How to predict bat problems in road projects

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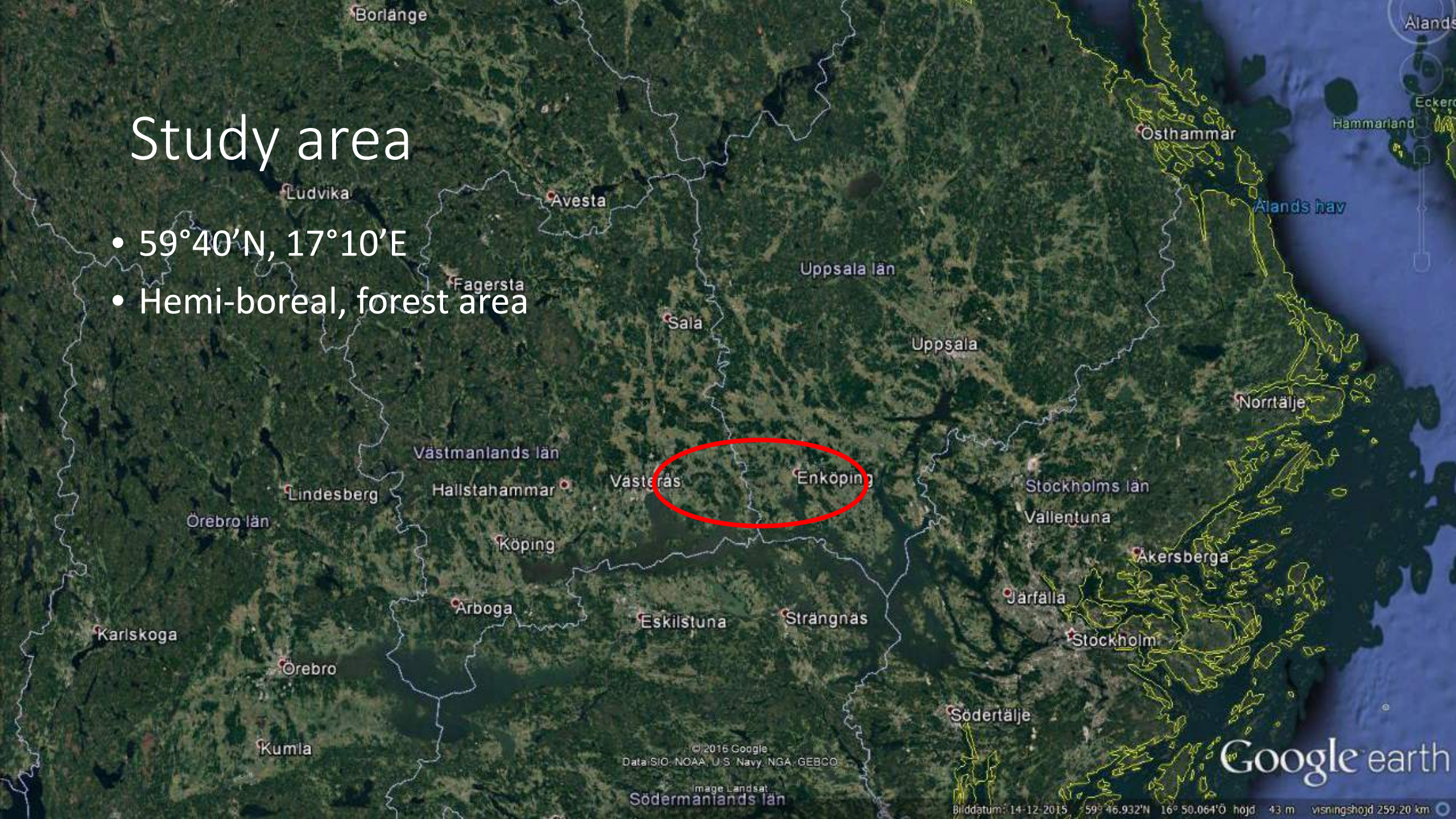
The problem

- Many species of bats are affected by roads
- Bats are also highly protected – Important to identify conflicts (EIA)
- 19 species in Sweden. Probably 10 of these are negatively affected. Of these 7 are red-listed.
- Positive impact might be increasing edge-area.
- The most likely and obvious reason: avoiding open space (predator avoidance)
- In Sweden two species have been studied in more detail: *Myotis brandtii* and *Myotis mystacinus*
- Important to predict bat occurrence

Study area

- 59°40’N, 17°10’E
- Hemi-boreal, forest area



Study area

Isby
Måtteby
Brunnby
Härnevi
Örsundsbro
Rotbrunna
Gunsta
Sparrsätraby
Jädra
Enköping
Kävra
Tallmyra
Orresta
Enköping V
Åkerby
Sneby
Berga
Näs
Hummelsta
Grillby
Ekolsund
Håra
Löt
Trogsta

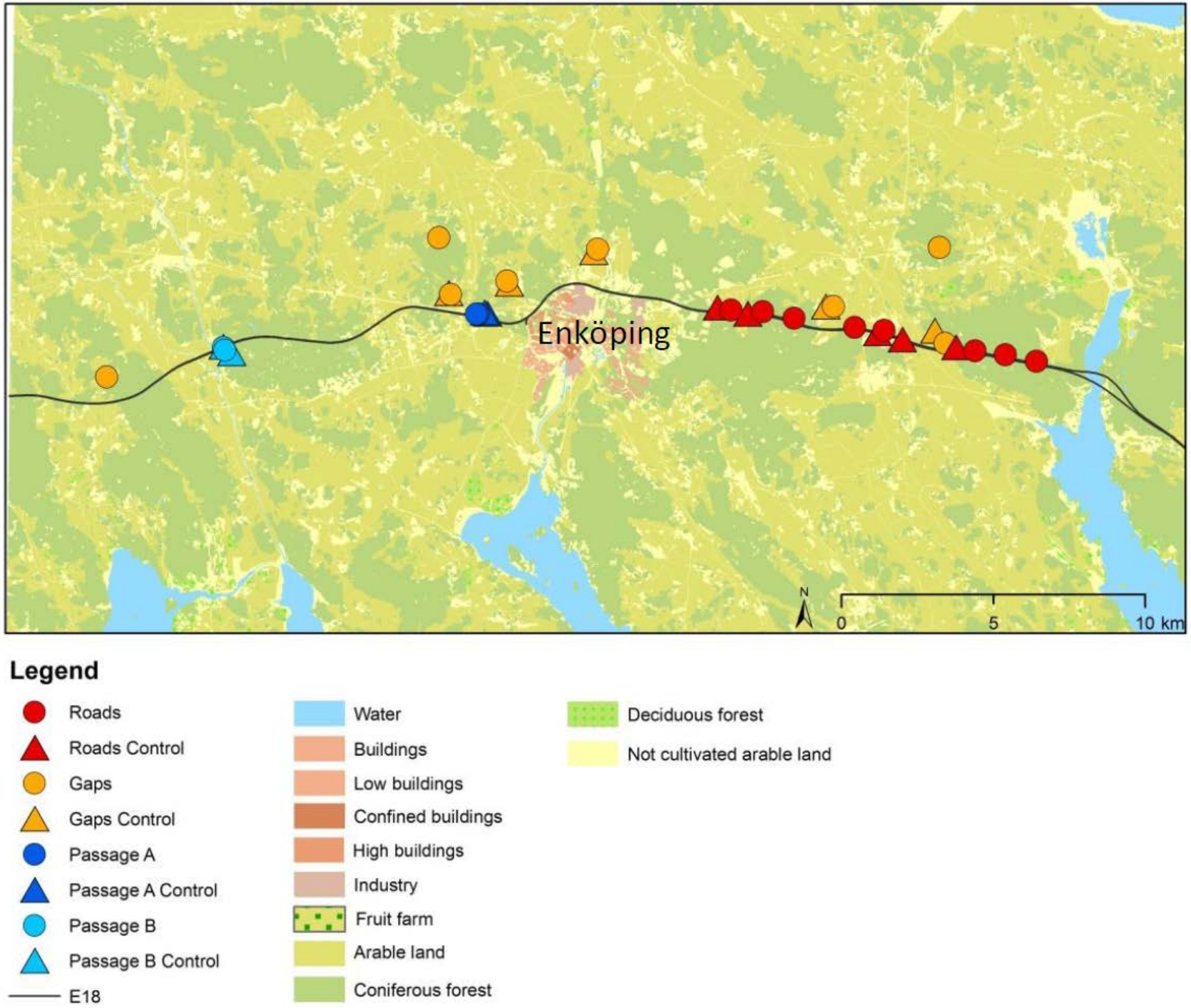
Google earth

Study species:
Myotis brandtii and *Myotis mystacinus*

- Small, forest species, occur sympatric in south Sweden
- *M.bra* is a common species, *M.mys* is less common
- Colonies in building
- In general low abundance of bats compared to central Europe

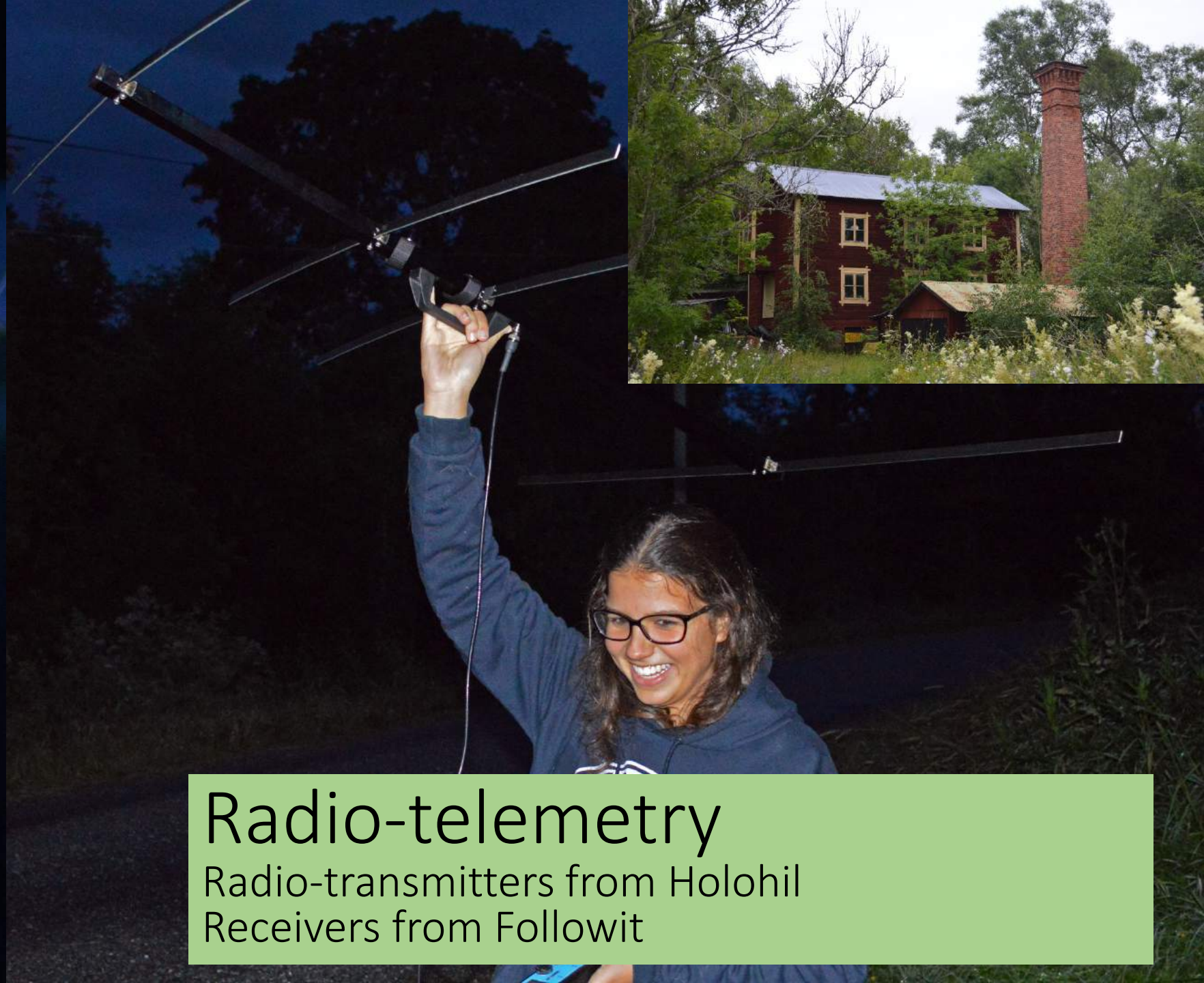
Methods

1. Automatic surveys of:
    - Roads
    - Gaps
    - Wildlife passage
    - Control sites
2. Manual survey of roads
3. Radio-telemetry



Surveys with auto-boxes

D500, Pettersson Elektronik AB

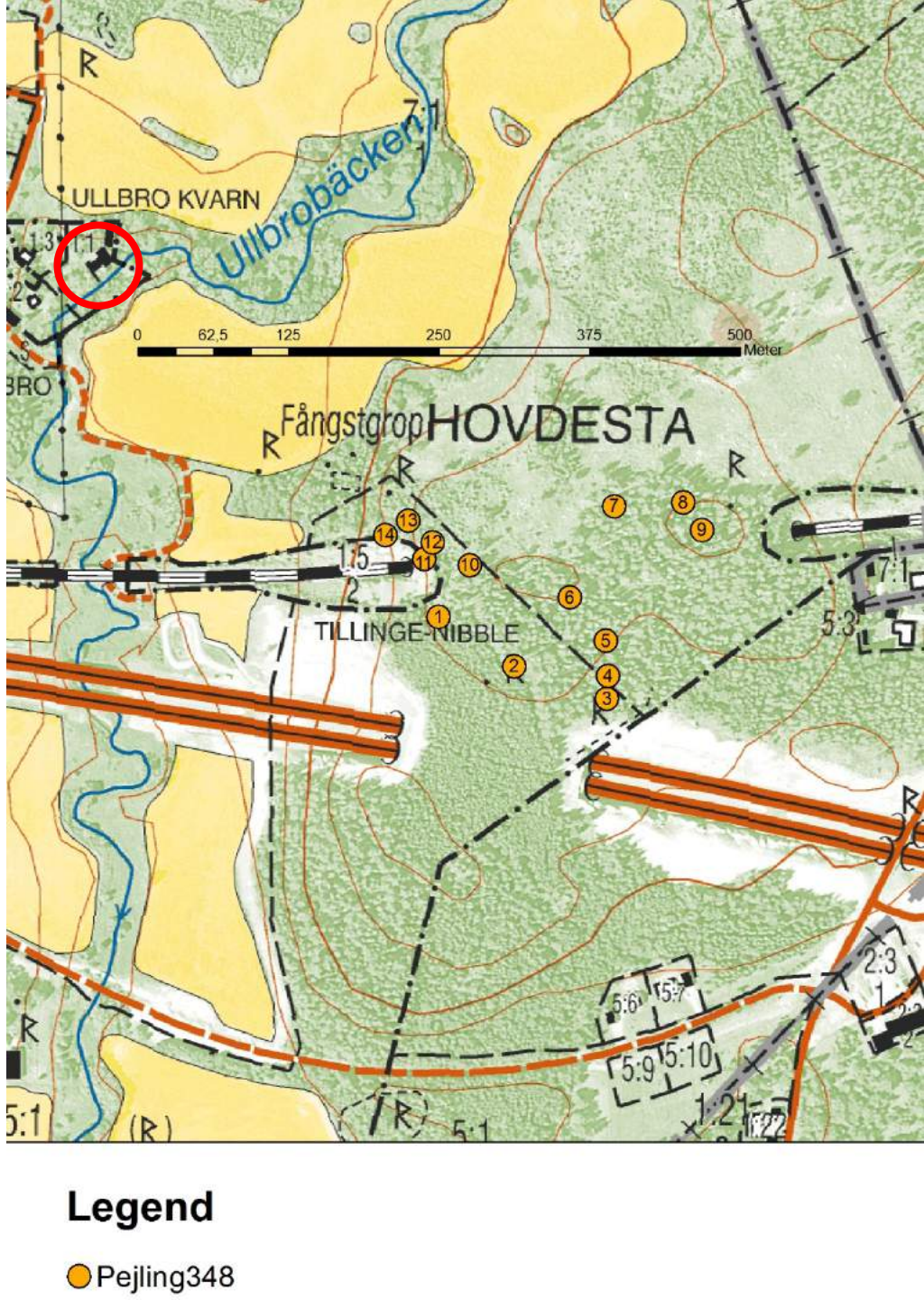


Radio-telemetry

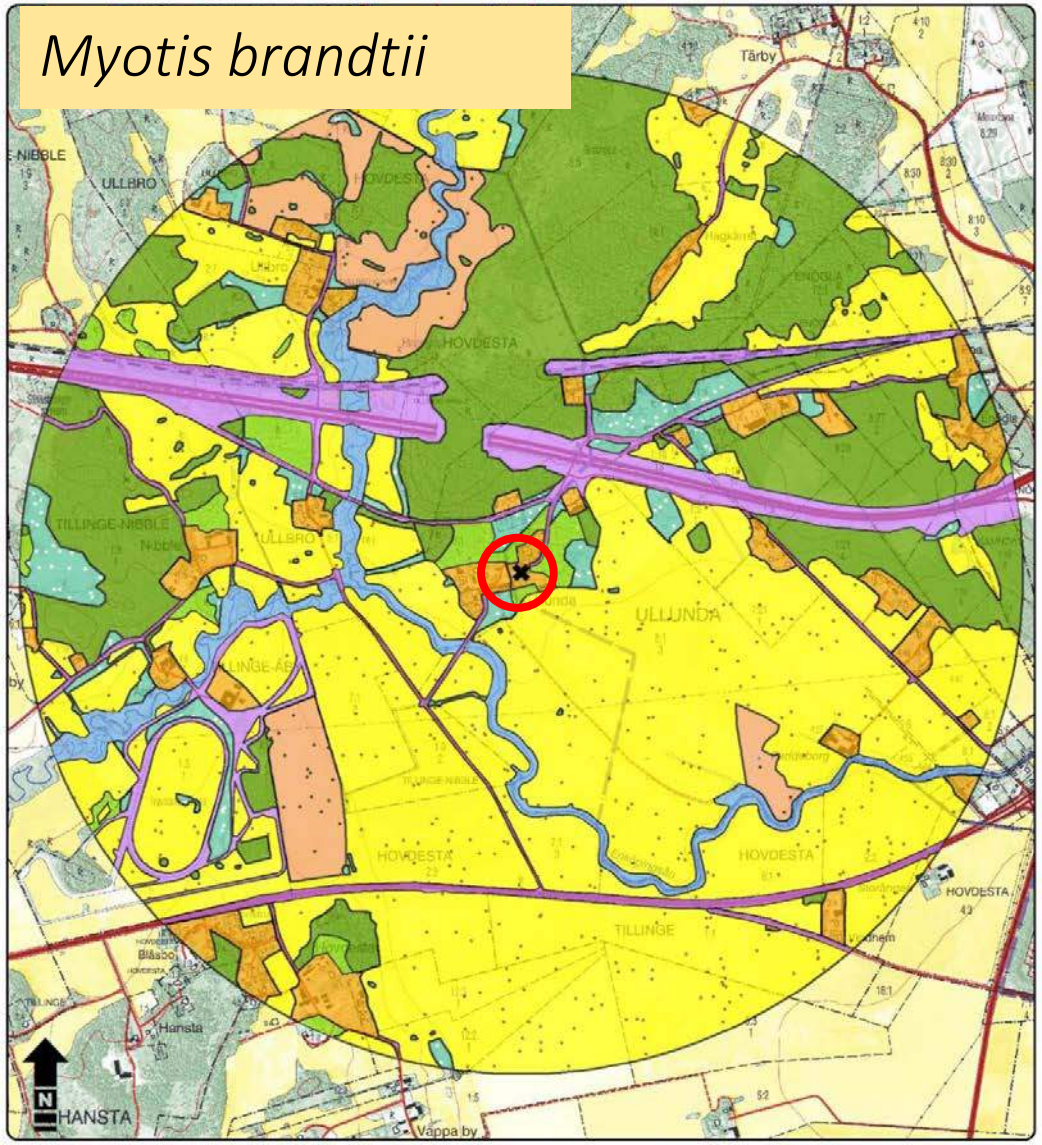
Radio-transmitters from Holohil
Receivers from Followit

Radio-telemetry

- Triangulation from listening points
- Following the bats in the forest by running after it. When found: Mark the positions with GPS.



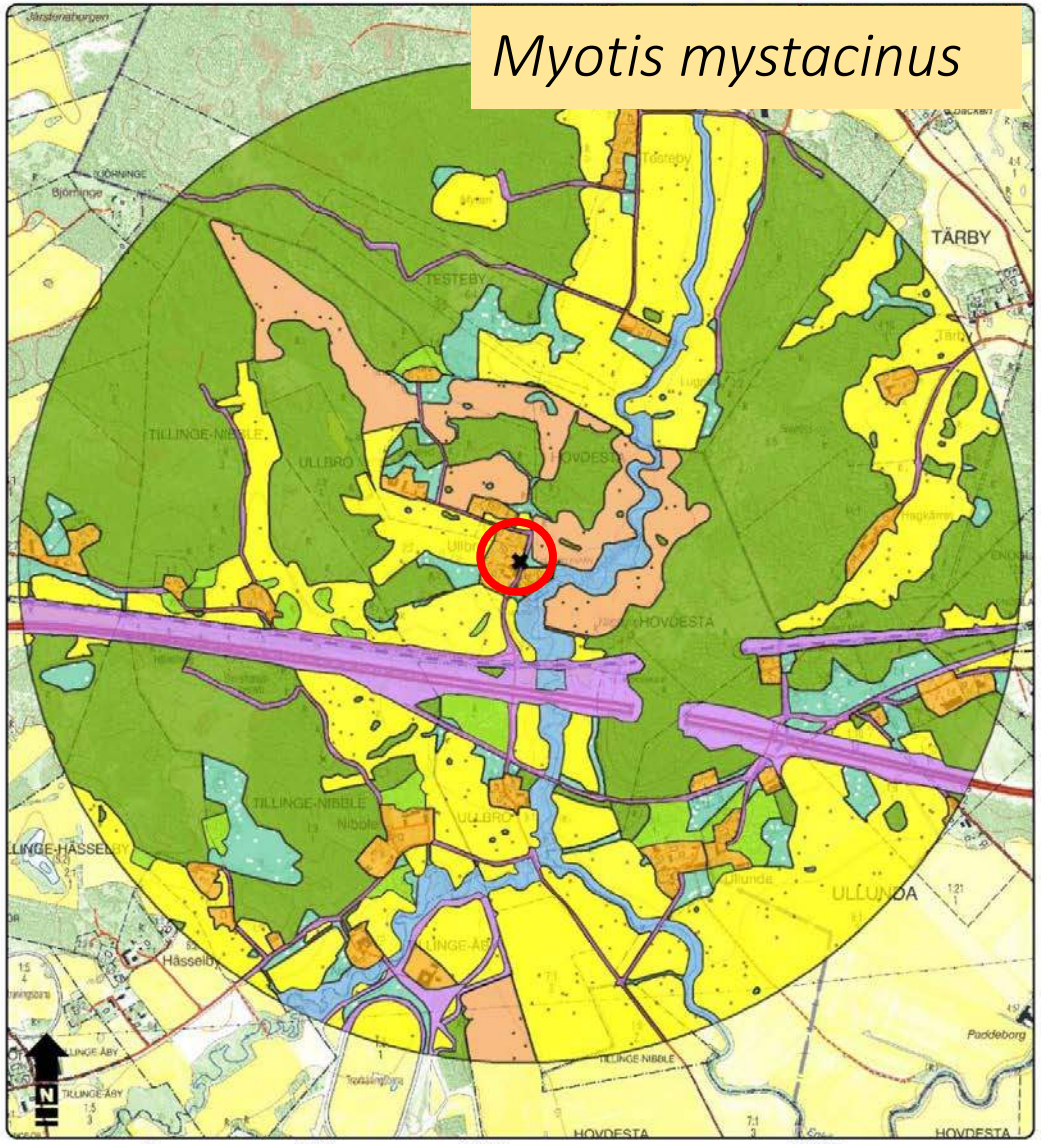
Myotis brandtii



Biotope

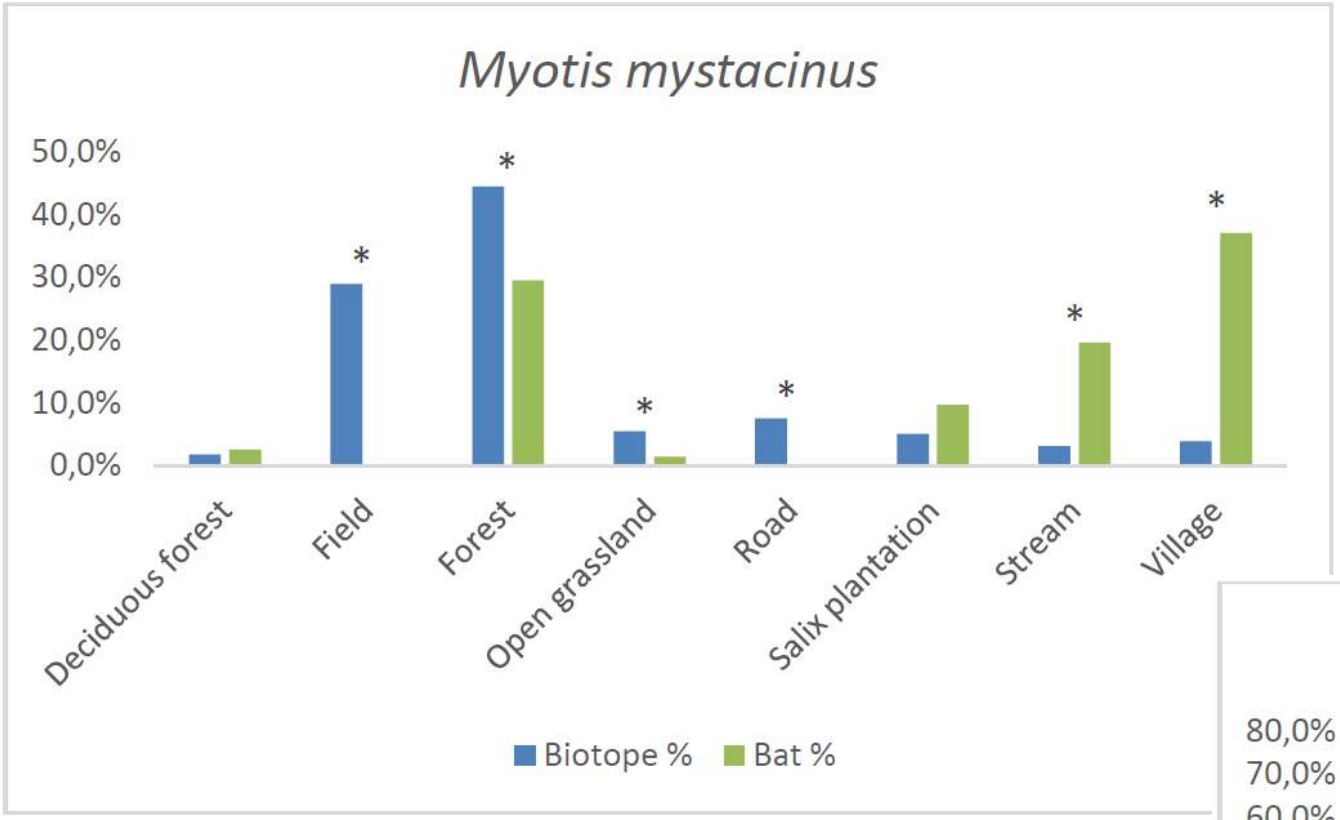
- Deciduous forest (1.7 %)
- Forest (23.2 %)
- Open grassland (3.9 %)
- Stream (3.7 %)
- Village (5.4 %)
- Field (49.3 %)
- Salix plantation (4.6 %)
- Road (8.3 %)
- ✖ Myotis brandtii colony

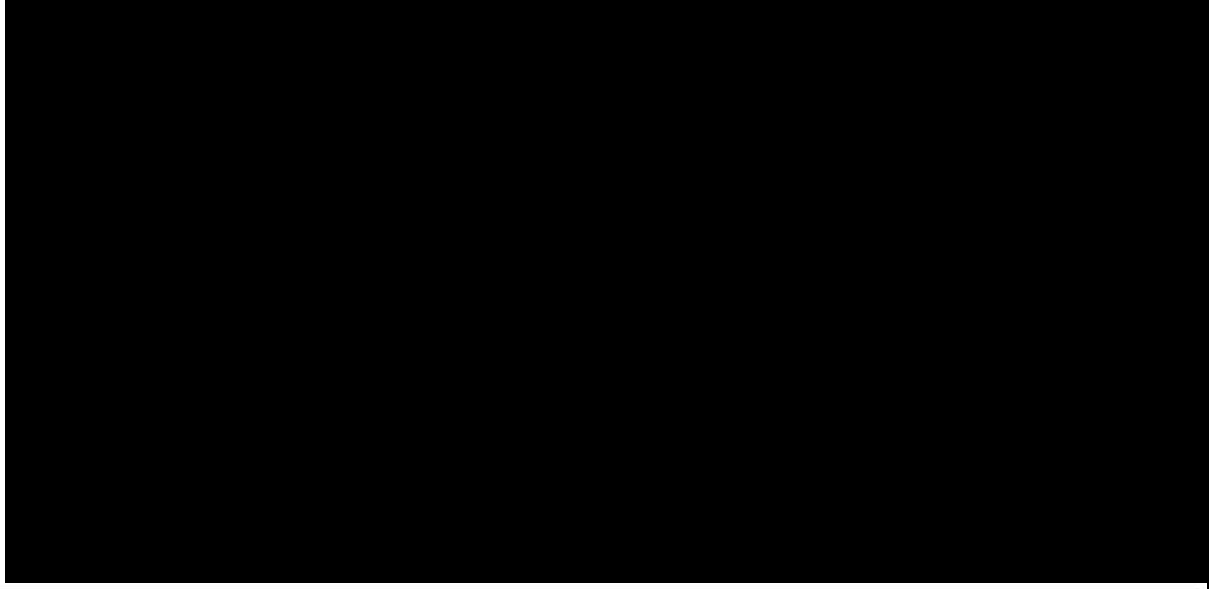
Myotis mystacinus

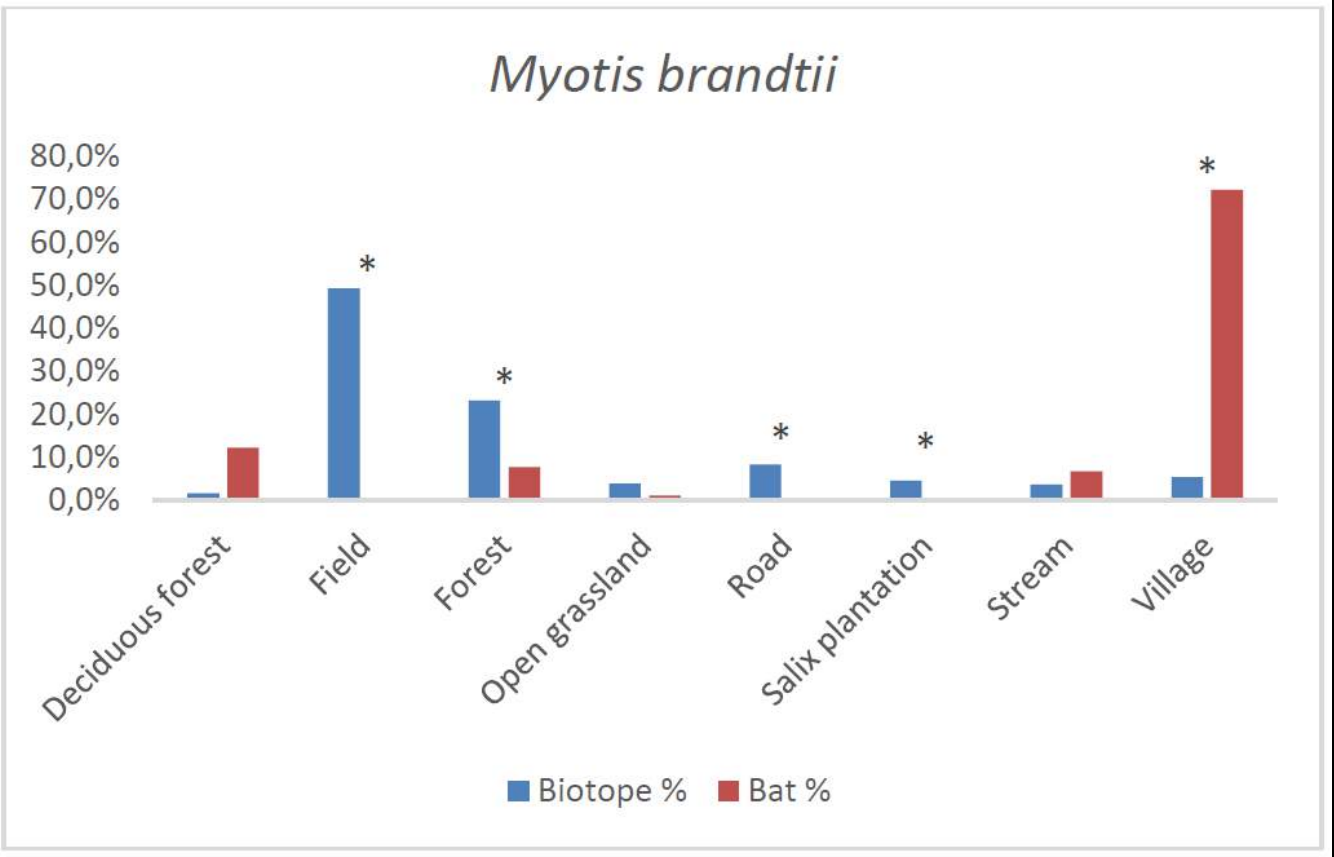


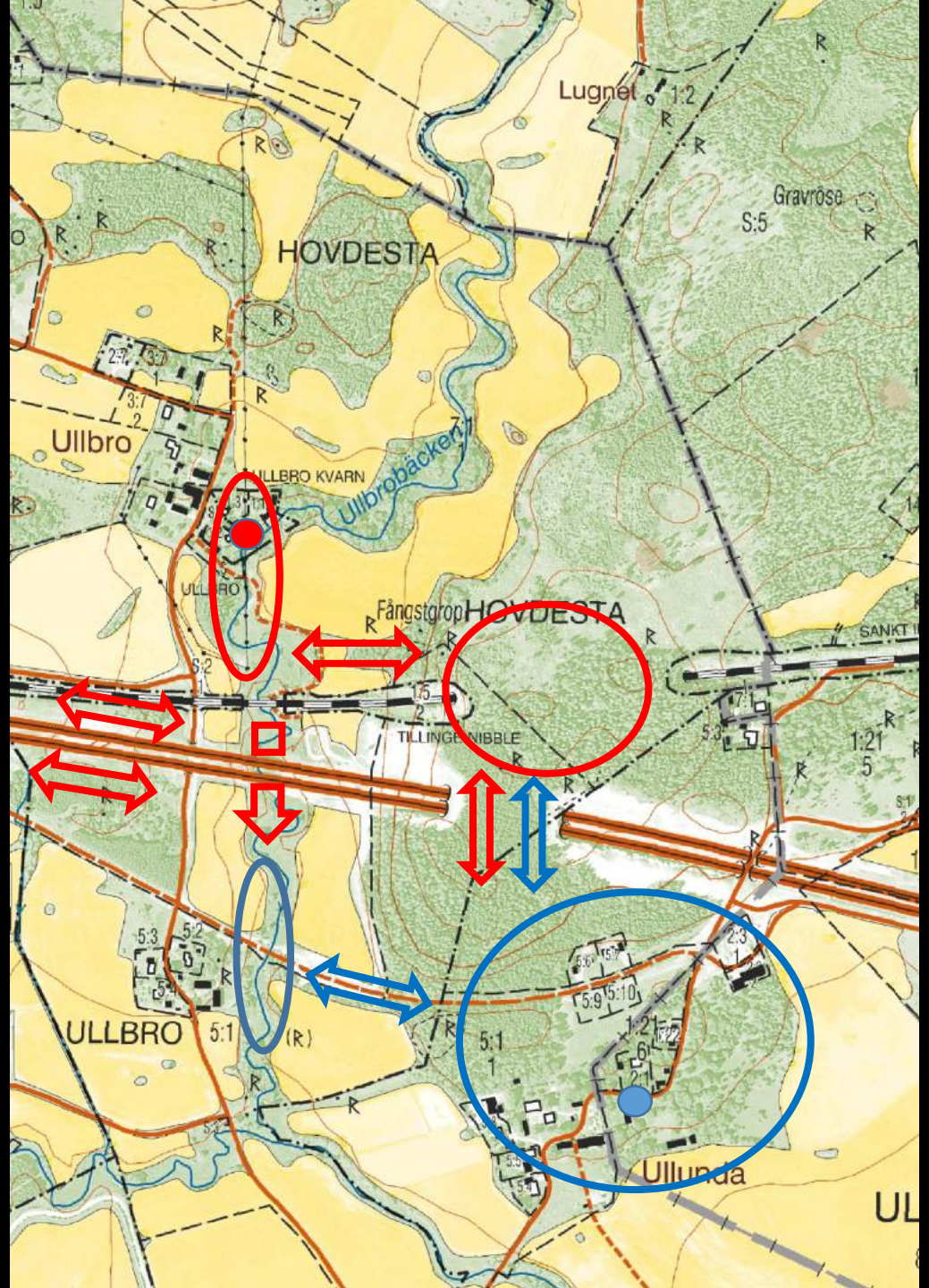
Biotope

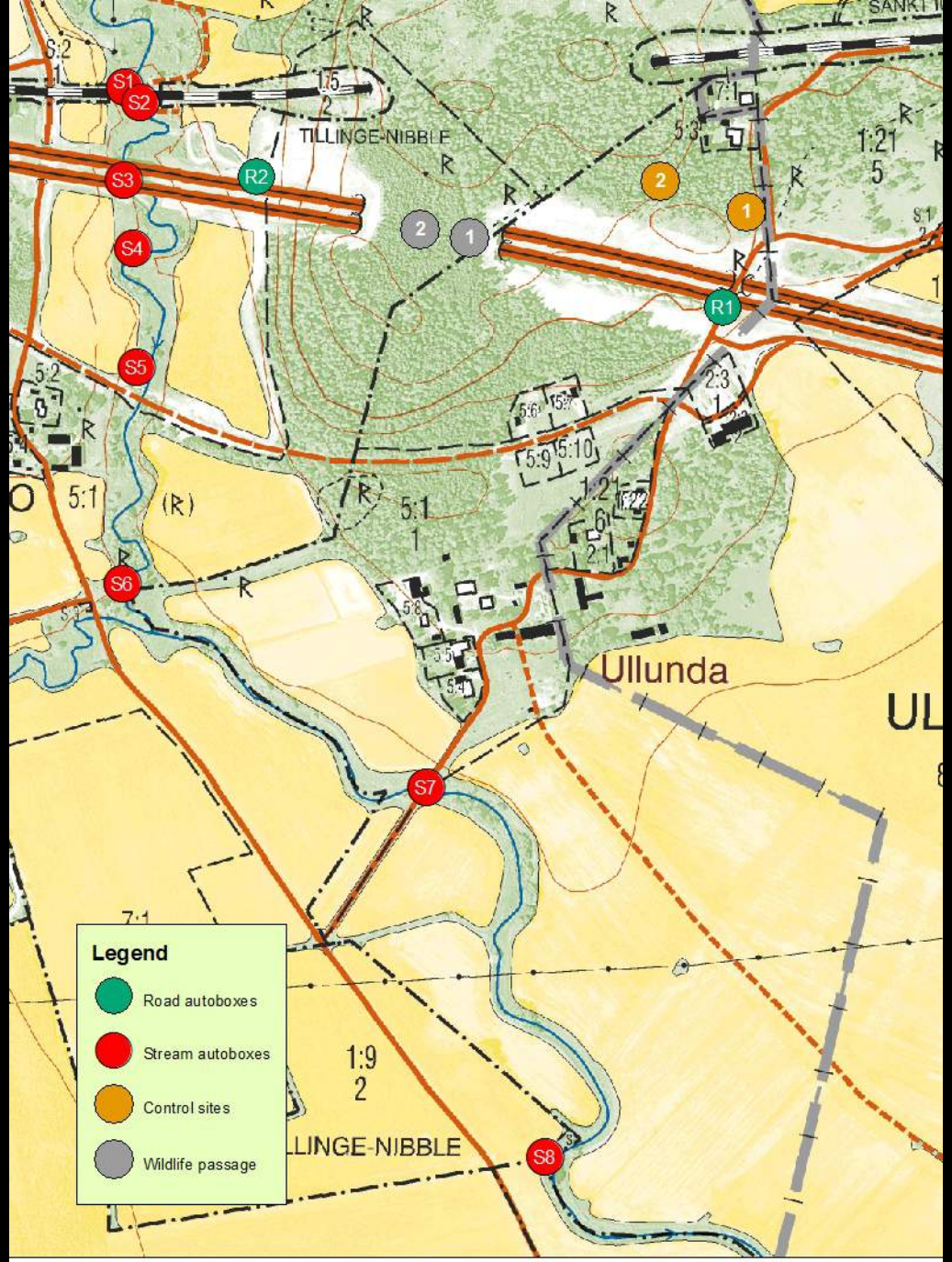
- Deciduous forest (1.8 %)
- Forest (44.5 %)
- Open grassland (5.4 %)
- Stream (3.0 %)
- Village (3.8 %)
- Field (29.0 %)
- Salix plantation (4.6 %)
- Road (7.5 %)
- ✖ Myotis mystacinus colony

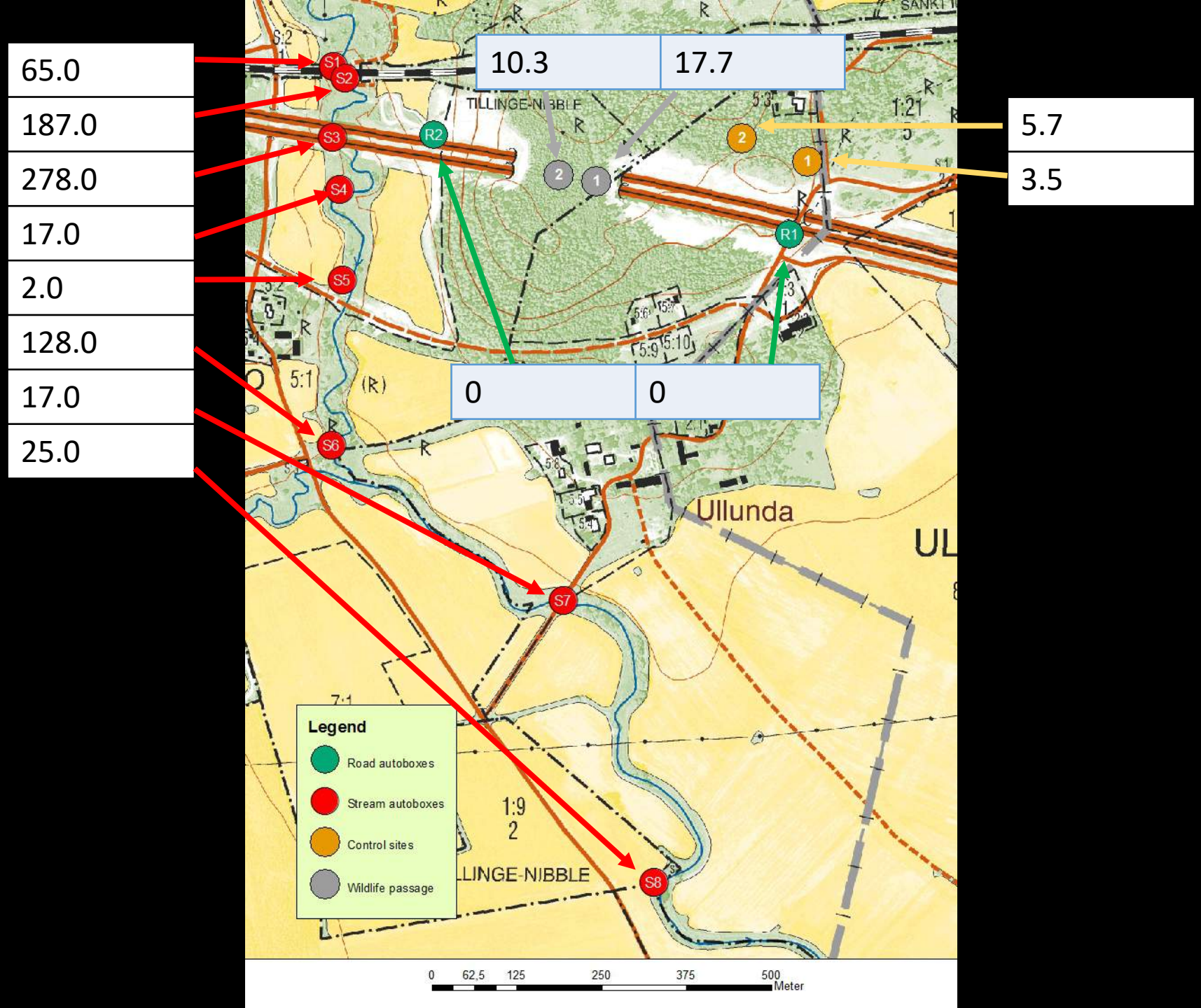

Myotis mystacinus
50,0%
40,0%
30,0%
20,0%
10,0%
0,0%
Deciduous forest
Field
Forest
Open grassland
Road
Salix plantation
Stream
Village
Biotope %
Bat %



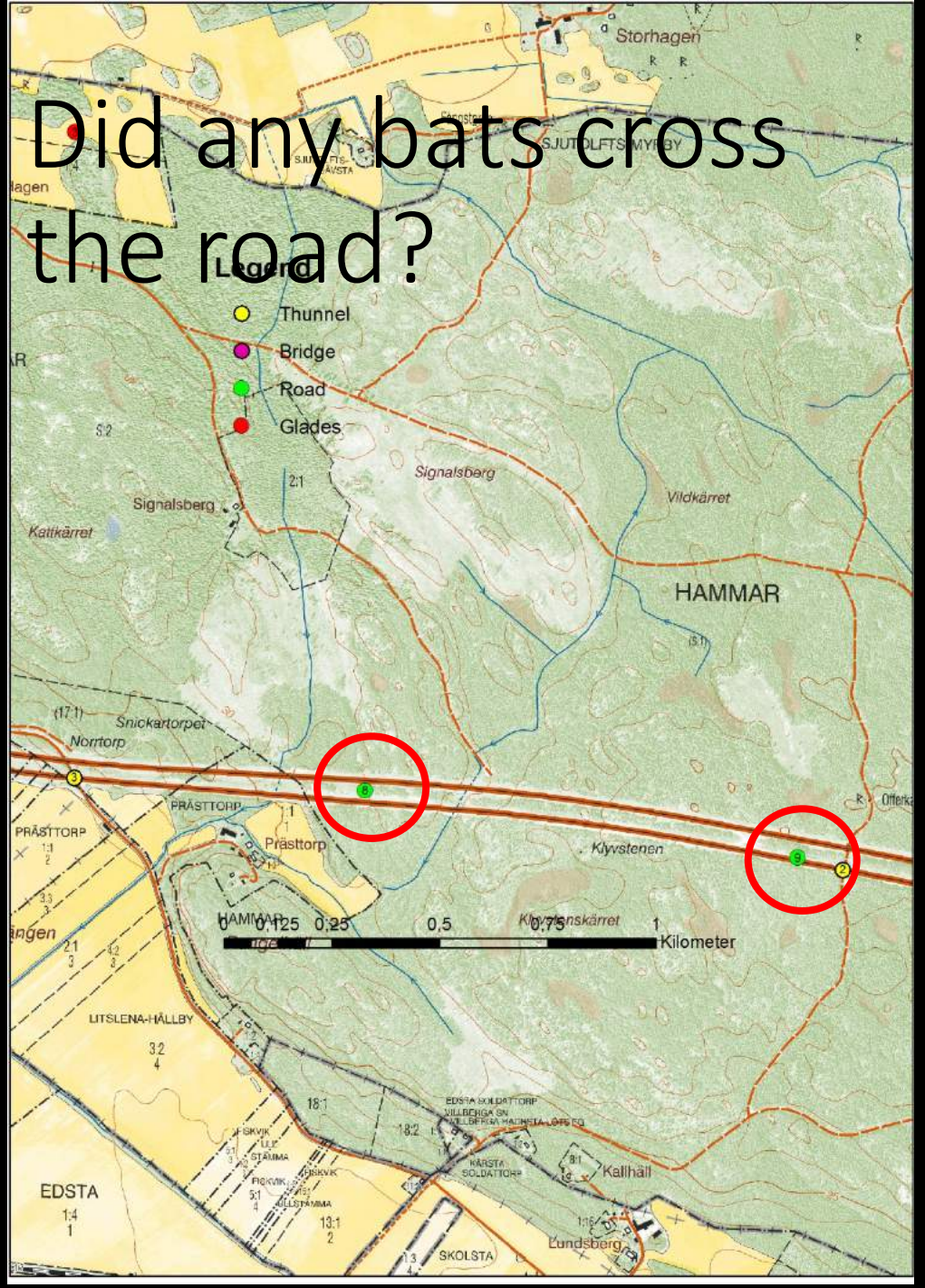

Myotis brandtii
80,0%
70,0%
60,0%
50,0%
40,0%
30,0%
20,0%
10,0%
0,0%
Deciduous forest
Field
Forest
Open grassland
Road
Salix plantation
Stream
Village
Biotope %
Bat %

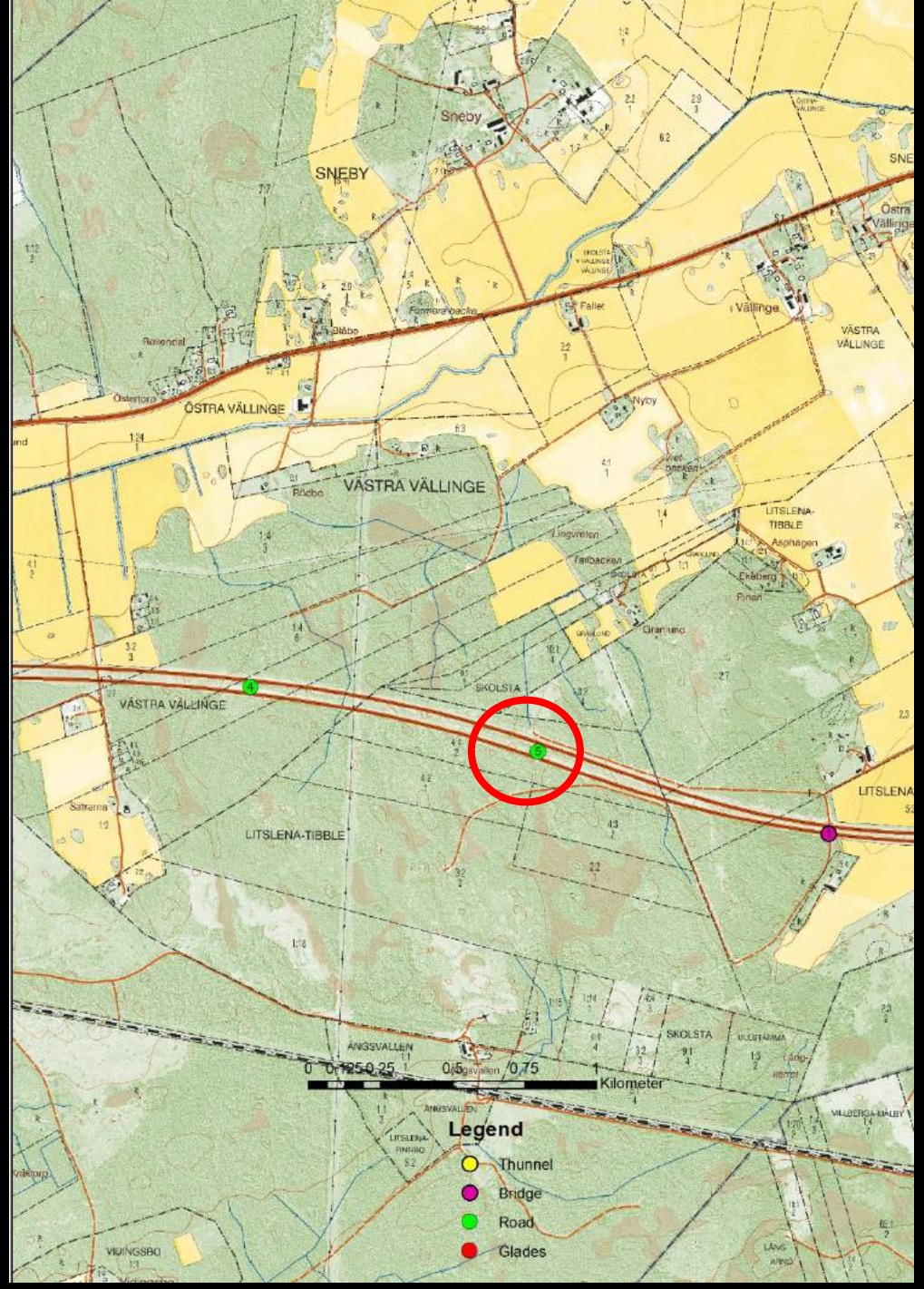

Lugnet
Gravrose
HOVDESTA
Ullbro
ULLBRO KVARN
Ullrobäcken
Fångstgrop
HOVDESTA
TILLINGE NIBBLE
ULLBRO
Ullunda


S1
S2
S3
S4
S5
S6
S7
S8
R1
R2
1
2
TILLINGE-NIBBLE
Ullunda
Legend
Road autoboxes
Stream autoboxes
Control sites
Wildlife passage
0
62,5
125
250
375
500
Meter


65.0
187.0
278.0
17.0
2.0
128.0
17.0
25.0
10.3
17.7
5.7
3.5
0
0
S1
S2
S3
S4
S5
S6
S7
S8
R1
R2
Ullunda
TILLINGE-NIBBLE
Legend
Road autoboxes
Stream autoboxes
Control sites
Wildlife passage
0
62,5
125
250
375
500
Meter

Did any bats cross the road?





So, they did not use this open space


But this semi-open
habitat was preferred

We conclude that…

- Brandt´s bat (*Myotis brantii*) and Whiskered bat (*Myotis mystacinus*) avoid big roads and railroads, but also other open areas during the period of pregnancy and lactation
- However, all open areas are not avoided, and probably the road is a stronger barrier
- Wildlife passages (under or above the road) might be very efficient in connecting foraging habitats for bats

Does this matter – Sweden is a forest dominated country?

- All forest habitats are not preferred habitats
- Fragmentation means that fewer sites will be available as colony sites

Is it possible to predict bat problems?

Yes, by using a habitat suitability model

By the model we should be able to answer questions about:

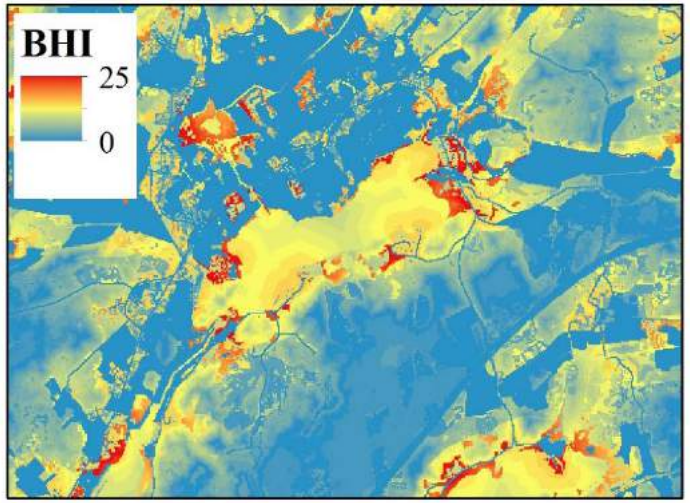
- Where to expect conflicts?
- Where is mitigation needed?
- Do we need any compensation (is it possible to compensate)?
- Where do we need more detailed investigations?

A habitat model must include movements and work on a landscape scale

Our goals with the model

Translate a real landscape to bat habitat index in order to predict:

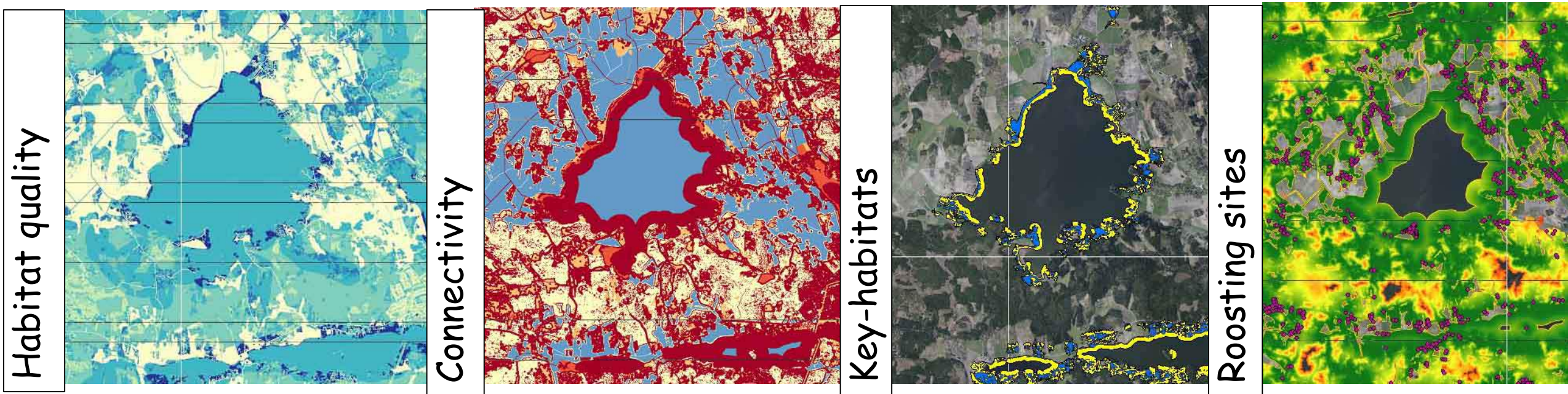
- species diversity
- abundance
- colonies
- movements
- seasonal variation



Creating Bat Habitat Index in several steps

- Insect abundance (habitat quality)
- Movement (Permeability, connectivity)
- Colonies, key-habitat (spring)

→ Bat Habitat Index (BHI)



Evaluation of the model

<u>Selection of sites in two steps:</u>

1. Random selection of 1000 sites.

Divided into groups based on:

BHI value

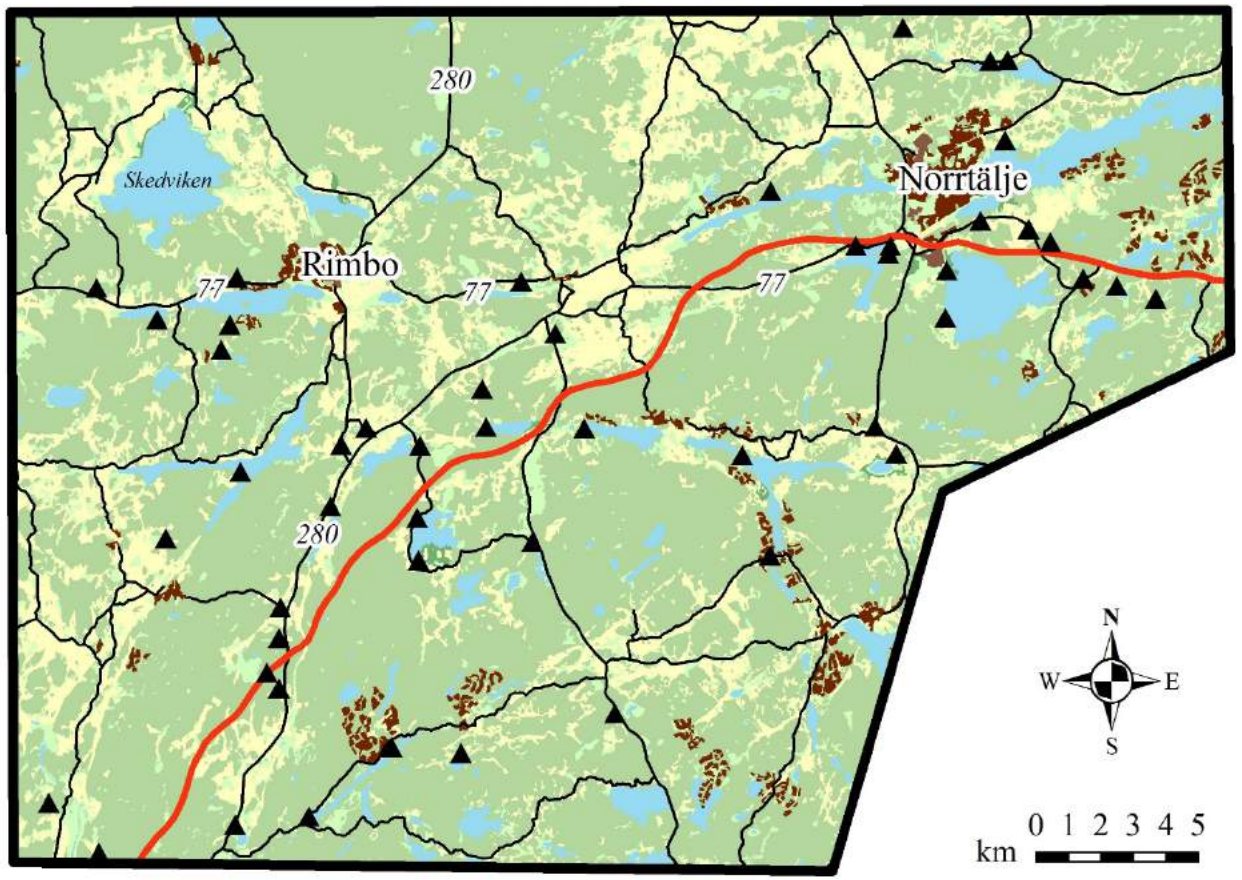
- Mean value within 30 m
  - High, medium, low
- Mean value within 200 m
  - High, medium, low

- Distance to main road
  - <2000 m, >2000 m

In total: 3 x 3 x 2 = 18 groups

2. Stratified random sampling procedure

⟹ 50 sites

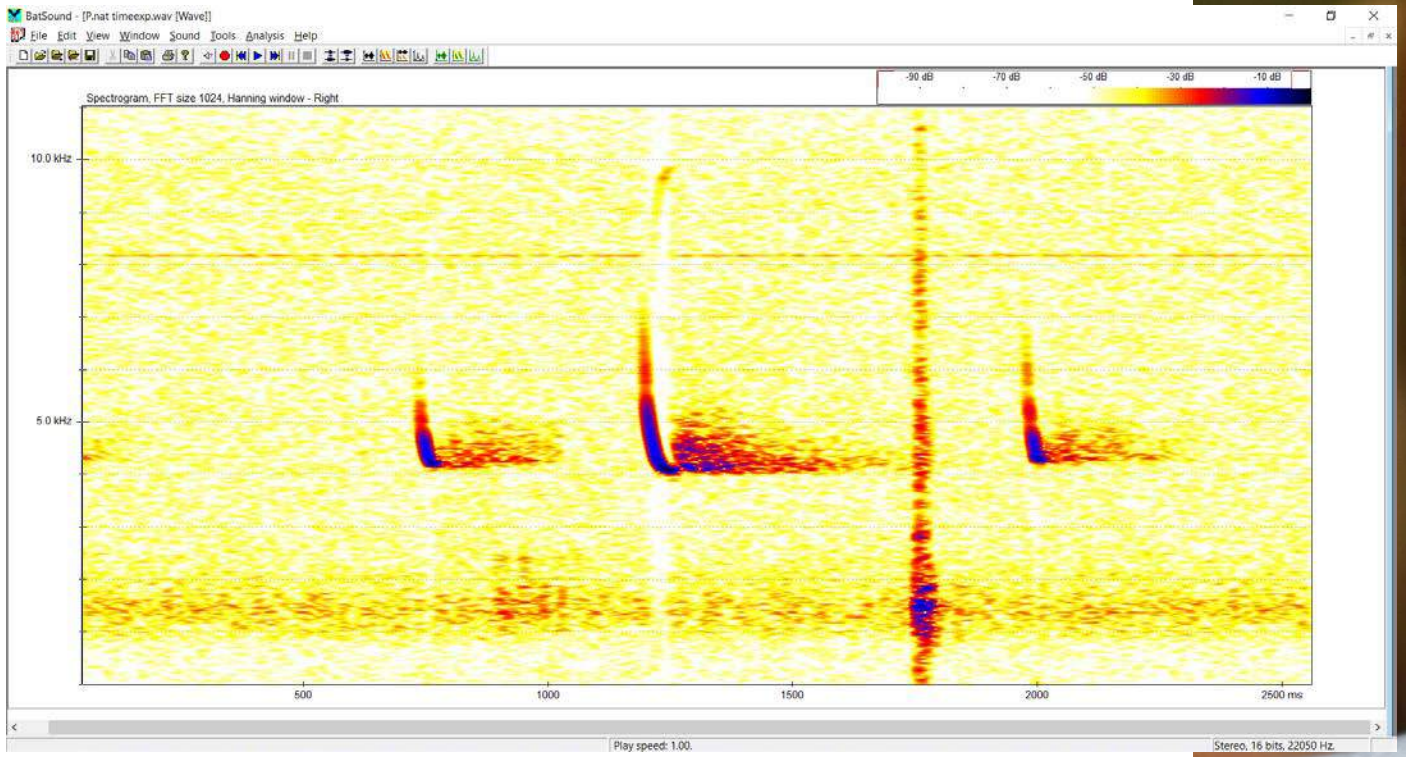


Coordinate system:
SWEREF99 TM
Data source: Lantmäteriet
(Terrängkartan vektor)

Coniferous and mixed forest
Deciduous forest
Agricultural field
Other open area
Water
Constructed area
Industrial area
E18
Other large roads
Sampling sites

Evaluation of the model

- In total 50 sites
- Four nights/site (200 samples)
- 23 nights in July
- Pettersson D500 auto-box and batsound



Evaluation of the model

Response variables

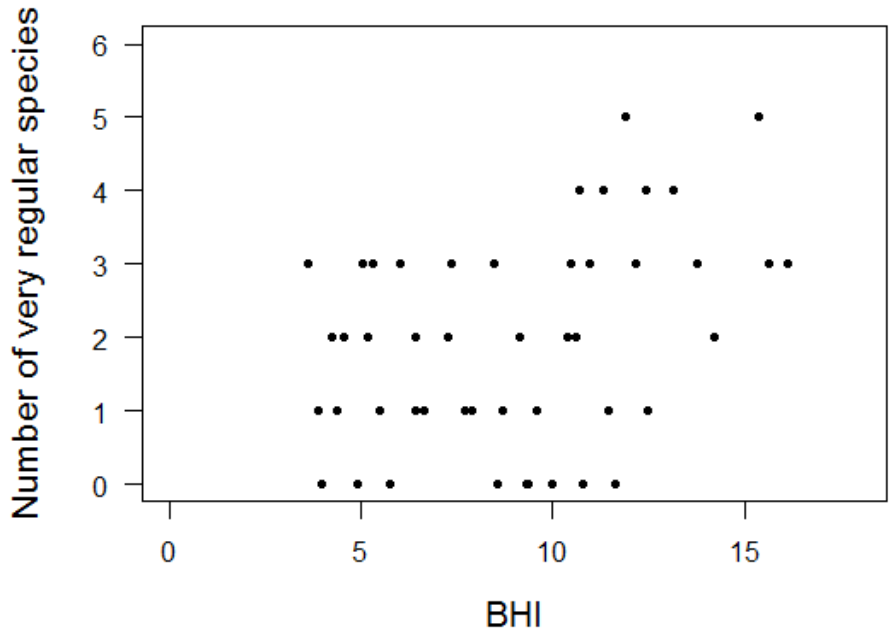
- Species richness: 1. total number, 2. regular species, 3. very regular species (sample size = 50)

- Activity: 1. Total, 2. Forest species, 3. Aerial hawking, 4. water-surface specialist (sample size = 200)

Evaluation of the model

Response variables

- Species richness: 1. total number, 2. regular species, 3. very regular species (sample size = 50)



Number of **very regular** species ~ BHI_**200**

p-value: 0.00576 **

Number of **very regular** species ~ BHI_**30**

p-value: 0.00931 **

Number of **regular** species ~ BHI_**200**

p-value: 0.0403 *

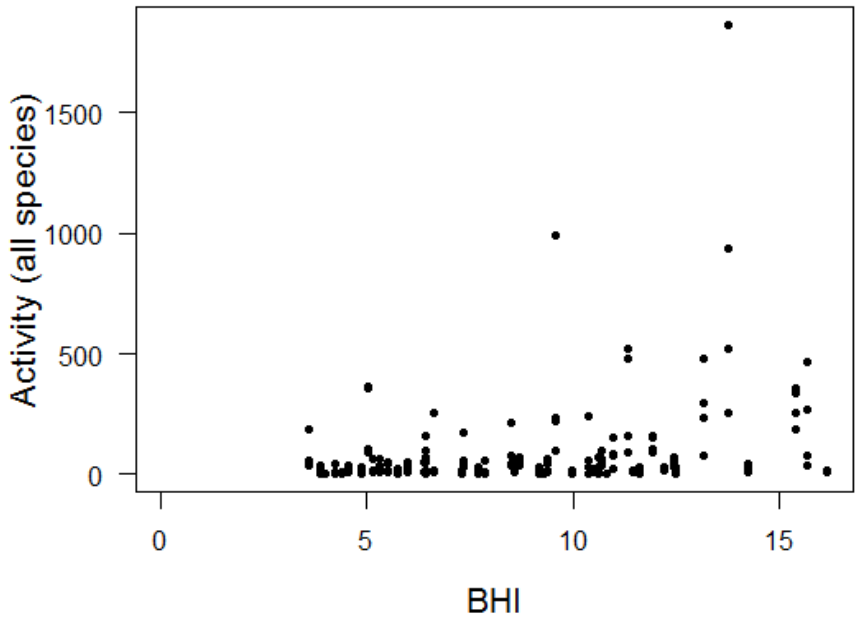
Number of **regular** species ~ BHI_**30**

p-value: 0.04403 *

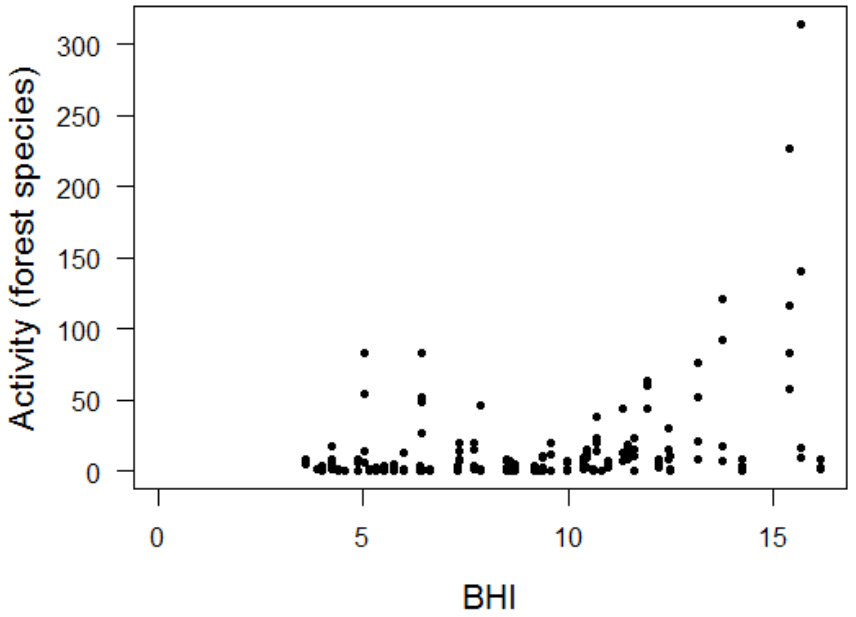
Evaluation of the model

Response variables

- Activity: 1. Total, 2. Forest species, 3. Aerial hawking, 4. water-surface specialist (sample size = 200)



p-value: 0.055



p-value: 0.002

Evaluation of the model
Conclusions

- The model works well for predicting activity of forest species, and number of regular species
- Combining connectivity (flight-friction) with habitat quality give better prediction compared to just using habitat quality
- The scale is important: mean value within 200 m give better prediction than within 30 meter
- There were no extra impact of the road (besides barrier) at the scale we used

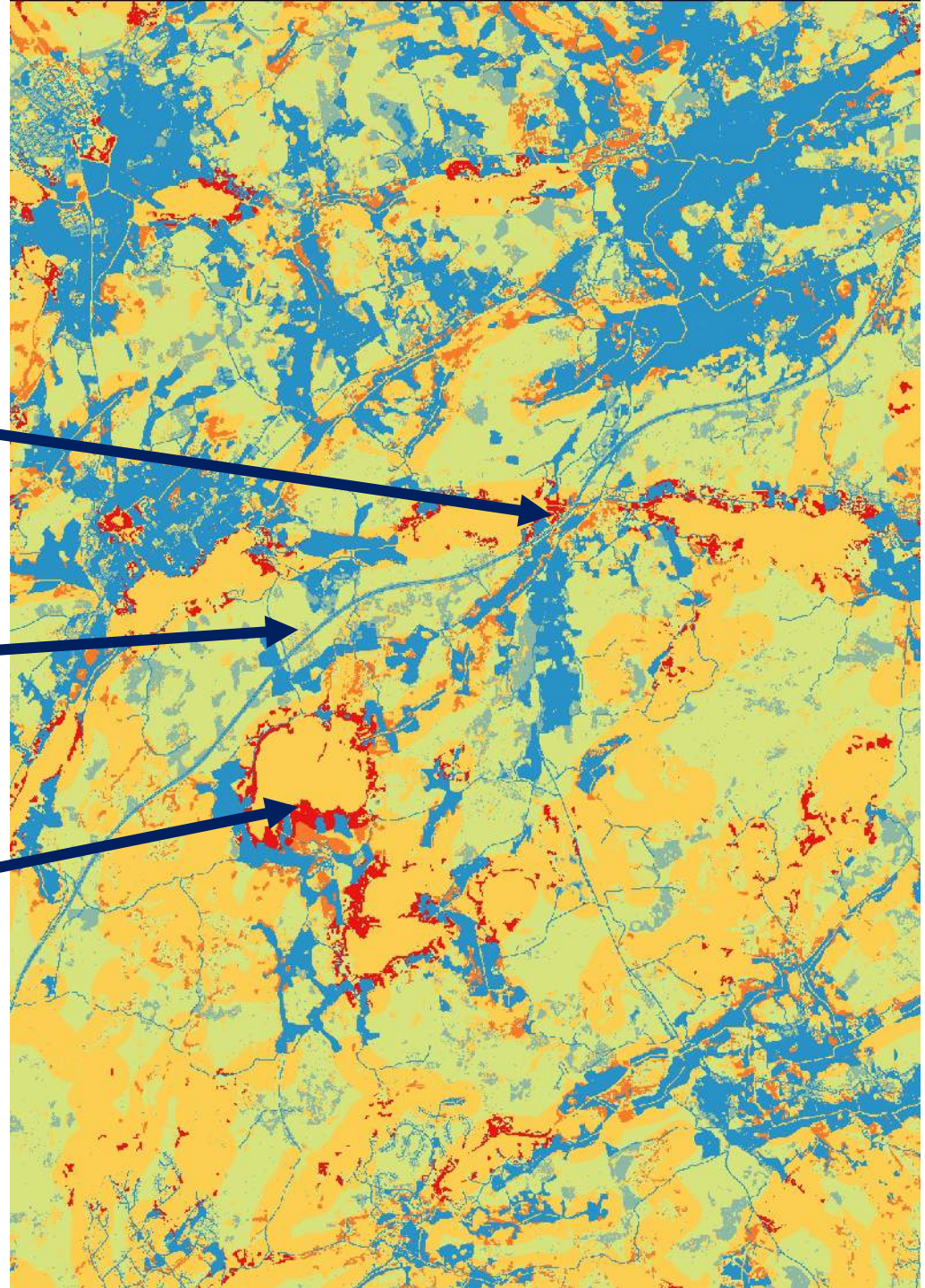
Evaluation of the model
Conclusions

- The model predicts bat occurrence
- Objective, standardised, transparent. Includes the whole landscape and connectivity
- Can easily be adjusted to specific assumptions, other sources of geographic information and new insights about bat ecology

Evaluation of the model
Conclusions

- More knowledge about different species concerning flight-paths, foraging area, connectivity, food selection
- Production of insects of the right type

- Possible conflict area
- “Safe” areas with low qualities
- “Risky” areas with high qualities



The model is ready to use!

The import-ance of land-scape context




Students: Rita Luz, Amanda Sjölund, Johanna Kammonen, Gesa von Hirschheydt


Project leader: Johnny de Jong

Computer modelling: Oskar Kindvall

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