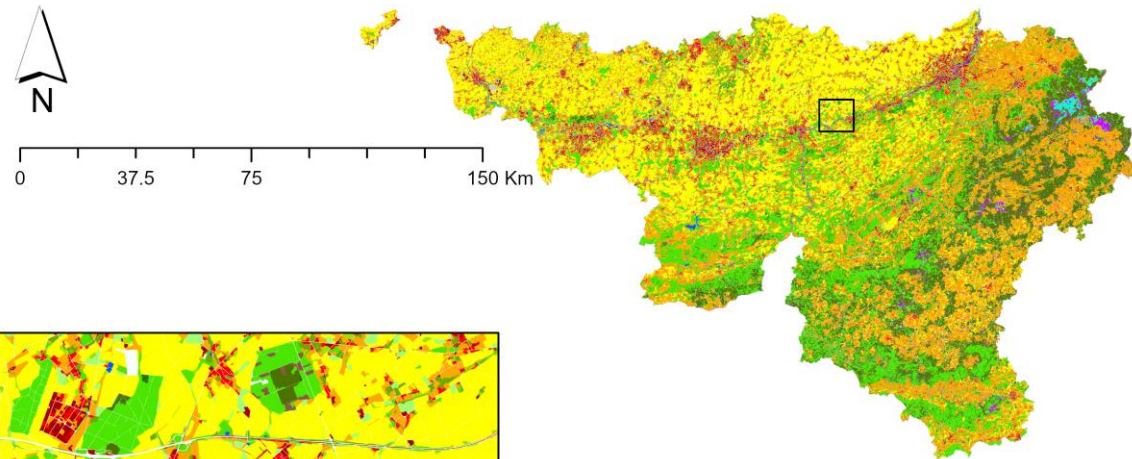
# Potential mapping of sub- networks





# I. Construction of the cartographic referential

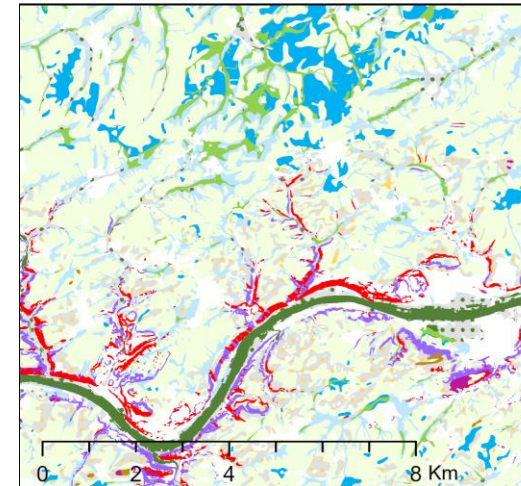
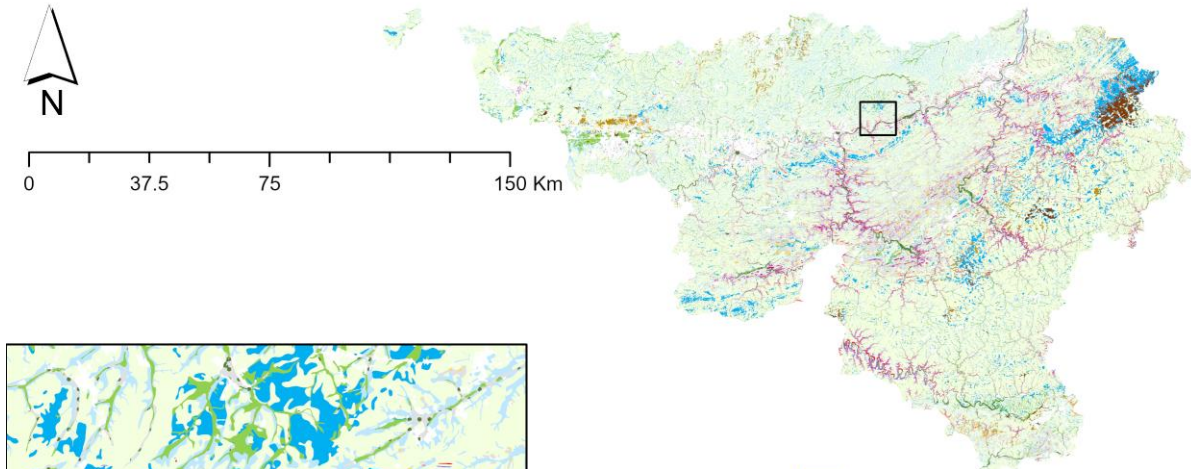
LifeWatch  
Ecotope



LCCSb

- |                                                               |                                                                                       |
|---------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Periodically herbaceous                                       | Recently cleared areas with forest regrowth, also includes forest gaps and Xmas trees |
| Mixed crop cover (with majority of crops)                     | Permanent monospecific productive grassland                                           |
| Mixed crop cover (with minority of crops)                     | Diversified grassland and shrubland                                                   |
| Broadleaved deciduous forest                                  | Mixture of vegetation and bare soils                                                  |
| Needleleaved sempervirens forest                              | Densely artificialized (>50% artificial surface)                                      |
| Mixed forest                                                  | Sparsely artificialized (>25% artificial surface)                                     |
| Mixed herbaceous and tree cover (with majority of trees)      | Bare soil                                                                             |
| Mixed herbaceous and tree cover (with majority of herbaceous) | Water                                                                                 |

Sensitive and marginal lands



Ecological contexts

- |                                                                            |                                                                                 |
|----------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Peaty and paratourbrial soils                                              | Other sandy textured soil                                                       |
| Non-alluvial and colluvial hydromorphic soil                               | Drier, artificial or unmapped soil located in low and very low flood hazard     |
| Alluvial and colluvial hydromorphic soil                                   | Slope of 15 to 20 degrees of cold exposure                                      |
| Drier, artificial or unmapped soil located in medium and high flood hazard | Context on slope of 15 to 20 degrees of warm exposure                           |
| Podzolic soil or podzolic soil in formation or degraded                    | Other surface substrate                                                         |
| Slope of more than 20 degrees of cold exposure                             | Alluvial or colluvial ecological context on moderately wet to very dry soil     |
| Slope of more than 20 degrees of warm exposure                             | Non-alluvial or colluvial ecological context on moderately wet to very dry soil |
| Shallow and very shallow substrate                                         | Undefined ecological context                                                    |

Sub-networks

Sub-networks  
mapping

I. Cartographic  
referential

II. Habitats  
modélisation

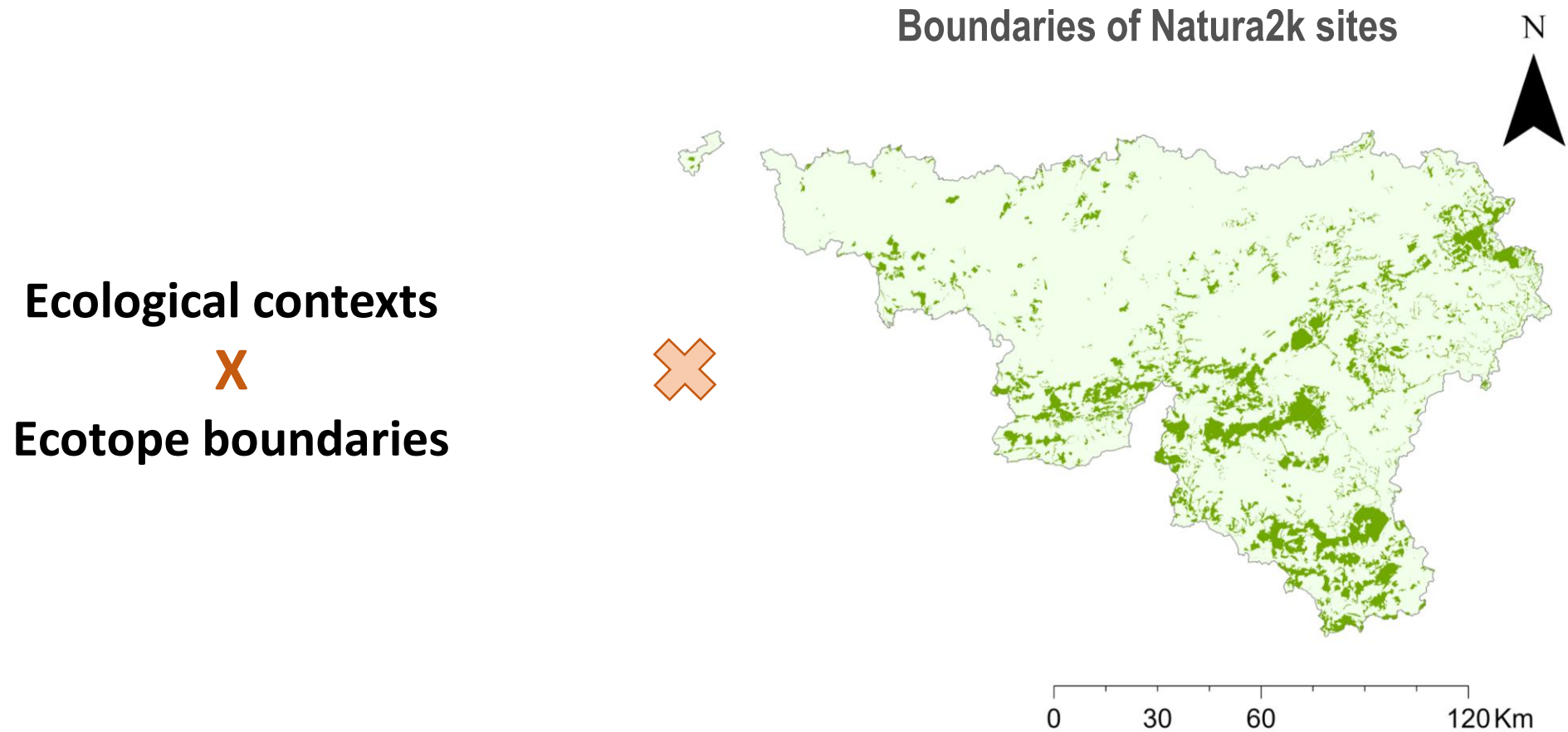
III. Final  
mapping

Biological  
data

Data crossing



# I. Construction of the cartographic referential



Sub-networks

Sub-networks  
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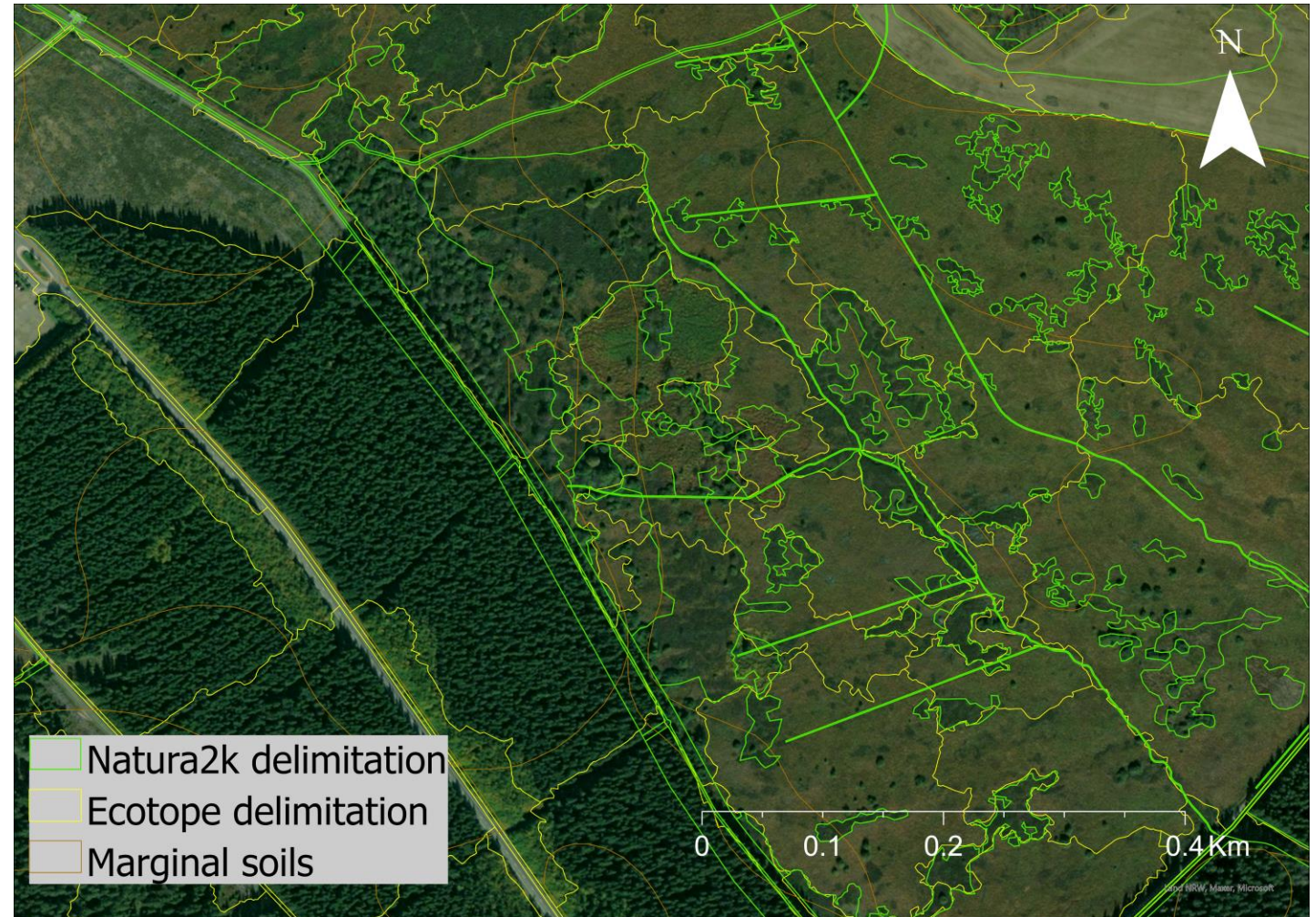
Biologic data

Data crossing



# I. Construction of the cartographic referential

**Final  
cartographic  
referential**



Sub-networks

Sub-networks  
mapping

**I. Cartographic  
referential**

II. Habitats  
modelisation

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Biological  
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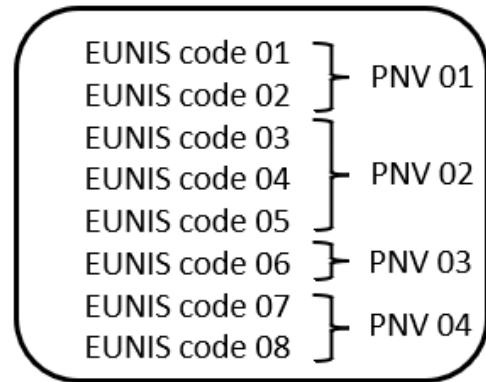
Data crossing



# II. Habitats modelisation

Method:

## 1. PNV construction

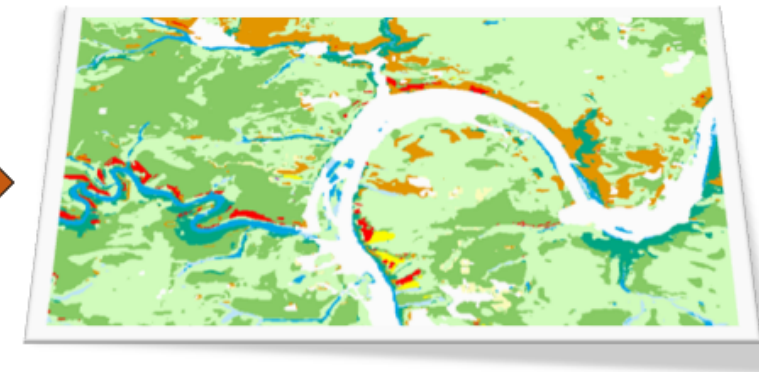


Environmental predictors

## 2. Individual PNV Modeling



## 3. Dominant PNV Classification



Sub-networks

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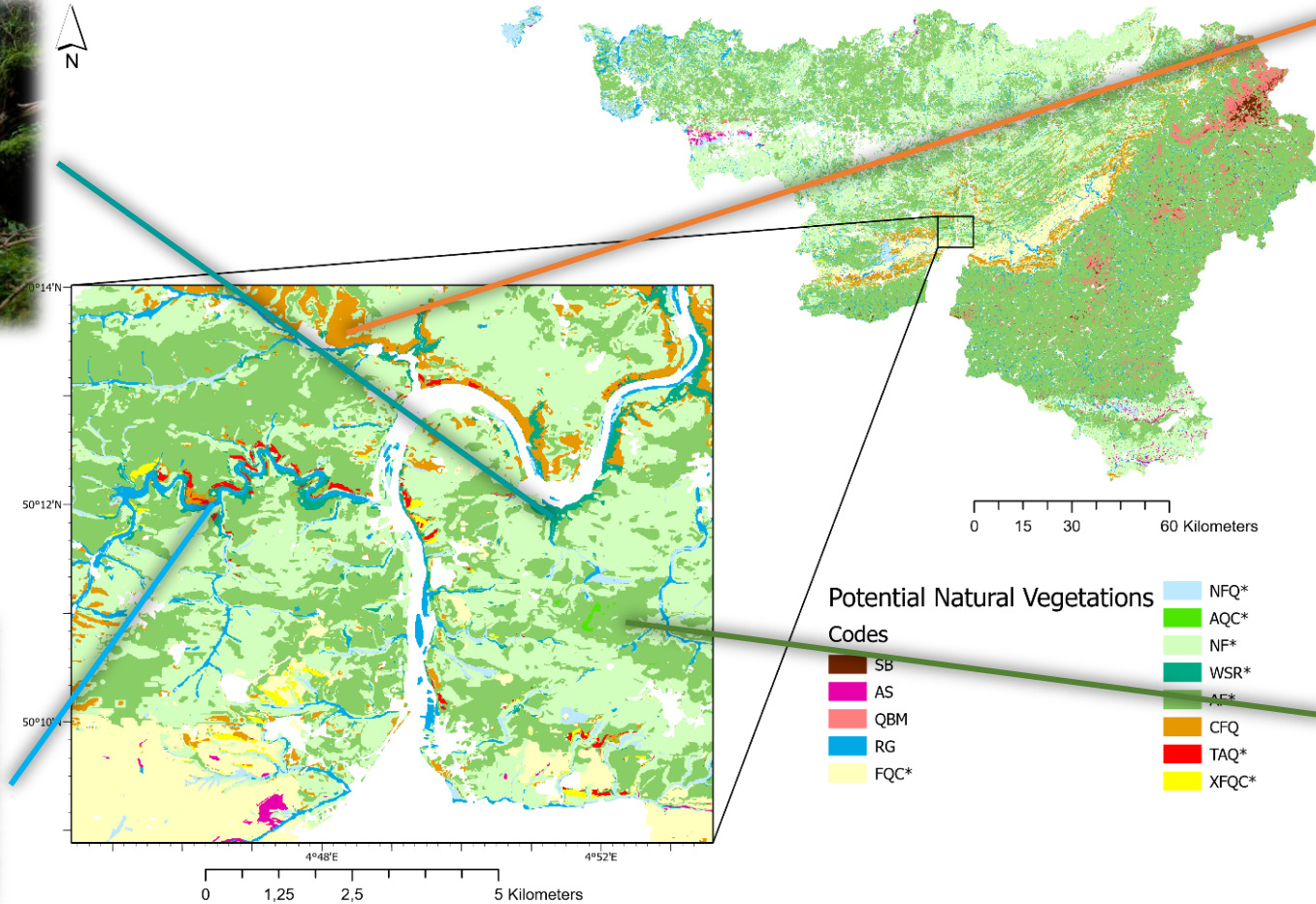
# II. Habitats modelisation



Wetland ravine forests



Alluvial forests



Beech and oak calcicole forests

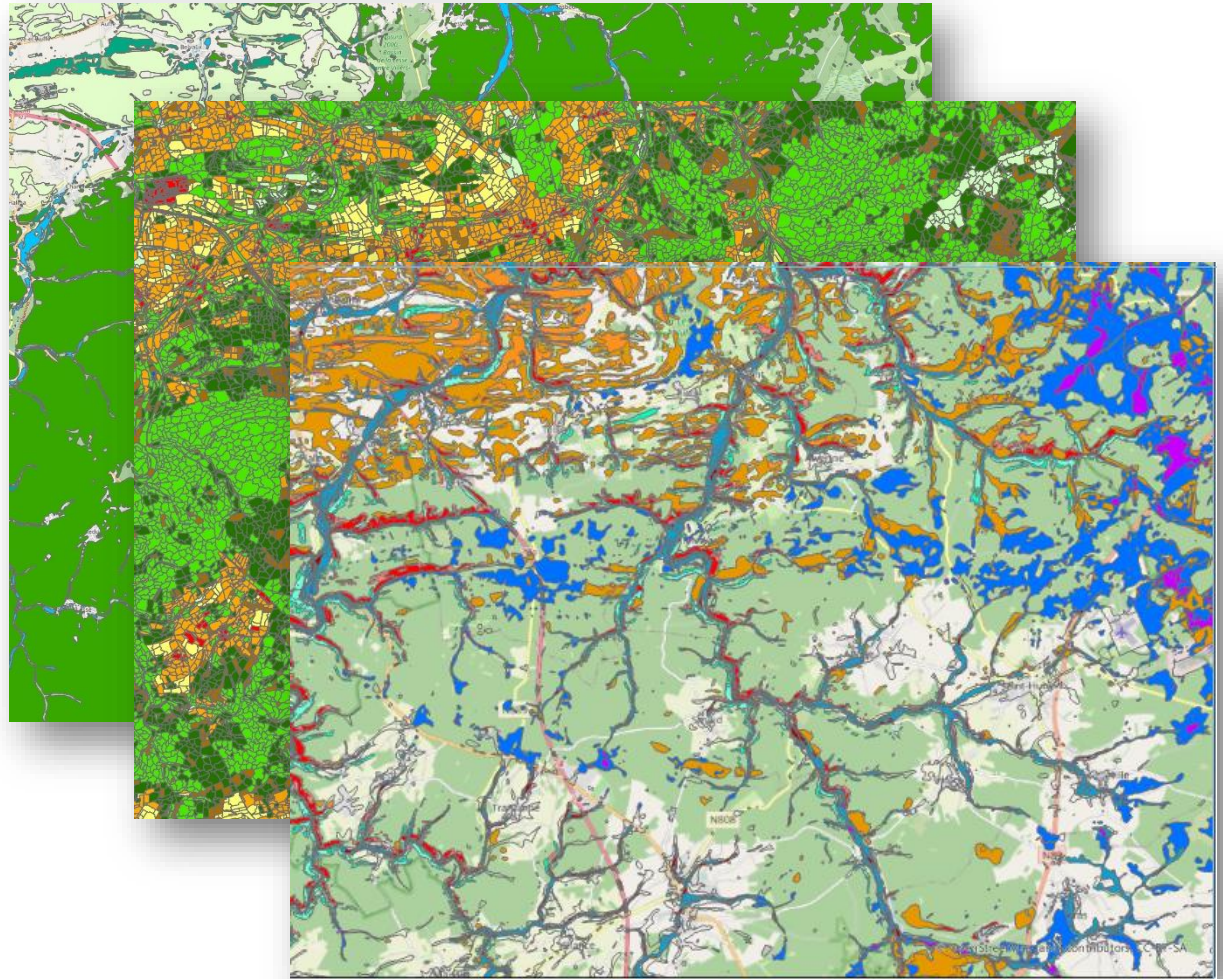


Acidophilous beech forests



# III. Final mapping of the ecological sub-networks

- PNV included in the cartographic referential in proportion of surface in each polygon
- Other environmental variables
  - **Ecotope variables**
  - Draining
  - Sensitive and marginal lands
  - SIGEC
  - Natura2k
  - Open areas of interest for biodiversity
  - And so on...





# III. Final mapping of the ecological sub-networks

- Potential natural vegetation are linked to sub-networks but are not equal
- Goal = refine the habitats models with other ecological variables

Exemple: Sub-network of bogs and poor fens

- PNV = Peat bogs
- Open areas
- Natural areas
- Marginal soils = peaty soil or paratourbous soil
- and so on...

Sub-networks

**Sub-networks  
mapping**

I. Cartographic  
referential

II. Habitats  
modelisation

III. Final  
mapping

Biological  
data

Data crossing

# III. Final mapping of the potential ecological sub-networks

## Final mapping of the potential ecological sub-networks



Sub-networks

Sub-networks  
mapping

I. Cartographic  
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Biological  
data

Data crossing



# Biological data



# Biological data: Data sorting

- 1990 to 2021: Points of presence (fauna and flora)
- Fauna: 2 300 000 observations
- Flora: 1 300 000 observations



 Observations.be

Ajouter une observation

Obsidentify propose Fauvette babillarde *Sylvia curruca* avec 100.0% de certitude **avertissement** ×  
accept uncertain predictions

Ajouter des photos ou des sons. La date, l'heure et la localisation seront extraits des fichiers multimédias si possible. Télécharger



Supprimer le fichier



Date

2020-04-19



Observations.be

Sub-networks  
mapping

Biologic data

I. Data sorting

II. Indicative  
species

III. Species  
distribution  
modeling

Data crossing

Data crossing



# Biologic data: Indicative species

- Each sub-networks is linked to a series of indicator species of flora and fauna



Marsh warbler



Ino fritillary



Field cricket



Nickerl's fritillary

## Open wetlands



White-faced darter

## Dry open areas



Acteon Skipper

Sub-networks  
mapping

**Biological data**

I. Data sorting

**II. Indicative  
species**

III. Species  
distribution  
modeling

Data crossing

Biological  
indicator

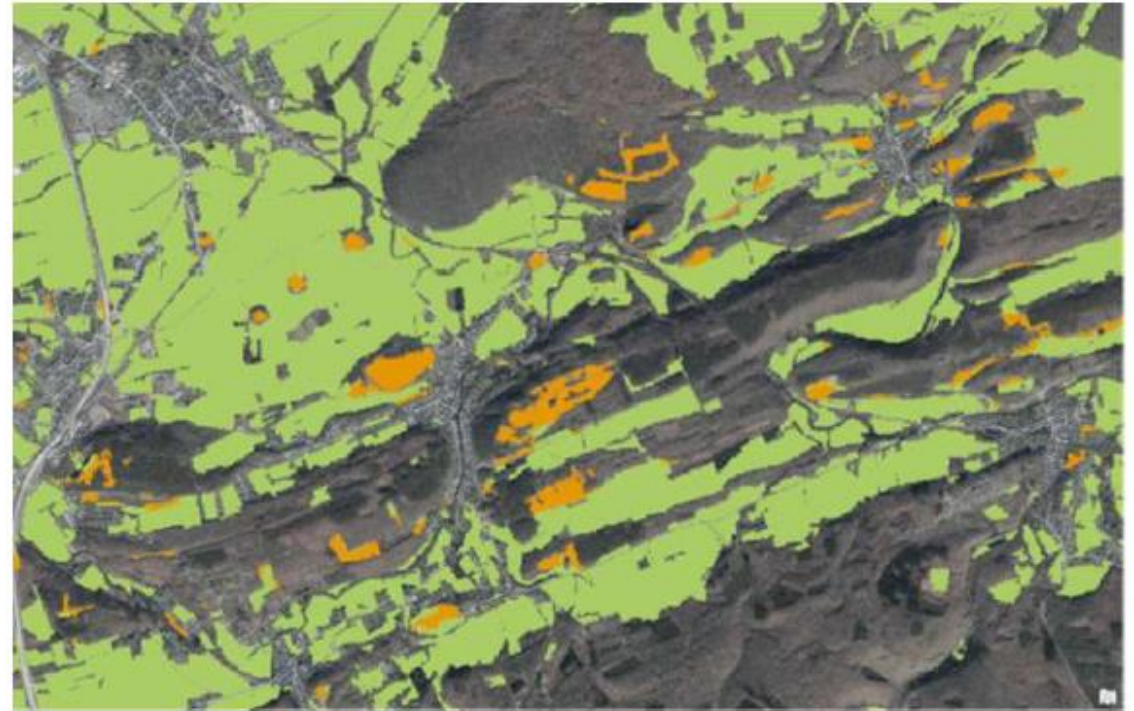
# Biologic data: SDM



Only for species of interest to be modelled and whose models are consistent

## Species distribution modelling

- Limits the problems of uneven sampling efforts
- Highlights areas potentially favourable to biodiversity
- The whole region is covered



*Ipheclides podalirius* distribution modeling

Orange = Presence

Green = Absence

Sub-networks  
mapping

**Biological data**

I. Data sorting

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species

**III. Species  
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modeling**

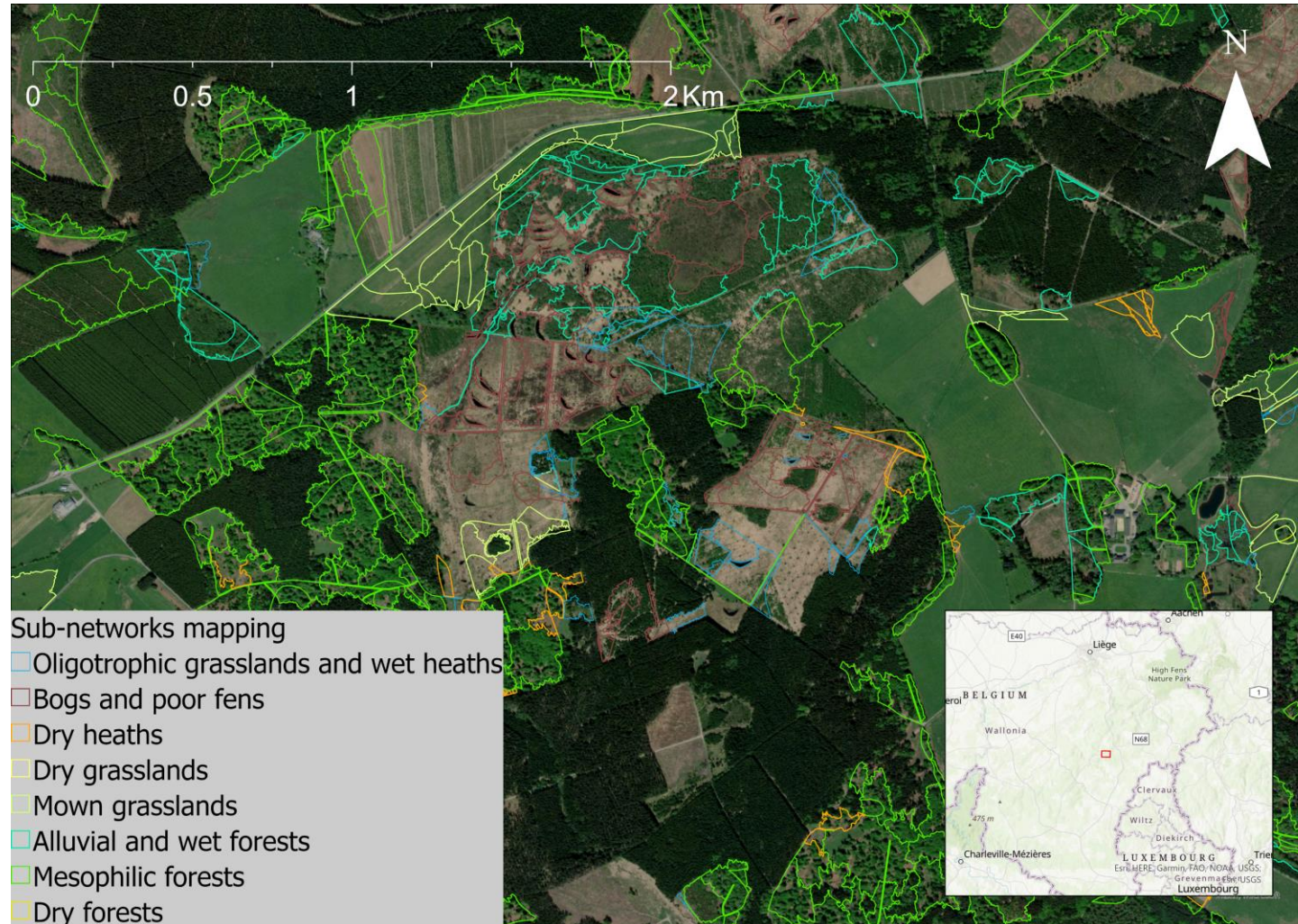
Data crossing

Biological  
indicator



# Data crossing

The objective is to carry out a mapping validation of the ecological sub-network via biological data



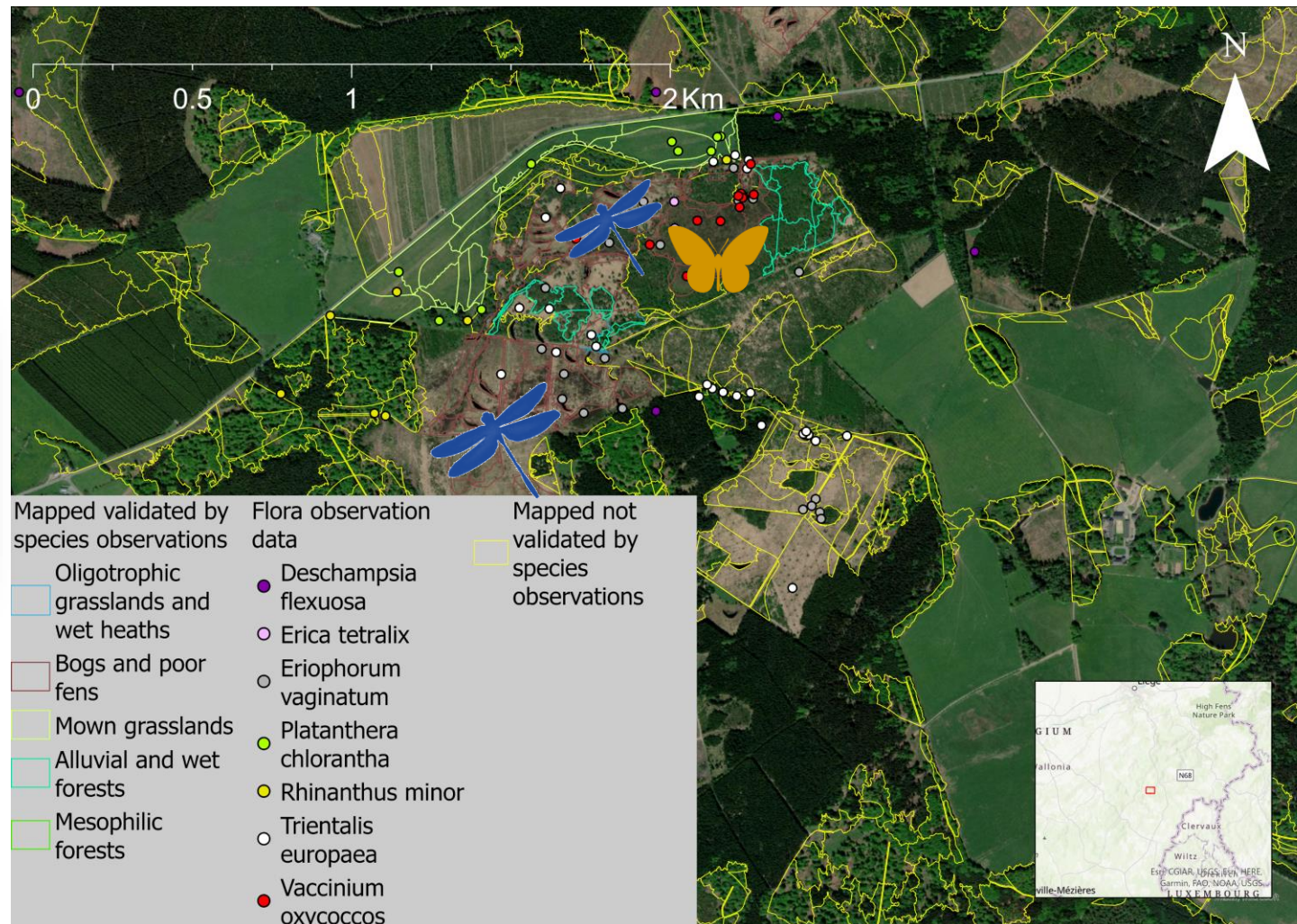


# Data crossing

The objective is to carry out a mapping validation of the ecological sub-network via **biological data**



*Sympetrum danae*



*Boloria aquilonaris*

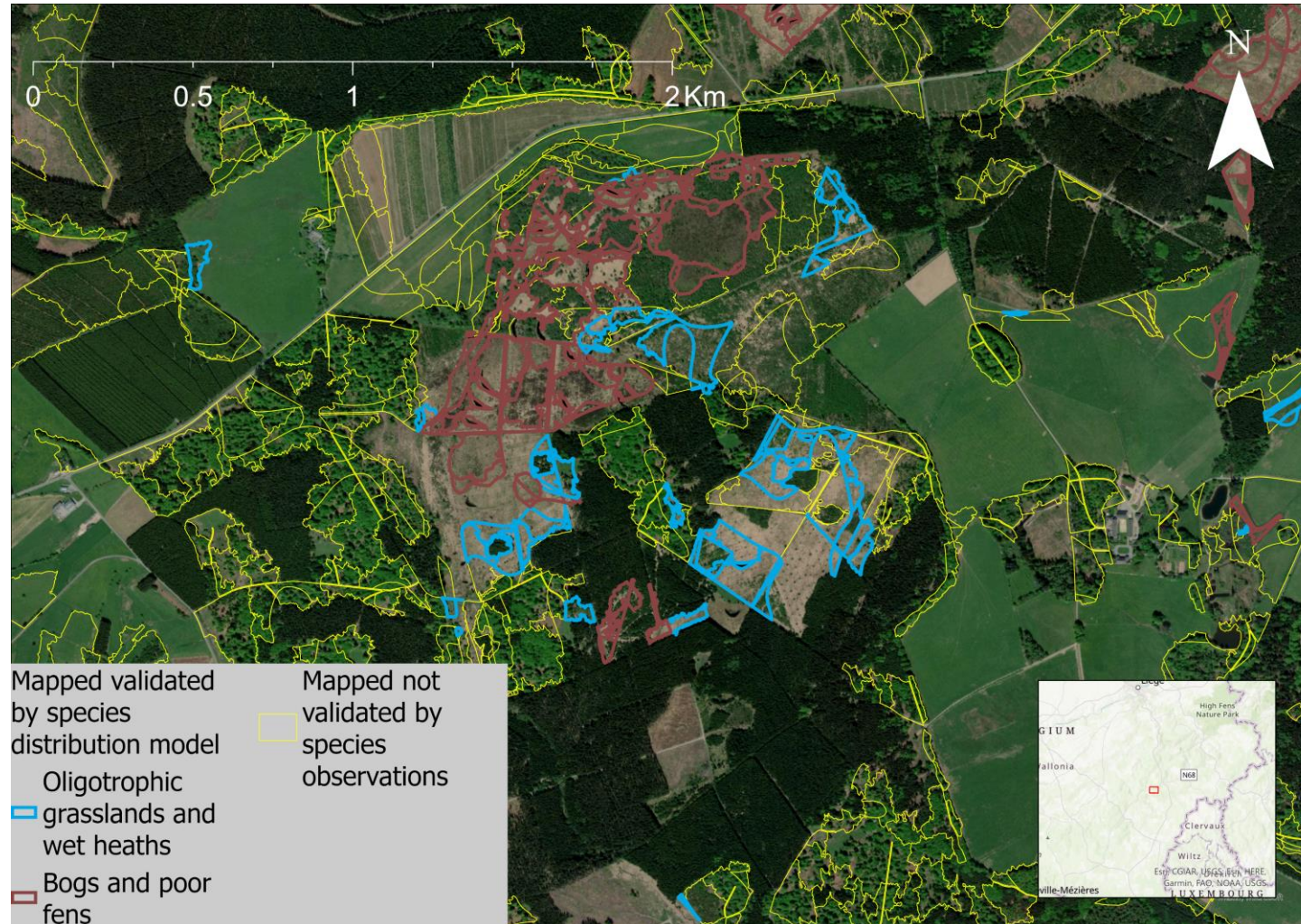


# Data crossing

The objective is to carry out a mapping validation of the ecological sub-network via biological data and **species distribution modeling**



*Somatochlora arctica*



*Boloria eunomia*

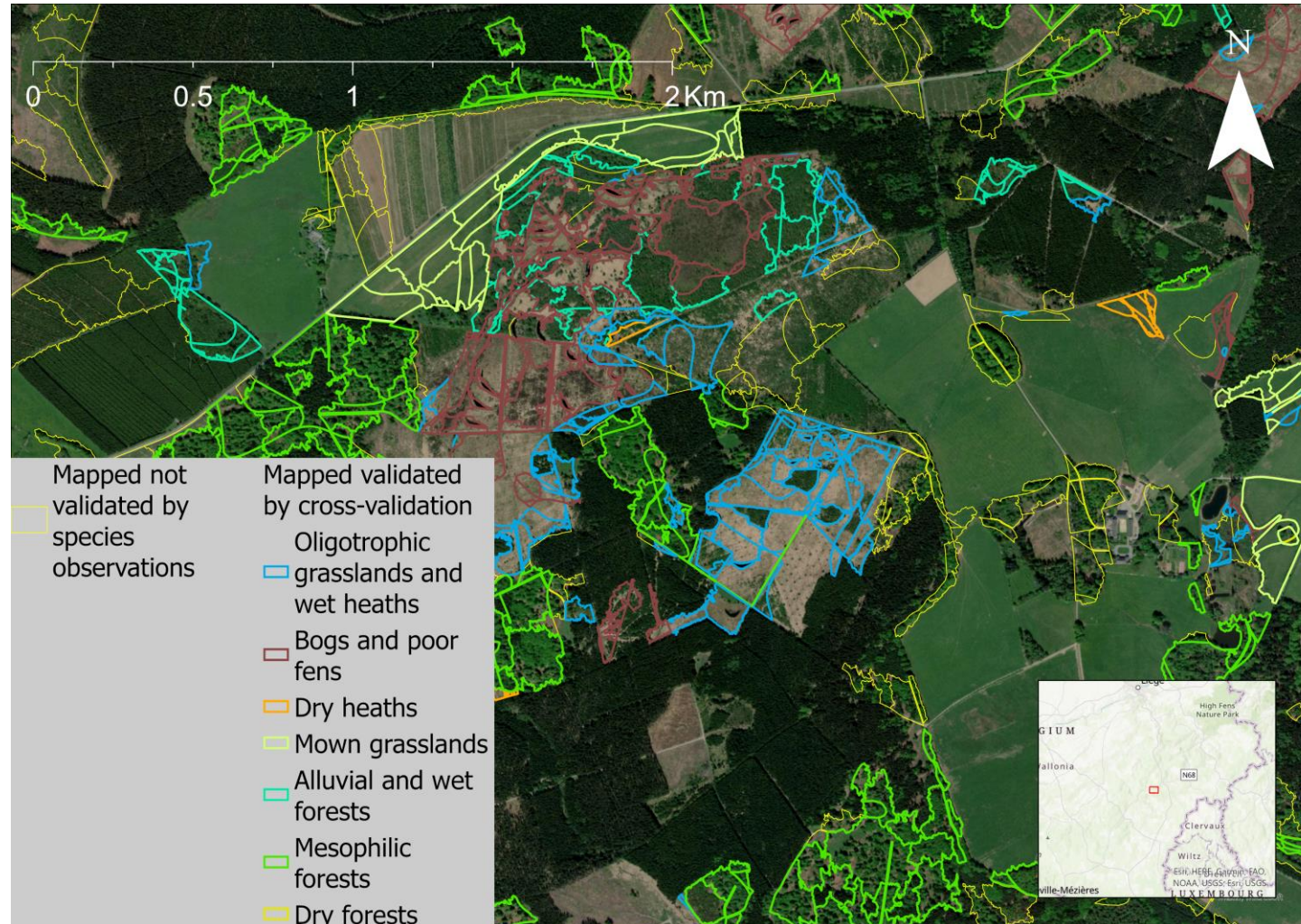


# Data crossing

The objective is to carry out a validation of the mapping of the ecological sub-network via biological data and species distribution modeling



*Hypericum pulchrum*



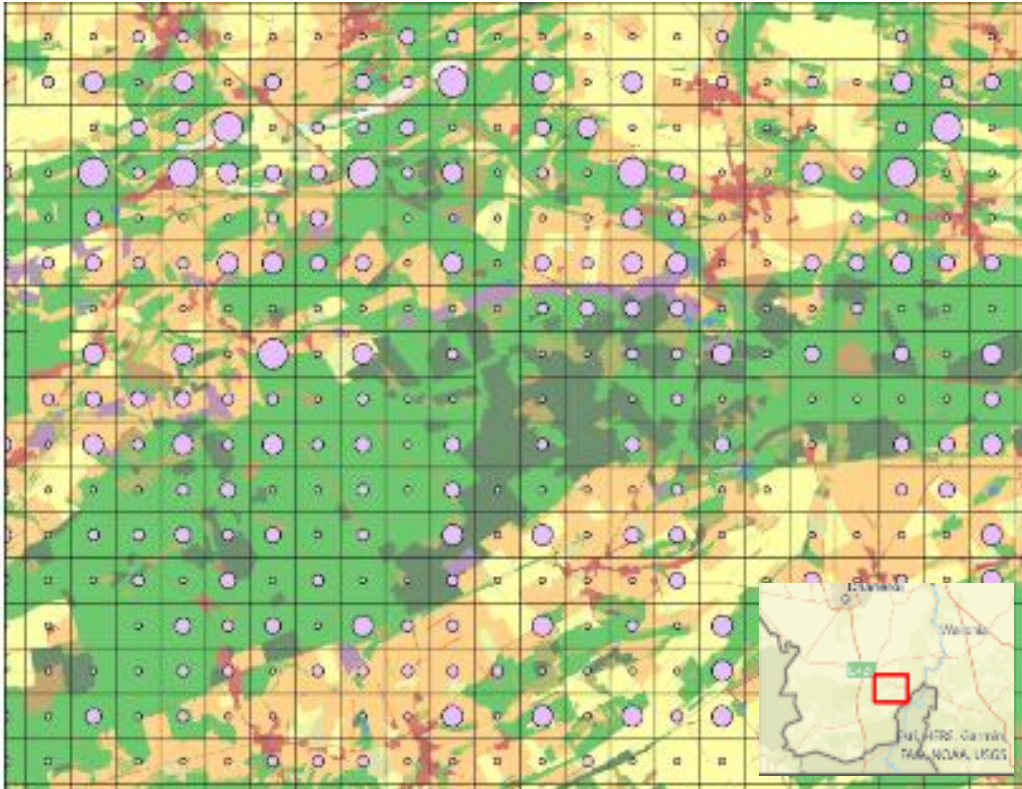
*Chorthippus montanus*



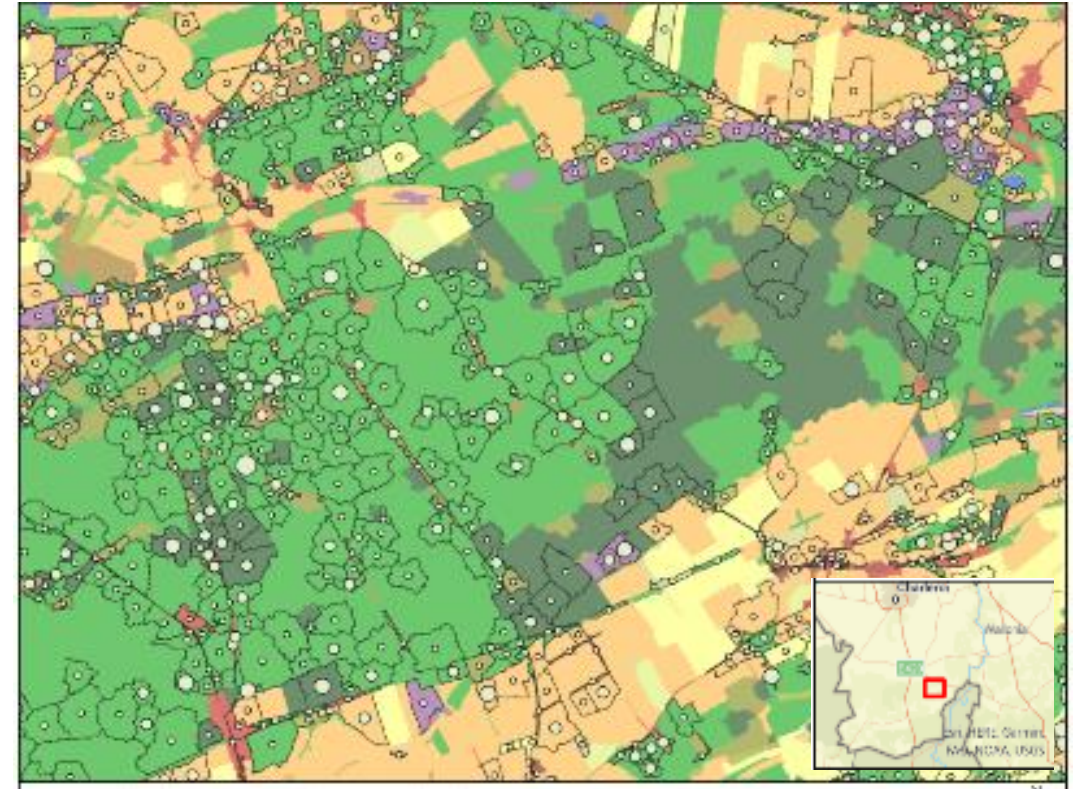
# Biological indicators

- Estimation of sampling effort
- Identification of biodiversity hotspots

Number of protected species per  
square kilometer



Number of protected  
species per ecotope polygon



# Conclusion and perspectives

The first essential step in building an ecological network at the scale of the Walloon Region is creating a functional ecological network that considers only the current state of the landscape, and disregards socio-economic concerns.

Those followed steps have been followed:

1. Diagnosis of existing habitat mapping
2. Diagnosis of existing biological and environmental data
3. Modelling of fauna and flora species and potential natural vegetation
4. Mapping a potential ecological network using only environmental data and habitat models
5. Validated this ecological network via species models and species observations data



# Conclusion and perspectives

- A new convention has begun to improve the method and results.
- Taking into account new environmental and cartographic data
- Increasing the range of the ecological sub-network
- Highlighting of restorable areas
- Carrying out a full analysis of the connectivity between the elements of each sub-networks



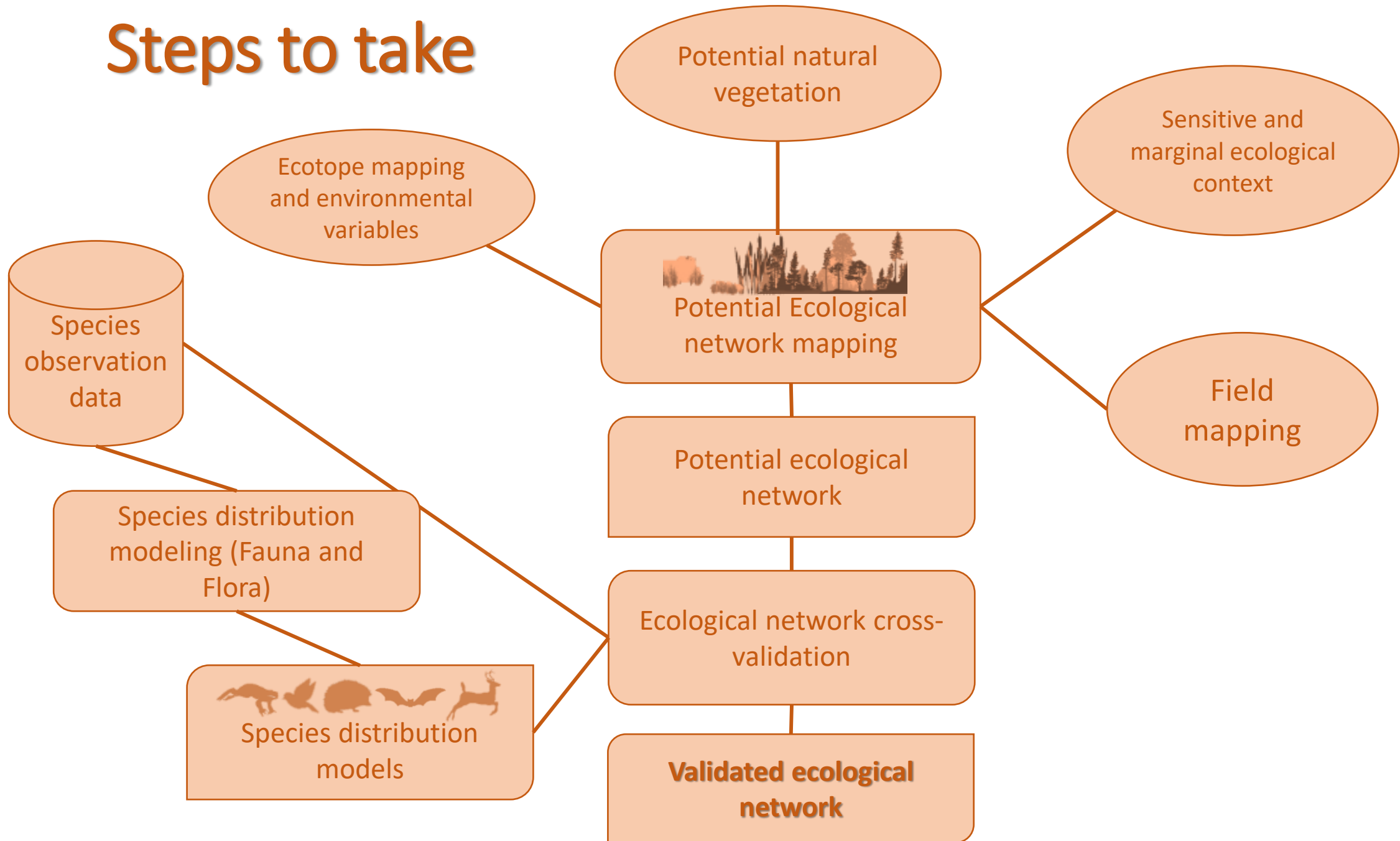


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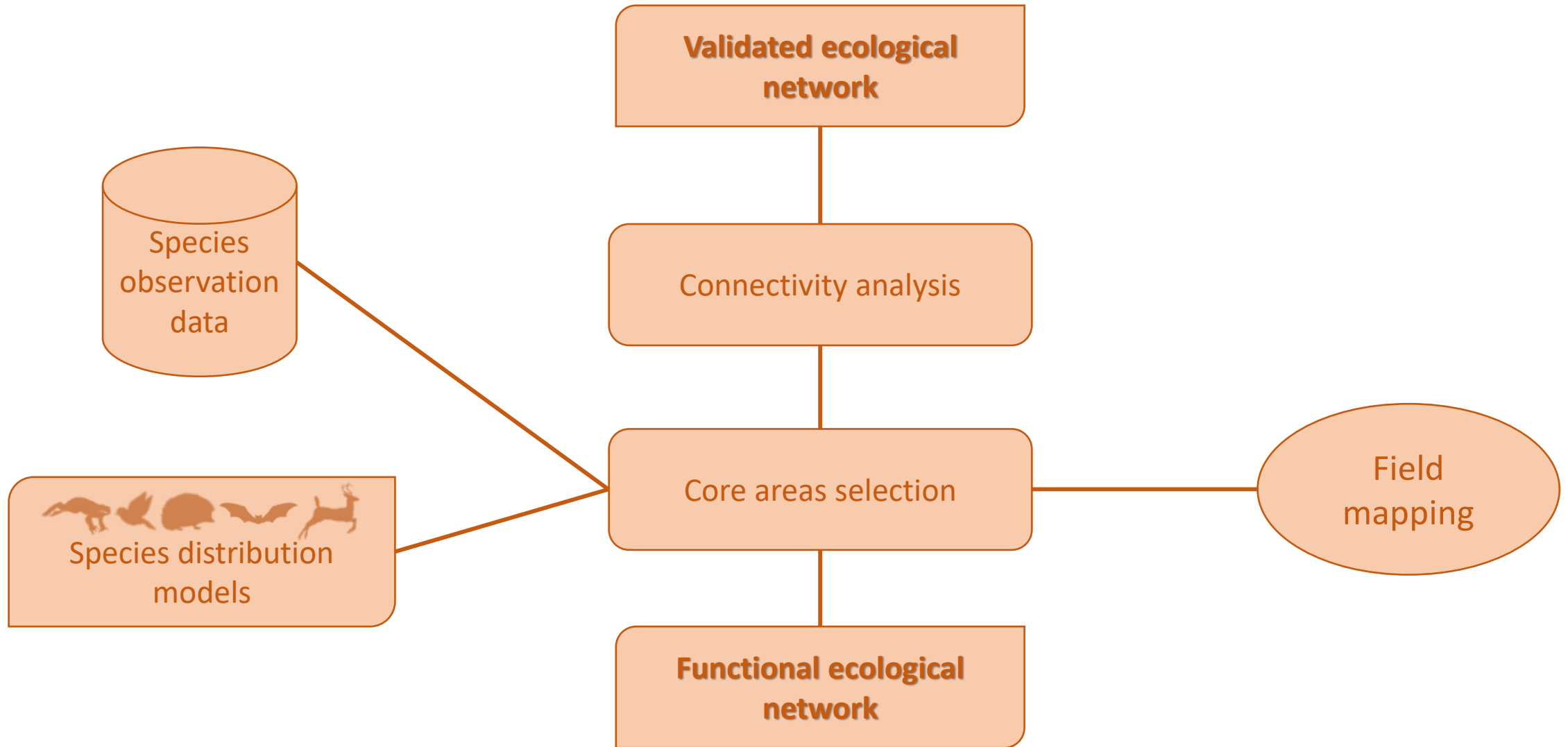
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[th.pollet@uliege.be](mailto:th.pollet@uliege.be)



# Steps to take



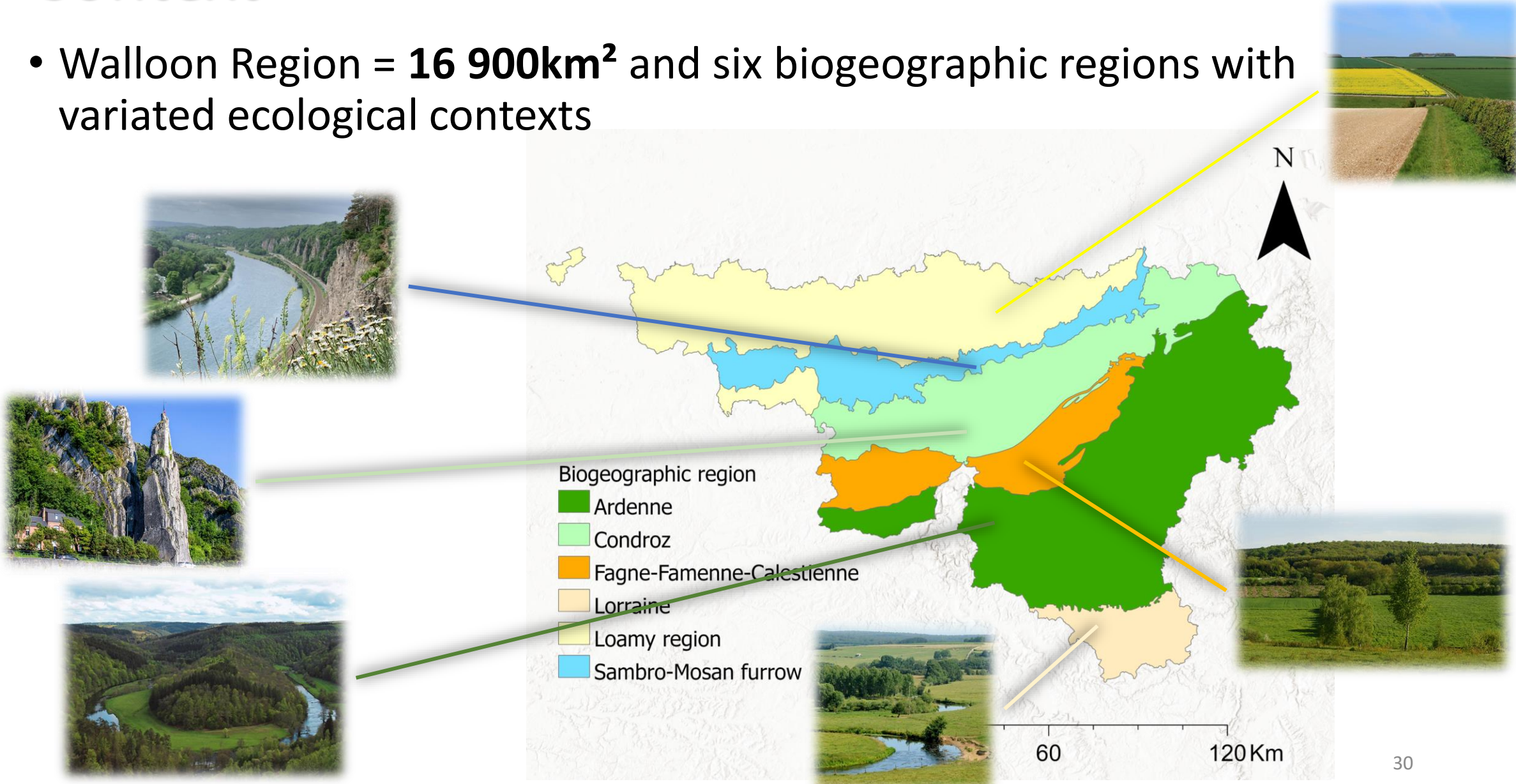
# Steps to take





# Context

- Walloon Region = **16 900km<sup>2</sup>** and six biogeographic regions with varied ecological contexts



# Sub-networks

- Level 1: Splitting habitats according to main ecological gradients (vegetation height, Naturalness and humidity)
- Level 2: Splitting habitats according to fauna species and connectivity issues



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©Louis-Marie Delascaille



©San Martin Gilles



©Simon Luc



# Sub-networks

- Level 3: The most accurate level that can be mapped outside the Natura2k network using Potential natural vegetation and environmental variables



G1.66



G1.A17



E1.26



E1.27

Calcareous beech-oak forests

Calcareous grasslands

©Lionel Wibail

Context

Objective

**Sub-  
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Sub-networks  
mapping

Biologic data

Data crossing

CONNECTIVITY

# II. Habitats modelisation

## Potential natural vegetation modeling



E1.26 Mesophilic and meso-xerophilic calcareous grasslands



E1.27 Xerophilous calcareous grasslands



Climax of a vegetation succession



Calicolous *Fagus* and *Quercus pubescens* forests



F3.1b Calcareous thermophilic thickets



G1.66 Medio-European calcareous beech forests



G1.71 Western Pubescent Oaks



G1.A17 Calciphilous sub-Atlantic oak-chestnut forest



## II. Habitats modelisation

### Advantages and benefits

- Better representation of rare habitats in the dataset
- Allows mapping of the ecological sub-networks habitats after combining with other data (land use for instance)
- Will also allow rapid identification of areas with high restoration potential



Sub-networks

**Sub-networks  
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I. Cartographic  
referential

**II. Habitats  
modelisation**

III. Final  
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Biologic data

Data crossing

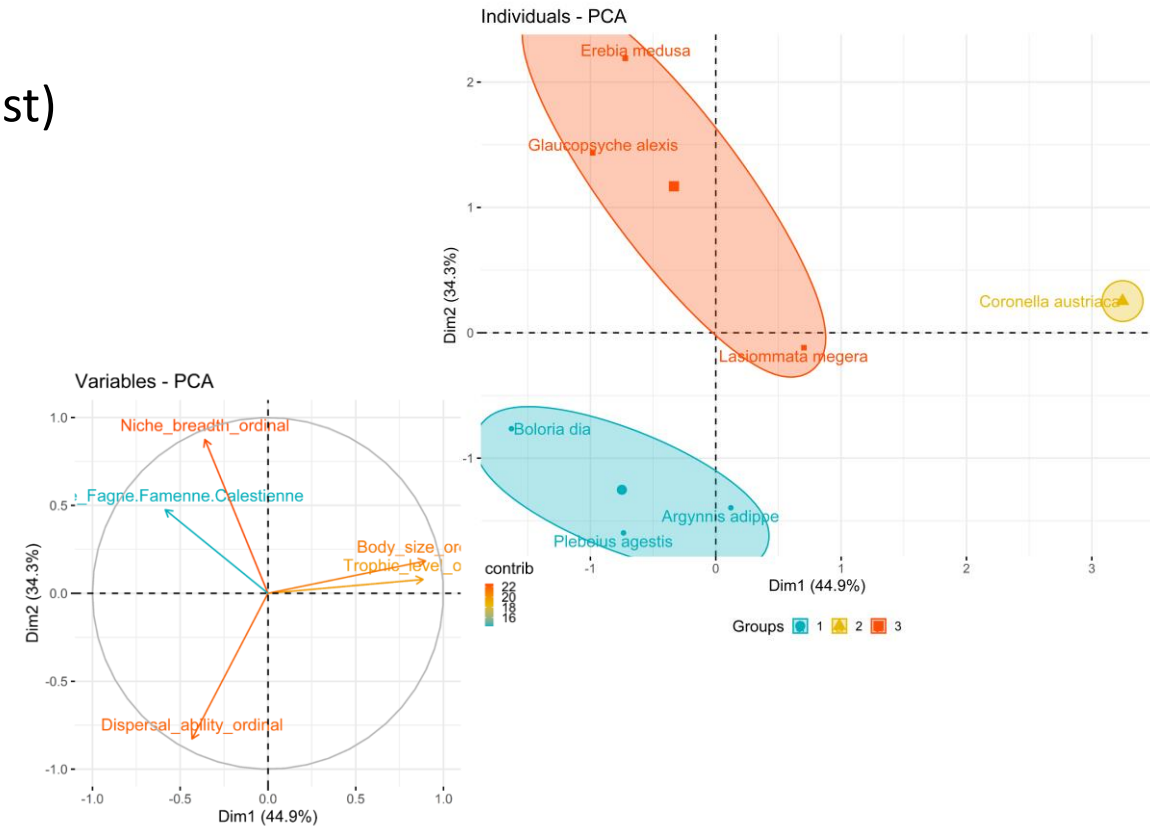
# Connectivity analysis

Grouping of species via their life traits in relation to sensitivity to fragmentation:

1. Specialisation (Generalist, Intermediate, Specialist)
2. Size (Small, Medium, Large)
3. Dispersal capacity (Short, Medium, Long)
4. Trophic level (Low, Medium, High)
5. Rarity

➔ Focal species identification

**Focal species:** Fragmentation-sensitive species representative of a species group with similar landscape connectivity needs

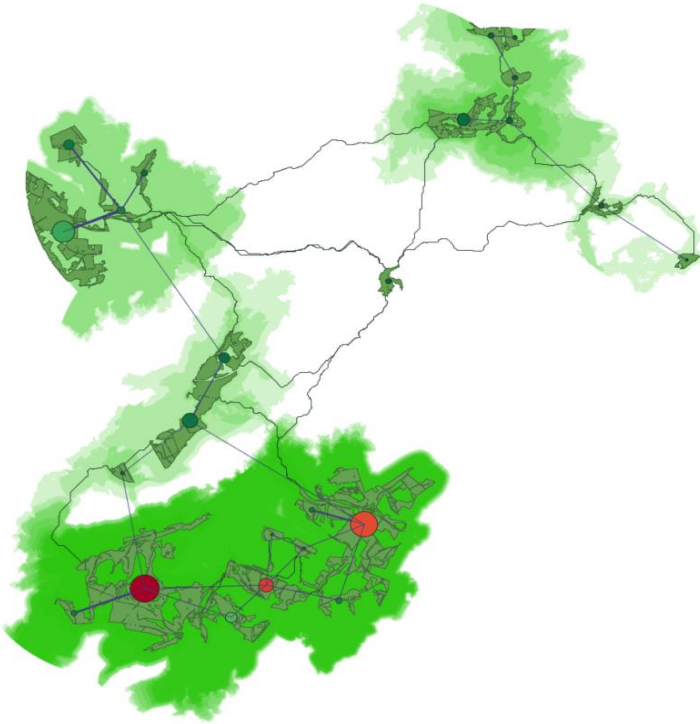




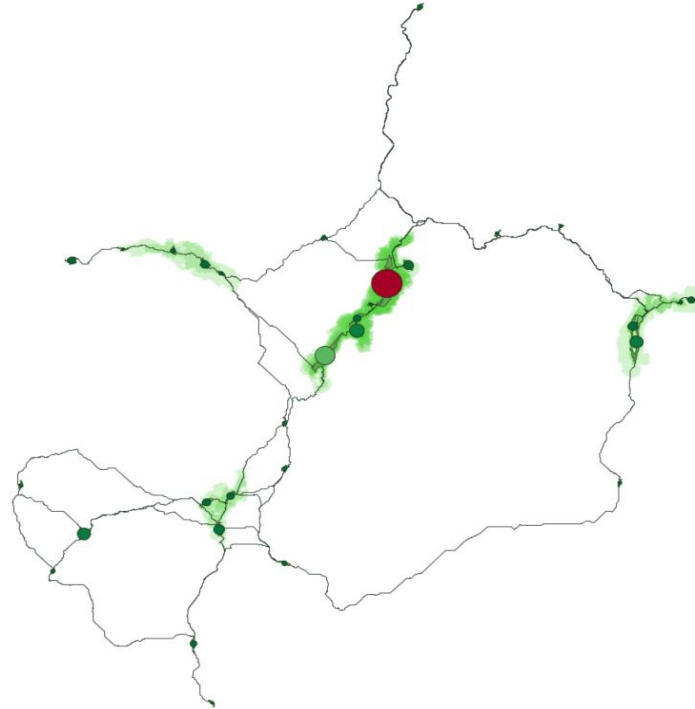
# Connectivity analysis



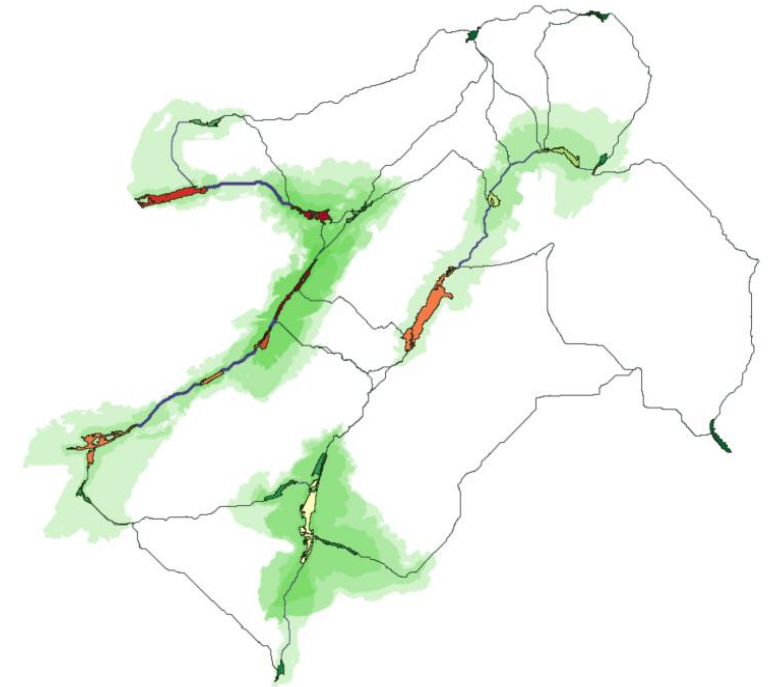
- Examples of results



Mesophilic forests



Open wetlands



Alluvial and wet forests

Context

Objective

Sub-networks

Sub-networks  
mapping




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**CONNECTIVITY**

# Connectivity analysis

- Exemples of results

-  Mesophilic forests
-  Alluvial and wet forests
-  Open wetlands

