# Population development and distribution in Czech Republic

Aleš Vorel,
Lenka Hamšíková
Jana Korbelová

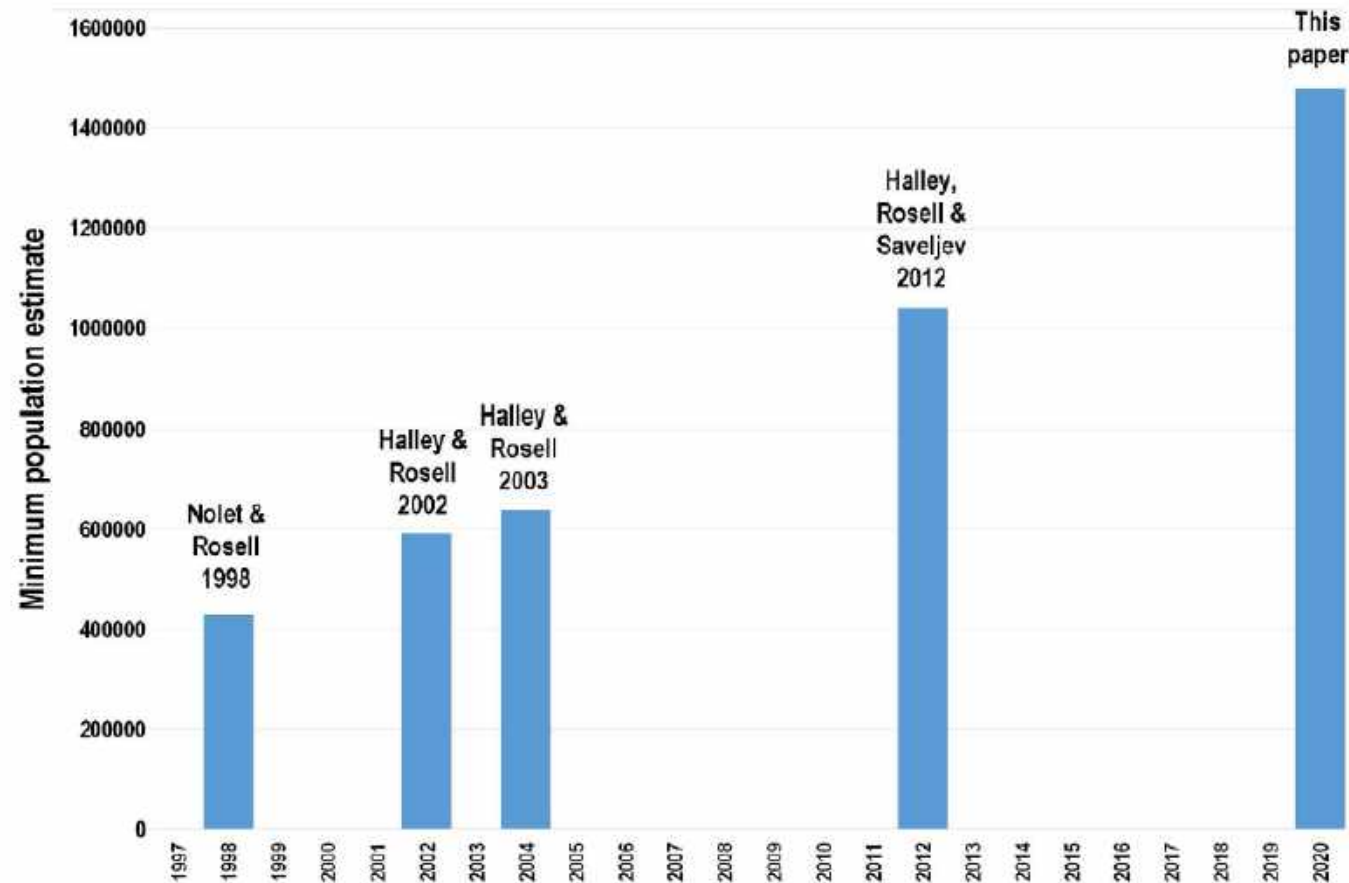# ...beaver population increases, continuously



Fig. 5. Minimum total Eurasian beaver *Castor fiber* population estimates 1998–2020. The sources are indicated. [Colour figure can be viewed at wileyonlinelibrary.com]

Halley, Saveljev & Rosell (2021)
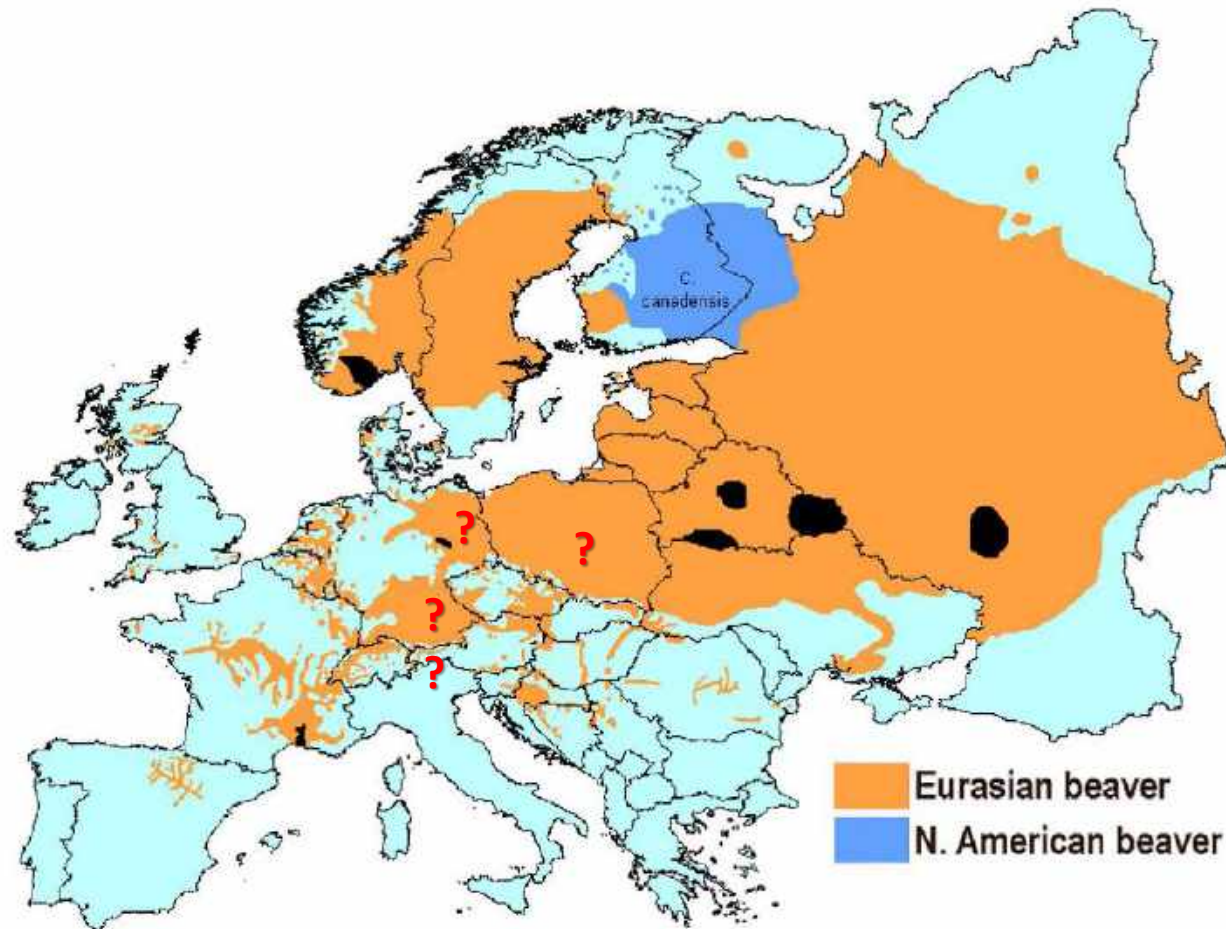
# ...beaver population increases, continuously



Fig. 2. Beaver distribution in Europe in 2020. Black = refugia where Eurasian beaver was never extinct. [Colour figure can be viewed at wileyonlinelibrary.com]

Halley, Saveljev & Rosell (2021)
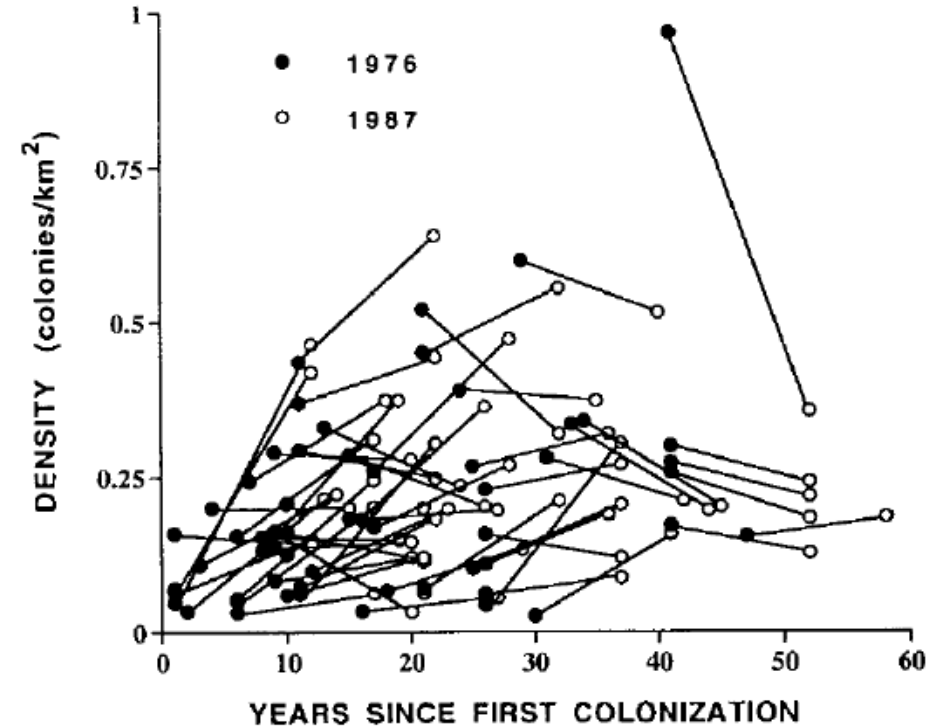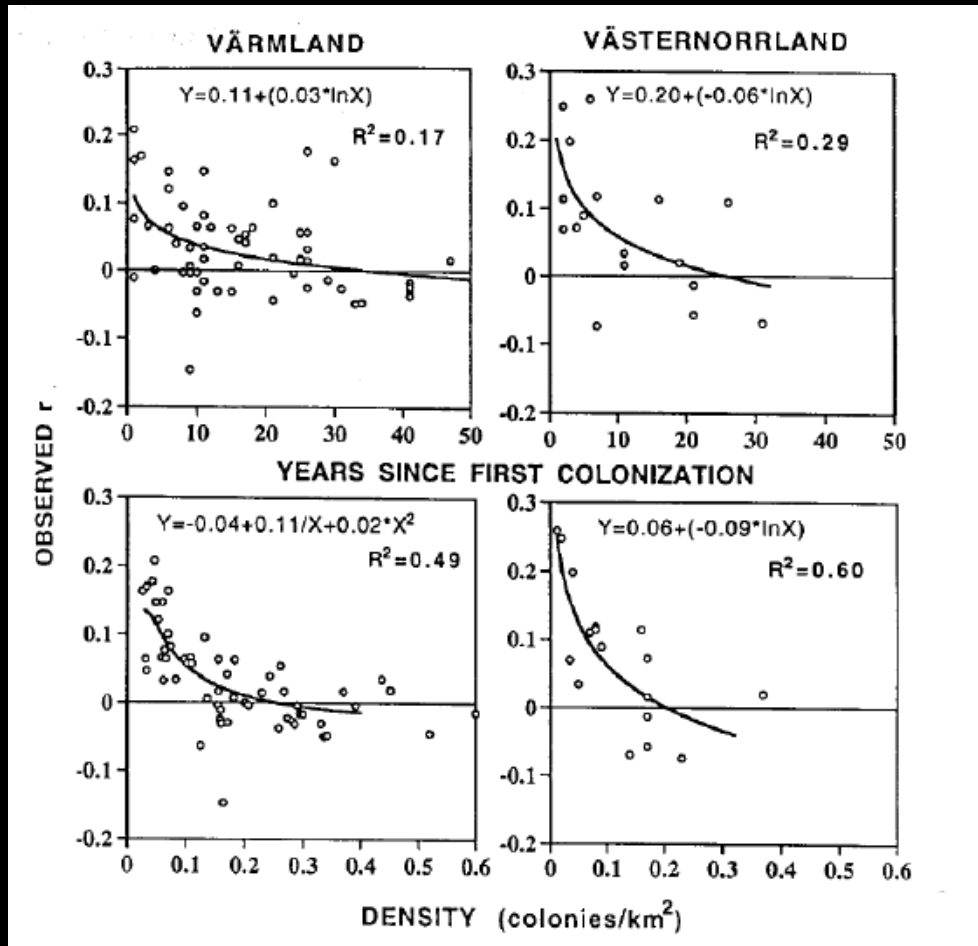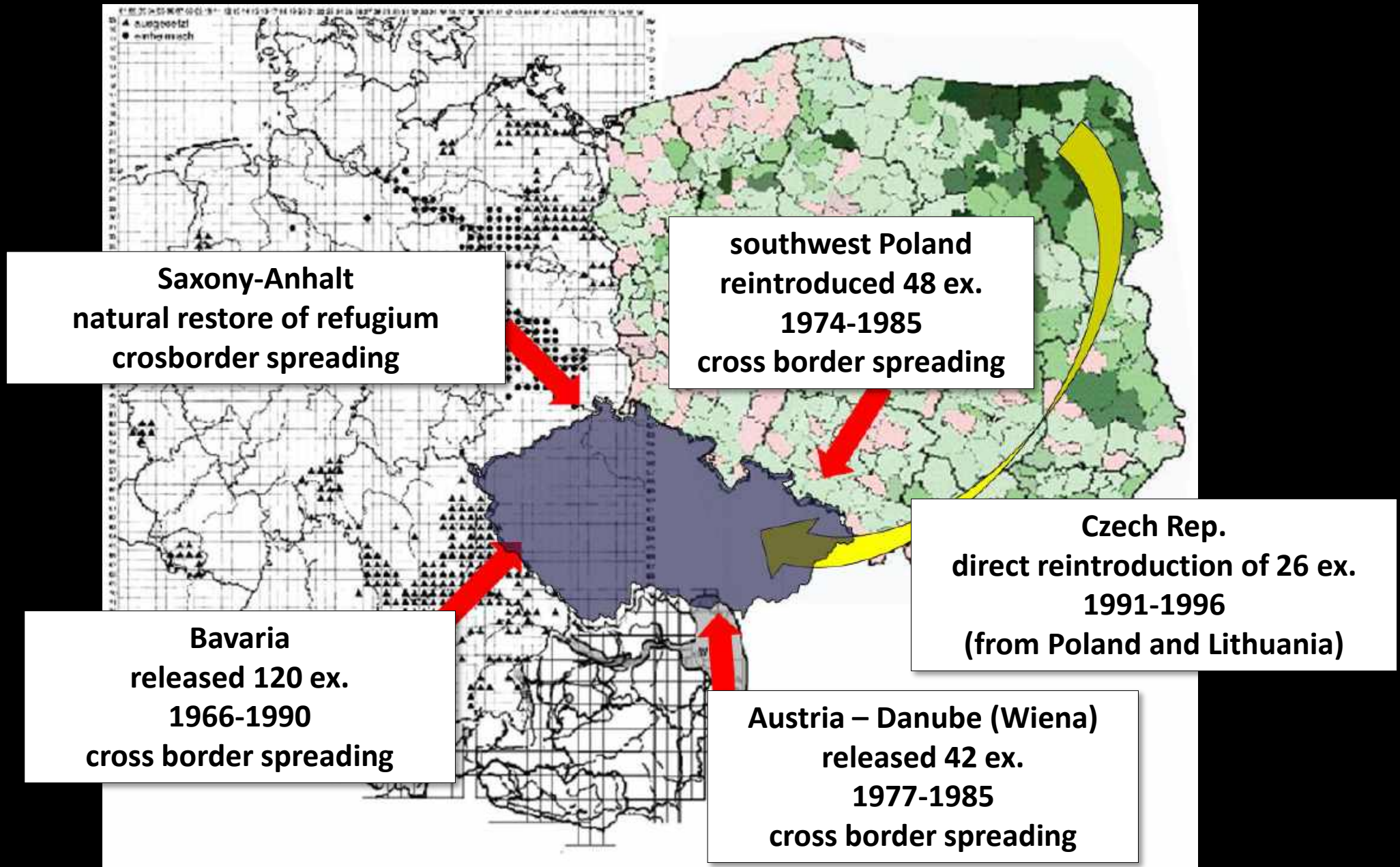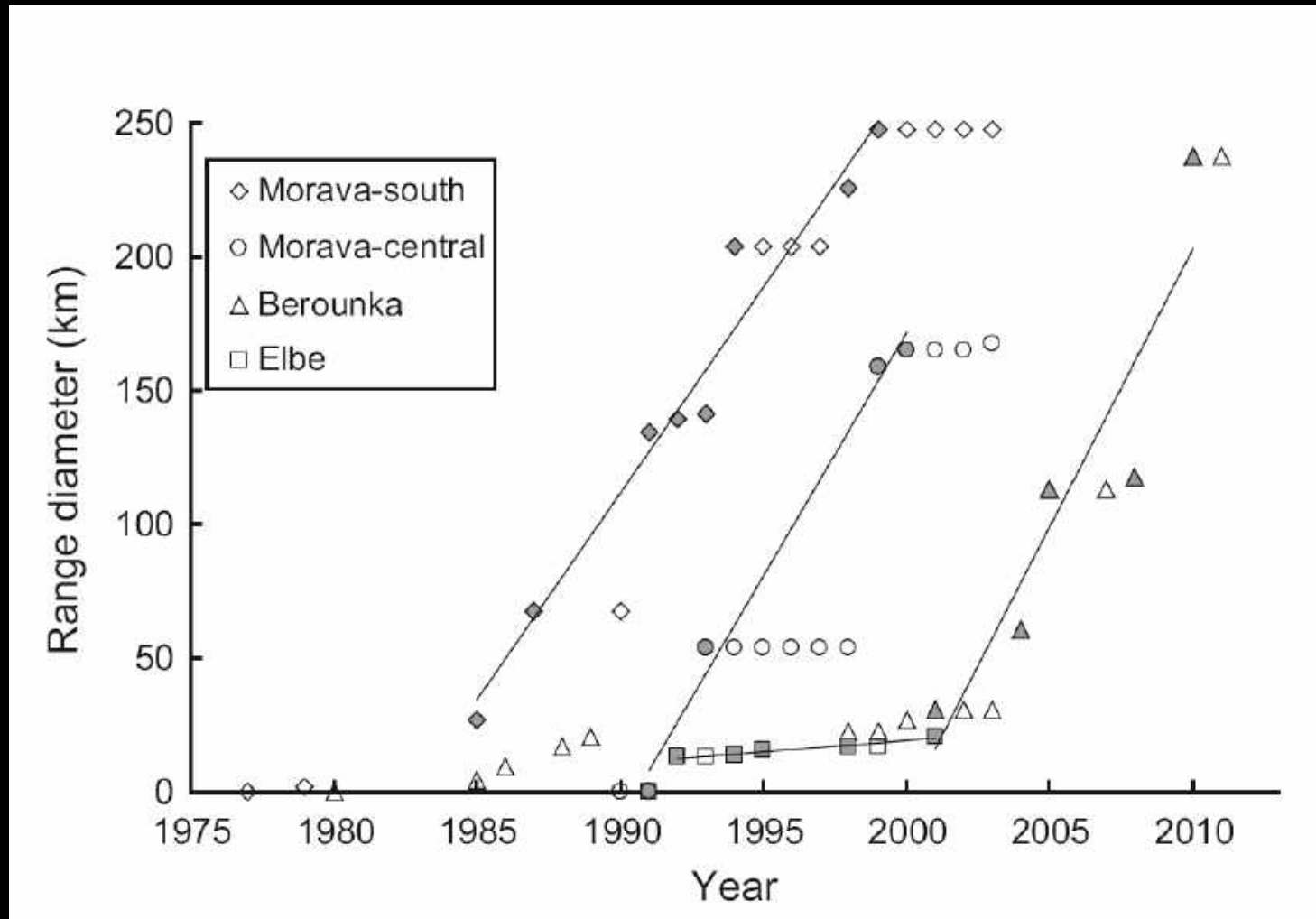
# Sweden
turn over in pop. dyn.



Figure 2. Changes in local beaver population densities in Värmland during an 11-year period, related to time since colonization (n = 58).
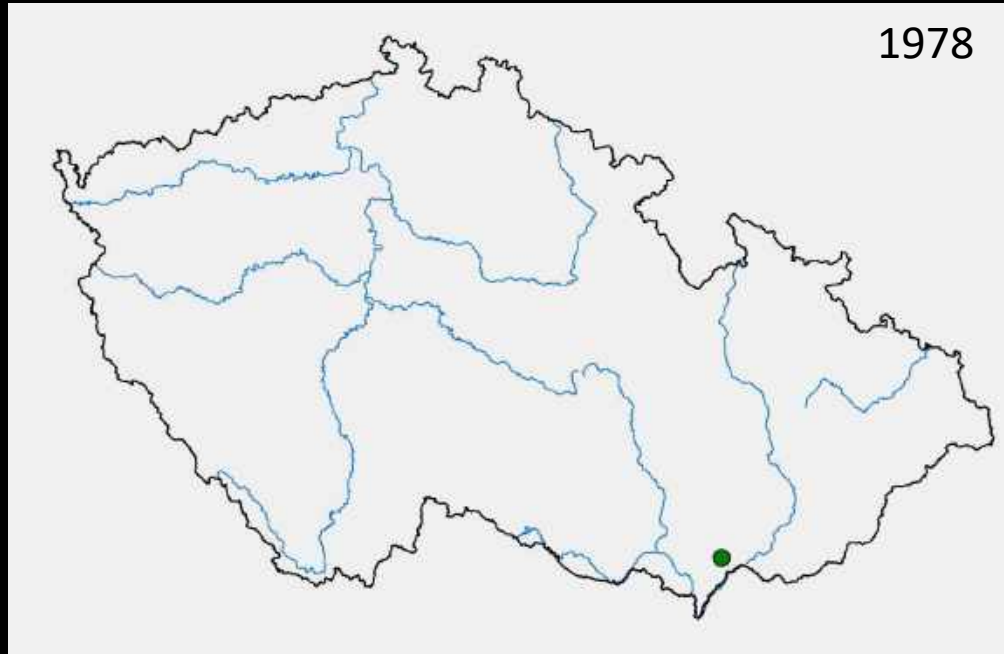
# Rehabilitation of beavers in CZE



**Saxony-Anhalt**
natural restore of refugium
crosborder spreading

**southwest Poland**
reintroduced 48 ex.
1974-1985
cross border spreading

**Bavaria**
released 120 ex.
1966-1990
cross border spreading

**Czech Rep.**
direct reintroduction of 26 ex.
1991-1996
(from Poland and Lithuania)
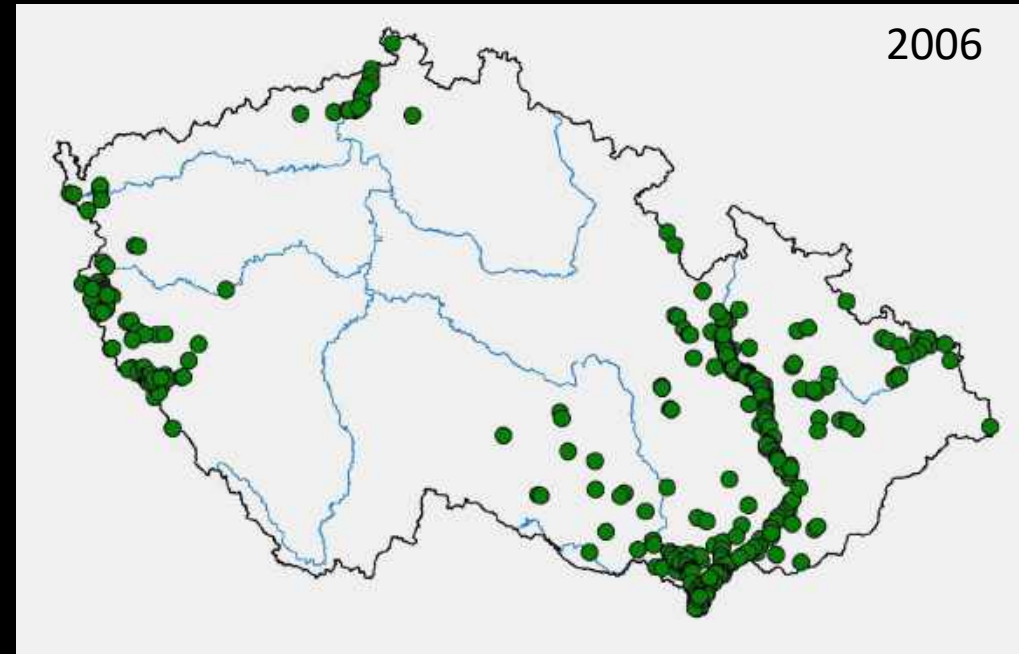
**Austria – Danube (Wiena)**
released 42 ex.
1977-1985
cross border spreading

# ..well documented population expansion



Barták, Vorel, et al. (2013)

# Territory distribution



1978

# Territory distribution



1978

2006
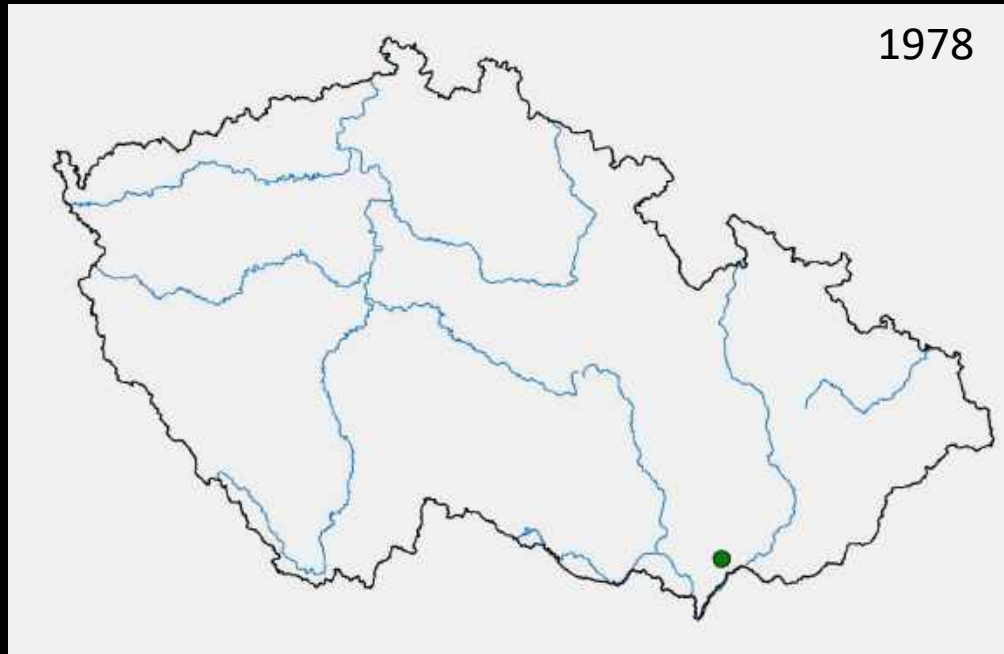
# Territory distribution
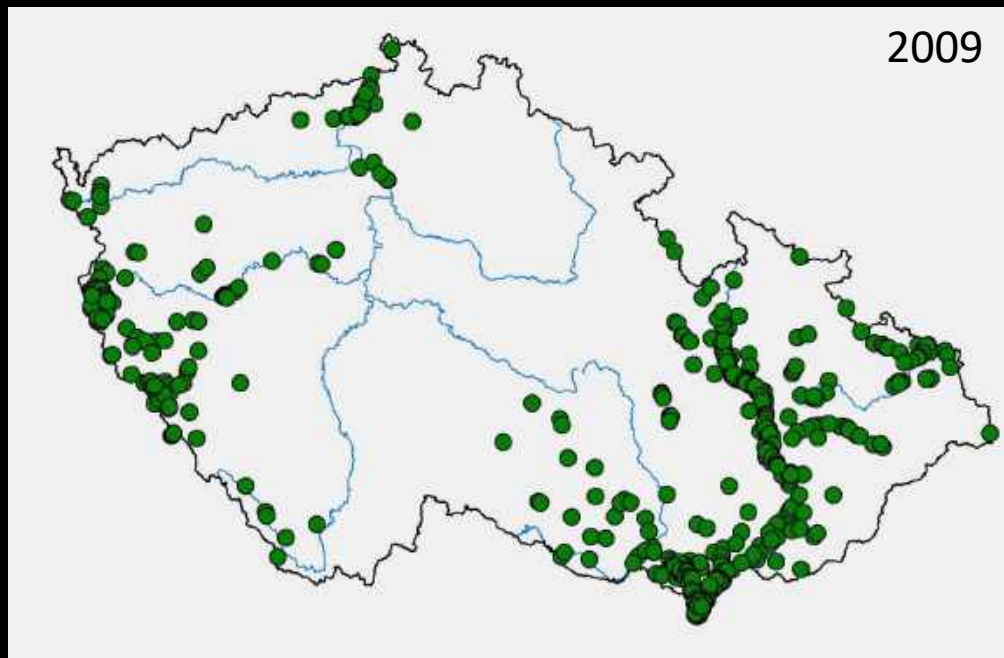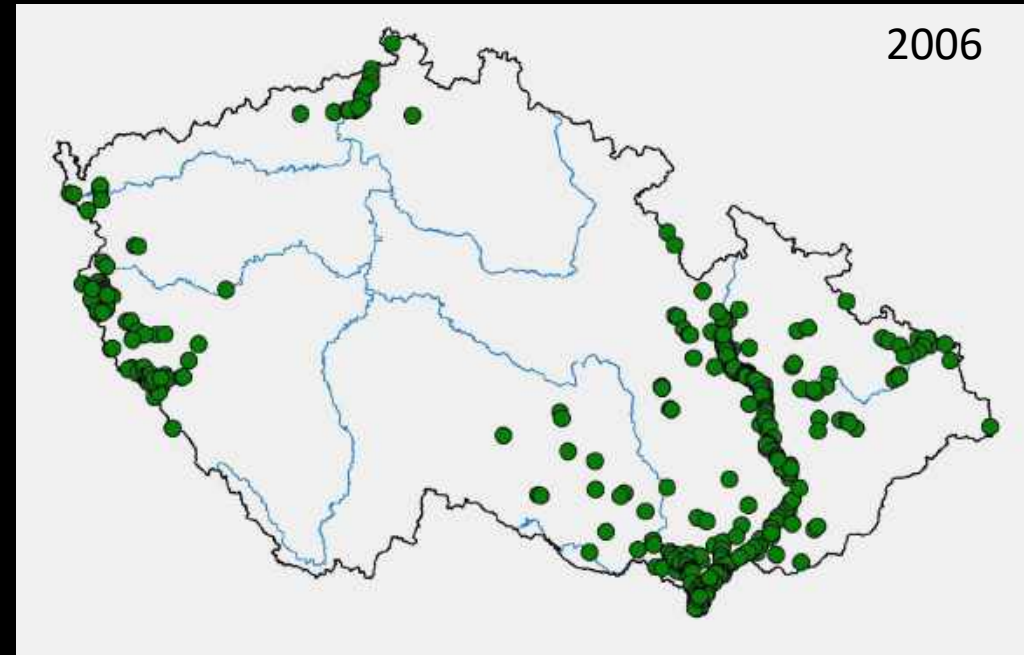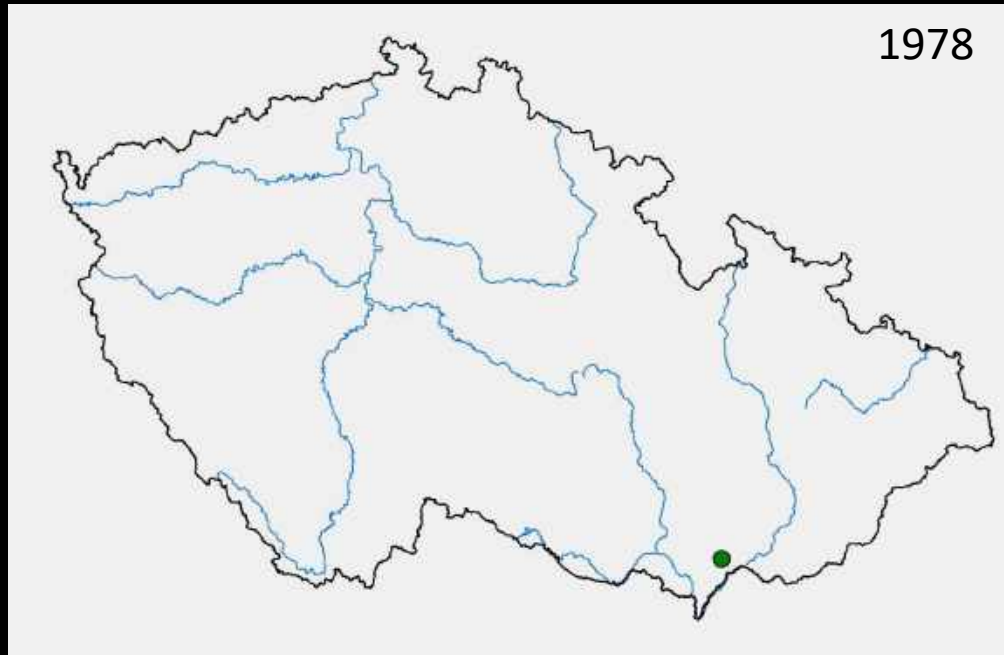
# Territory distribution
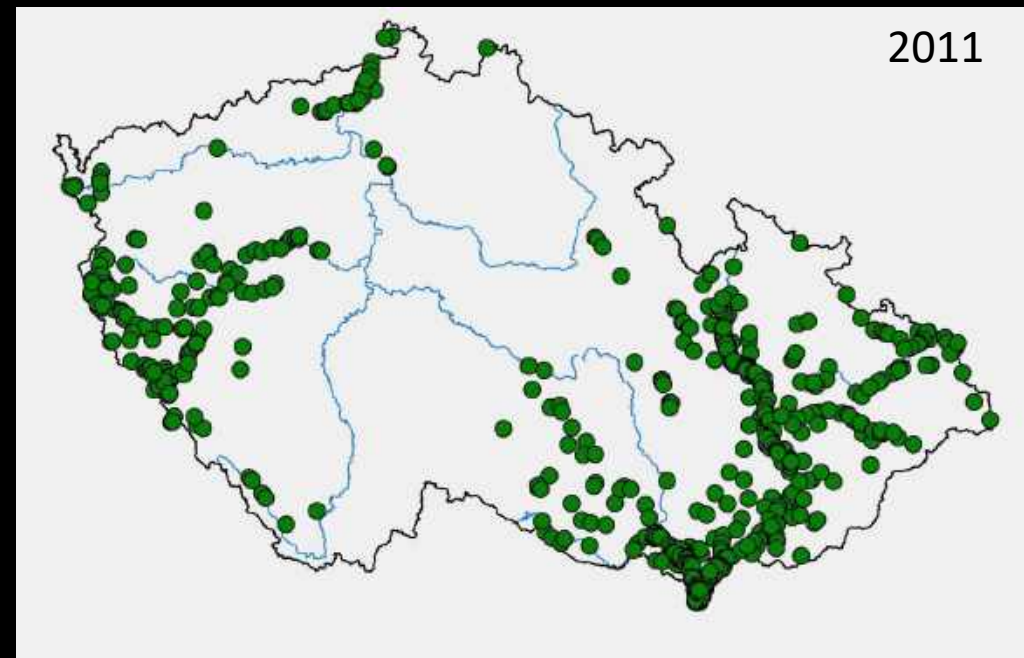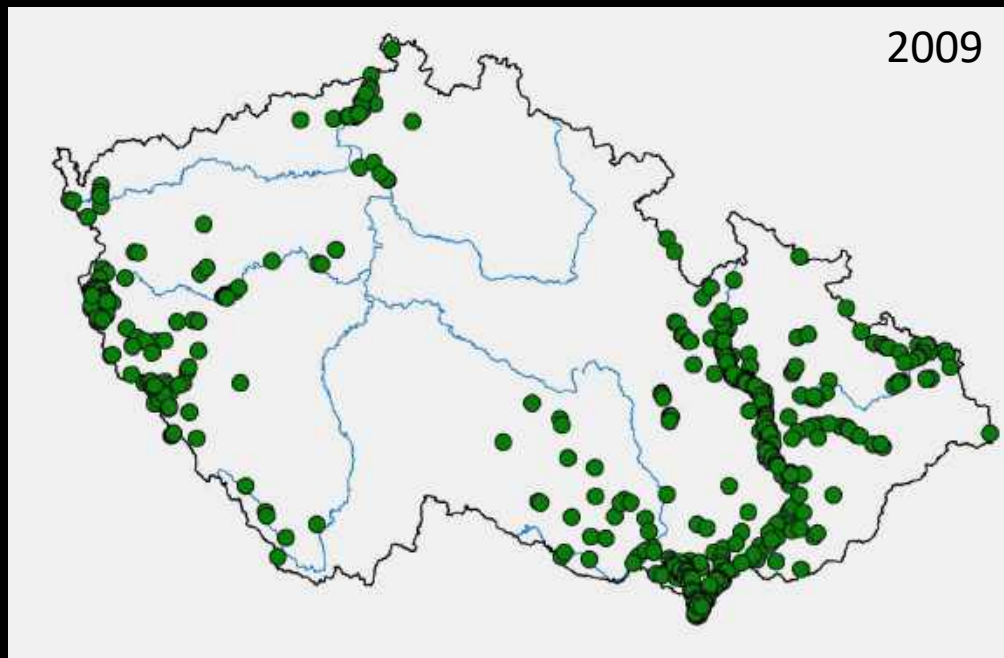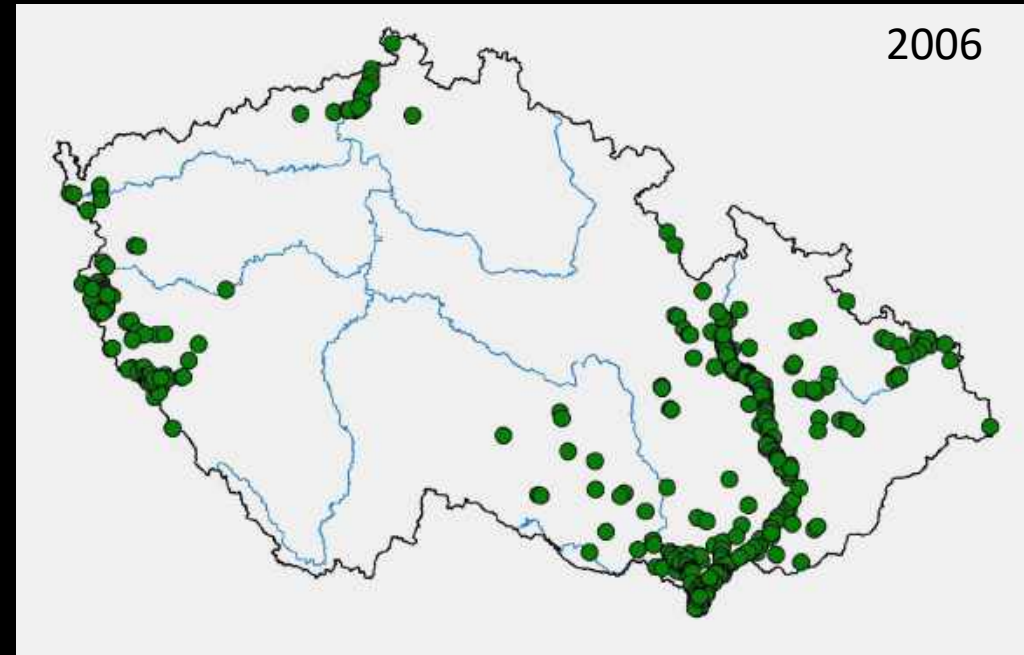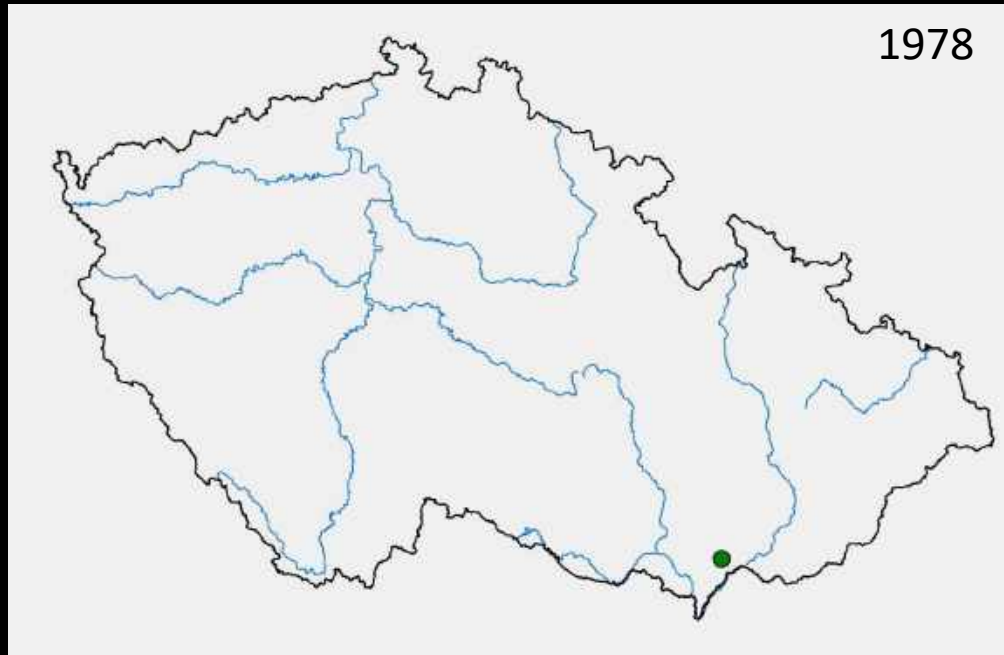
# Territory distribution vs. grid cells presence
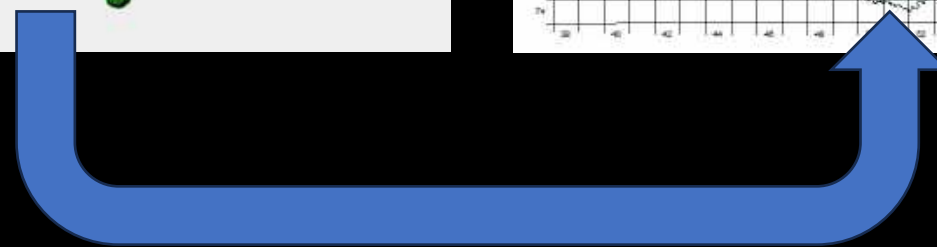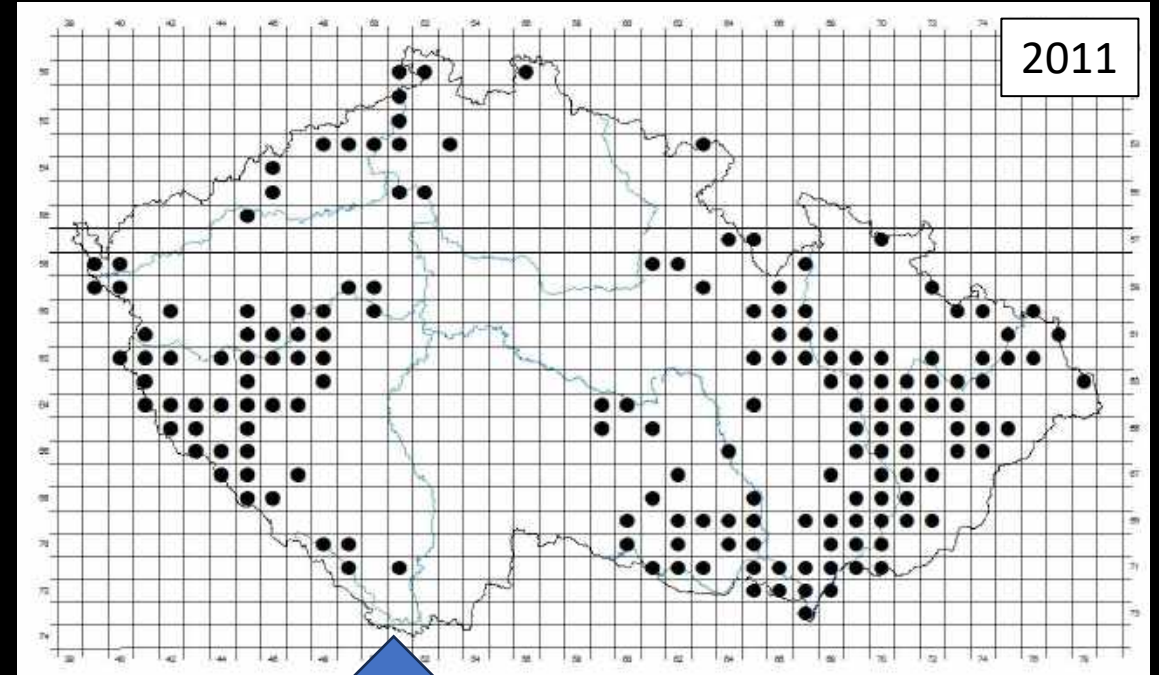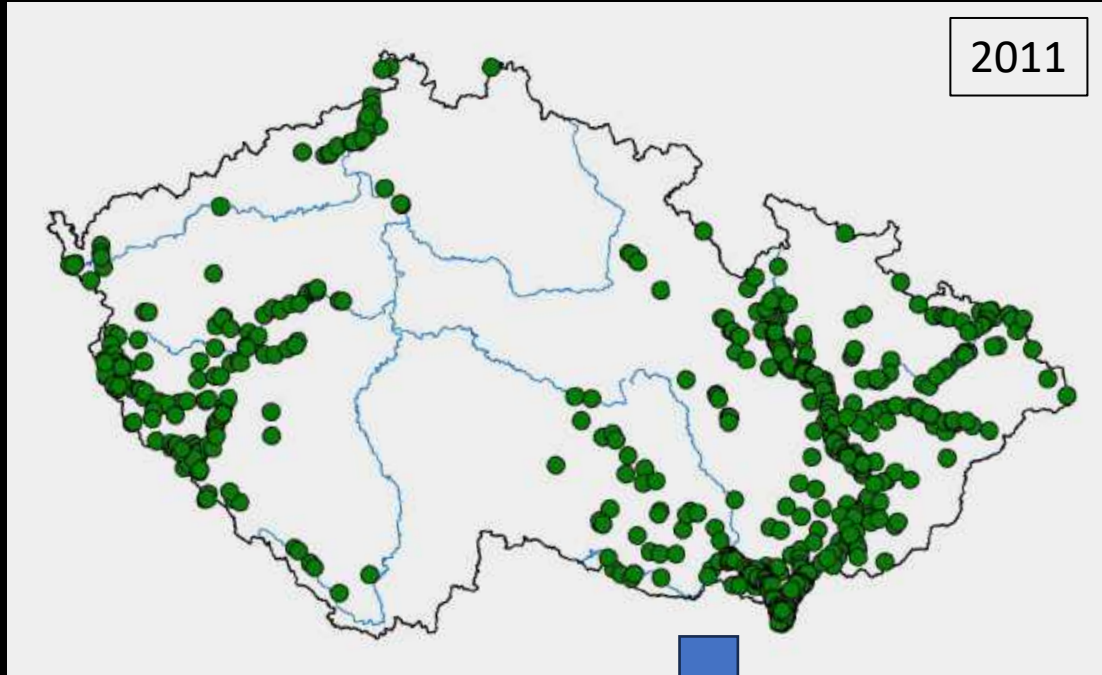
# Aim of the study

What is happening inside of existing occupation?

# Tasks of the study

I.     Current distribution and abundance in CZE
II.   Local population dynamics

# Data

Compiling all accessible occupancy data

# Task I.

# Current distribution and abundance in CZE

# Working matrix – grid cell
## (KFME - Kartierung der Flora Mitteleuropas)
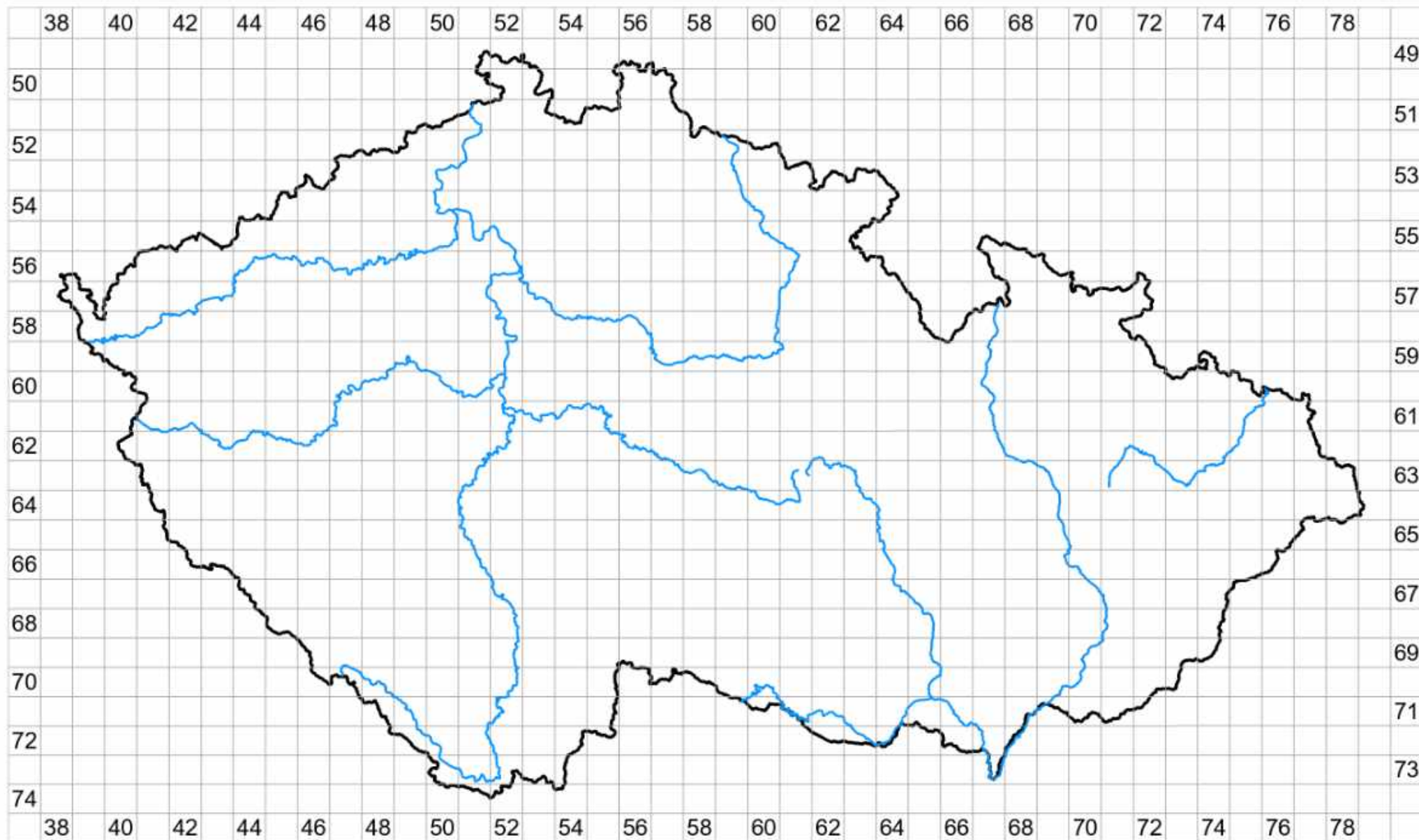


Methods

**Compiling occupancy data**

1. **Gathering all data resources:**
   1. long-term monitoring programs
   2. small local projects
   3. public/professional data in national dBase (NDOP)

2. **Separation of grid cells acc. to data quality**

3. **Determination of pop. density as a function of age of occupation (validated model)**

4. **Data processing:**
   applying the equitation function on all grid cells
   summarization of grid cells numbers

**Methods**
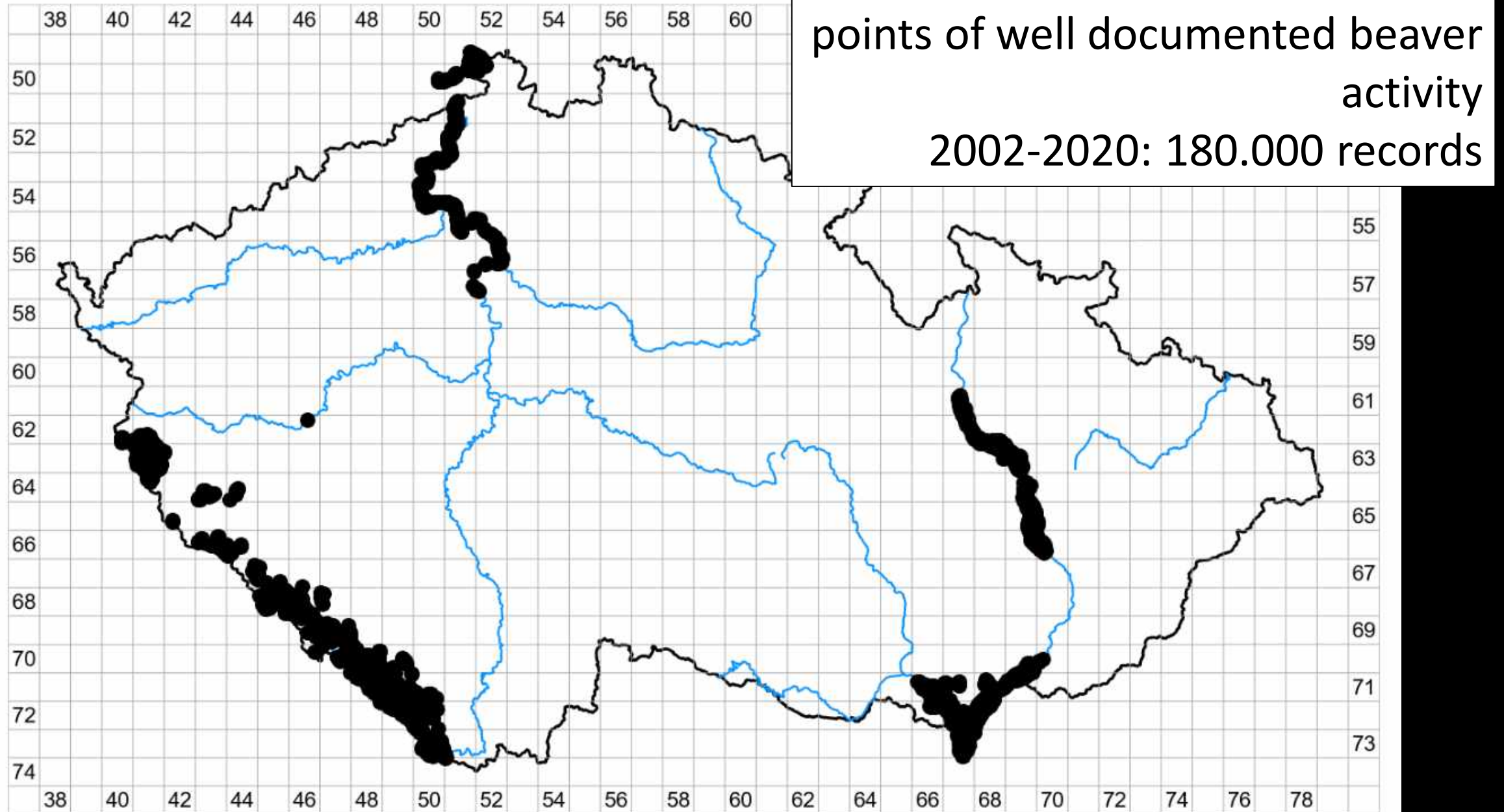
# Long-term monitoring programs



points of well documented beaver activity

2002-2020: 180.000 records

Methods

**Methods**

points of well documented beaver activity

2002-2020: 180.000 records
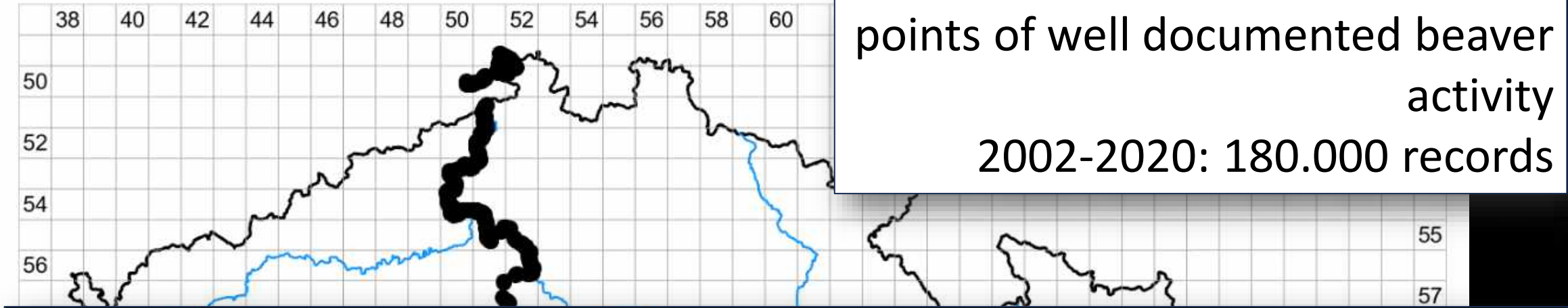
| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LA_D | | 14 | 11 | 13 | 14 | 15 | | 16 | 14 | 18 | 13 | 18 | 19 | | 17 | | 18 | |
| LA_S | | | | | | | | | | | | 7 | 9 | | 6 | | 18 | |
| CL | 16 | 31 | 32 | 33 | 36 | 36 | 35 | | | 39 | | 45 | | 44 | | 50 | | 53 |
| LP | 59 | 40 | 40 | | 43 | | | | | 42 | | | | | | | | |
| CH | 17 | 20 | 35 | 34 | | | | | | 30 | | | 33 | | | | | |
| ND | 42 | 44 | 49 | 50 | | | | 49 | | | | 49 | 40 | | | | | |
| SP | 53 | 78 | 79 | | 98 | | 61 | | 60 | | 91 | 85 | 65 | 41 | | | 49 | 50 |
| STR | 5 | 7 | 6 | | | | | | | | 16 | | 6 | | 11 | | | |

# Public (non-profesional) data

occasional (unvalidated) points
2002-2020: 15000 records

Methods

**Compiling occupancy data**

1. Gathering all data resources:
   1. long-term monitoring programs
   2. small local projects
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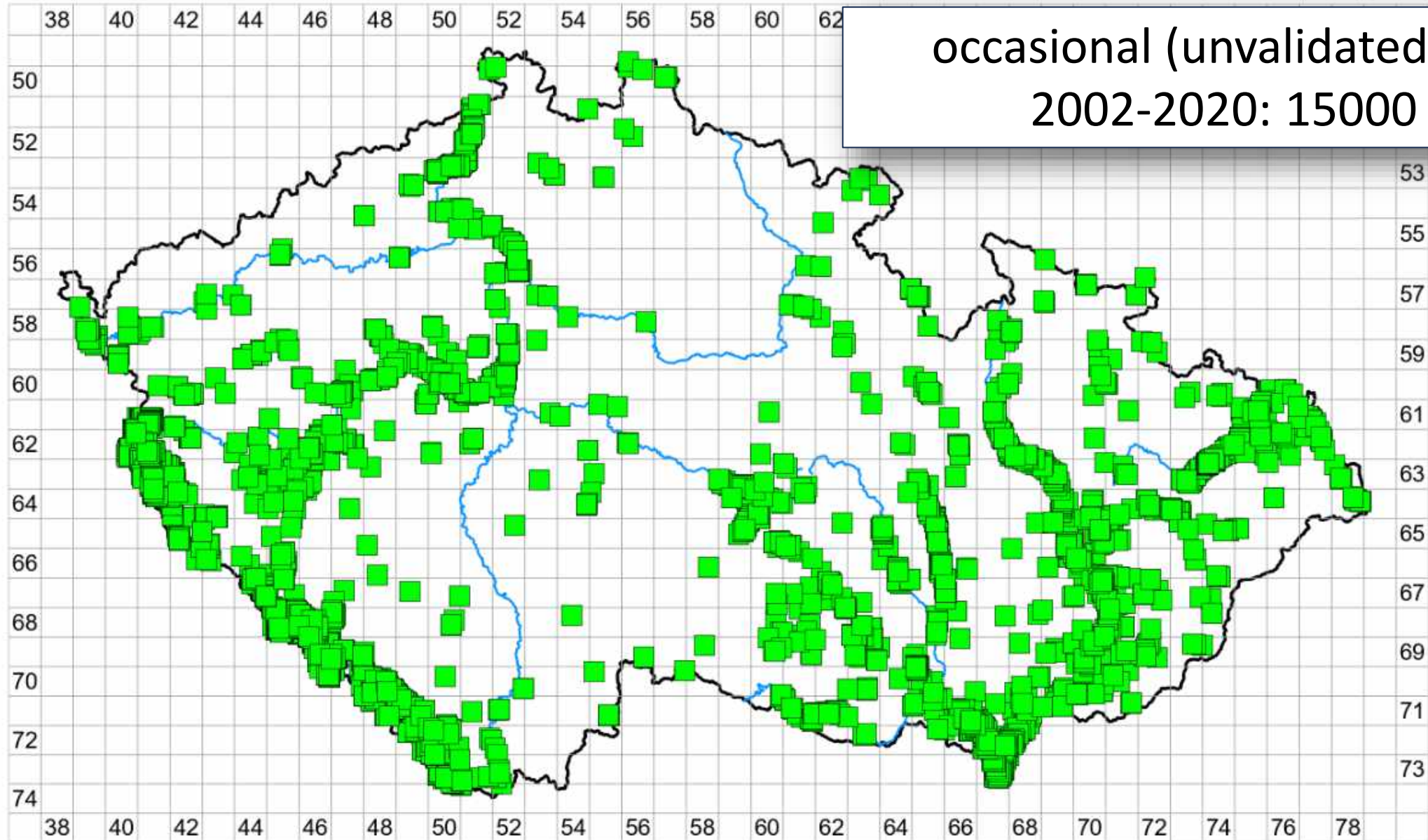2. **Separation of grid cells acc. to data quality**

# Separation of grid cells acc. to data quality

**Three types grid cells with different occupation knowledge**

1. fully surveyed cells
   - **we know all territories within a whole cell**

2. cells surveyed in part
   - **only several territories are known**

3. recognized start of occupation
   - **without any info how many cells exist here**

**Fully surveyed cells**
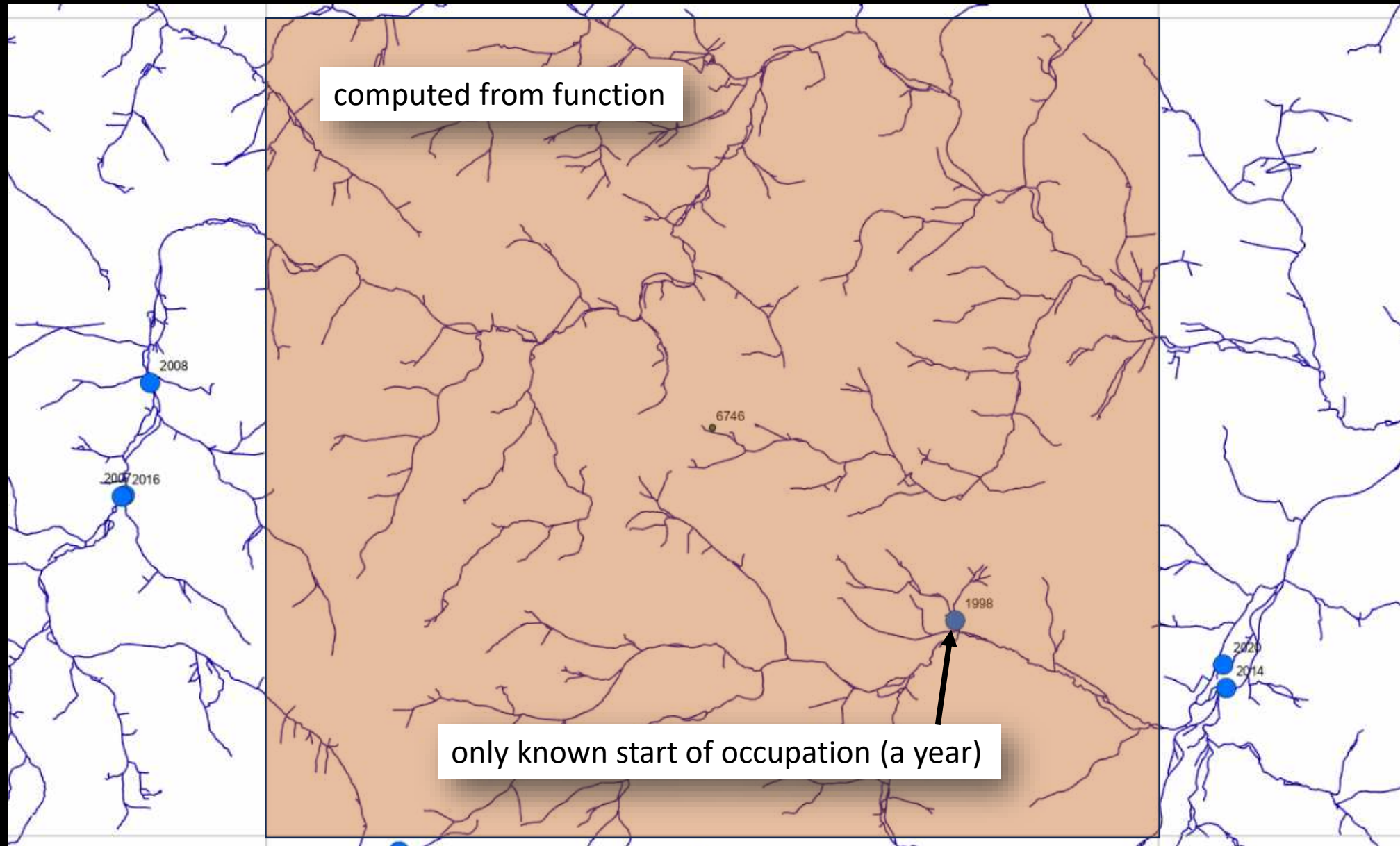(occupation quantified in 2019)

Active beaver family
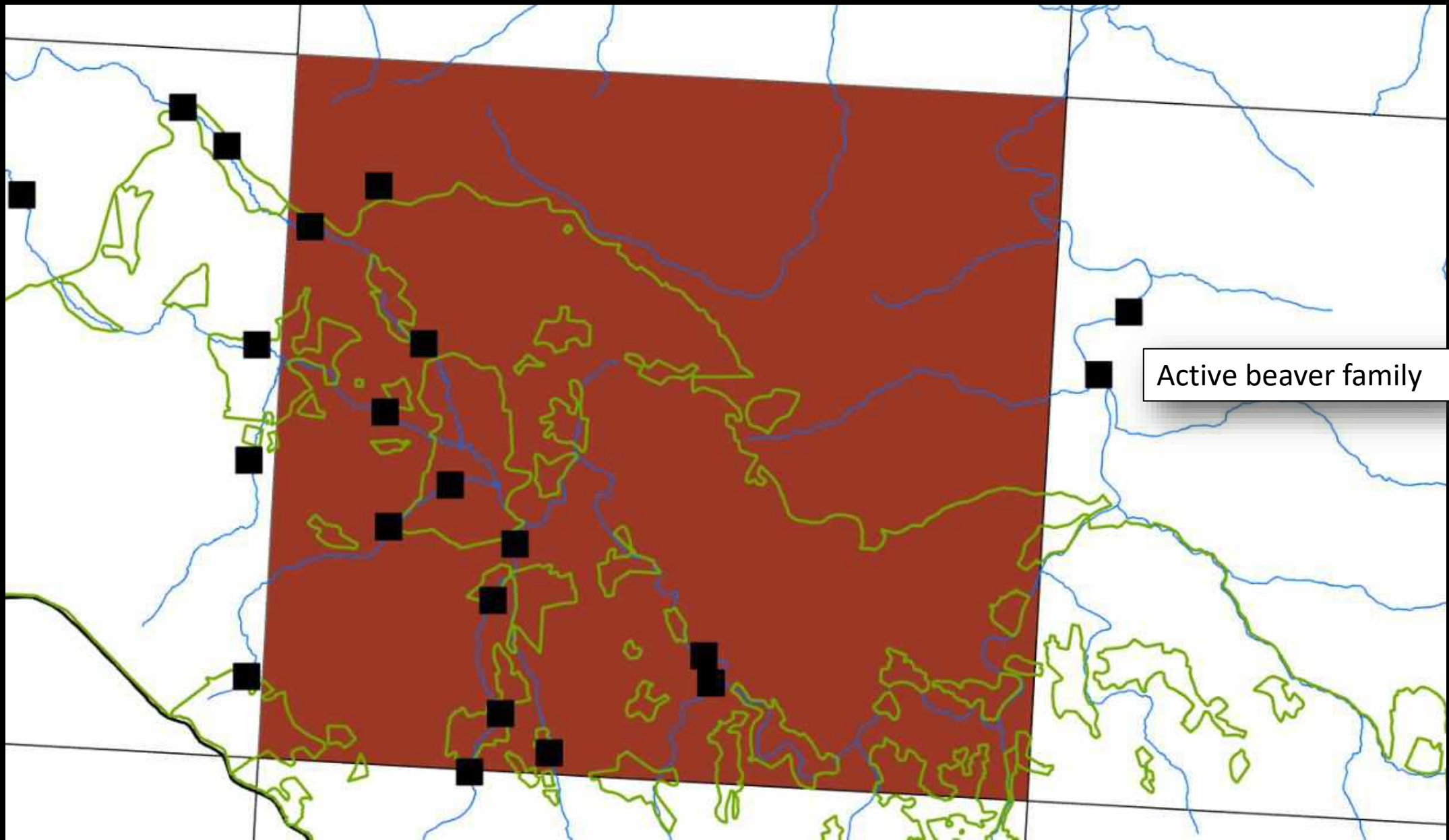
**Cells surveyed in part**
(occupation quantified during a time on a part of grid)

Methods

summed

computed from function
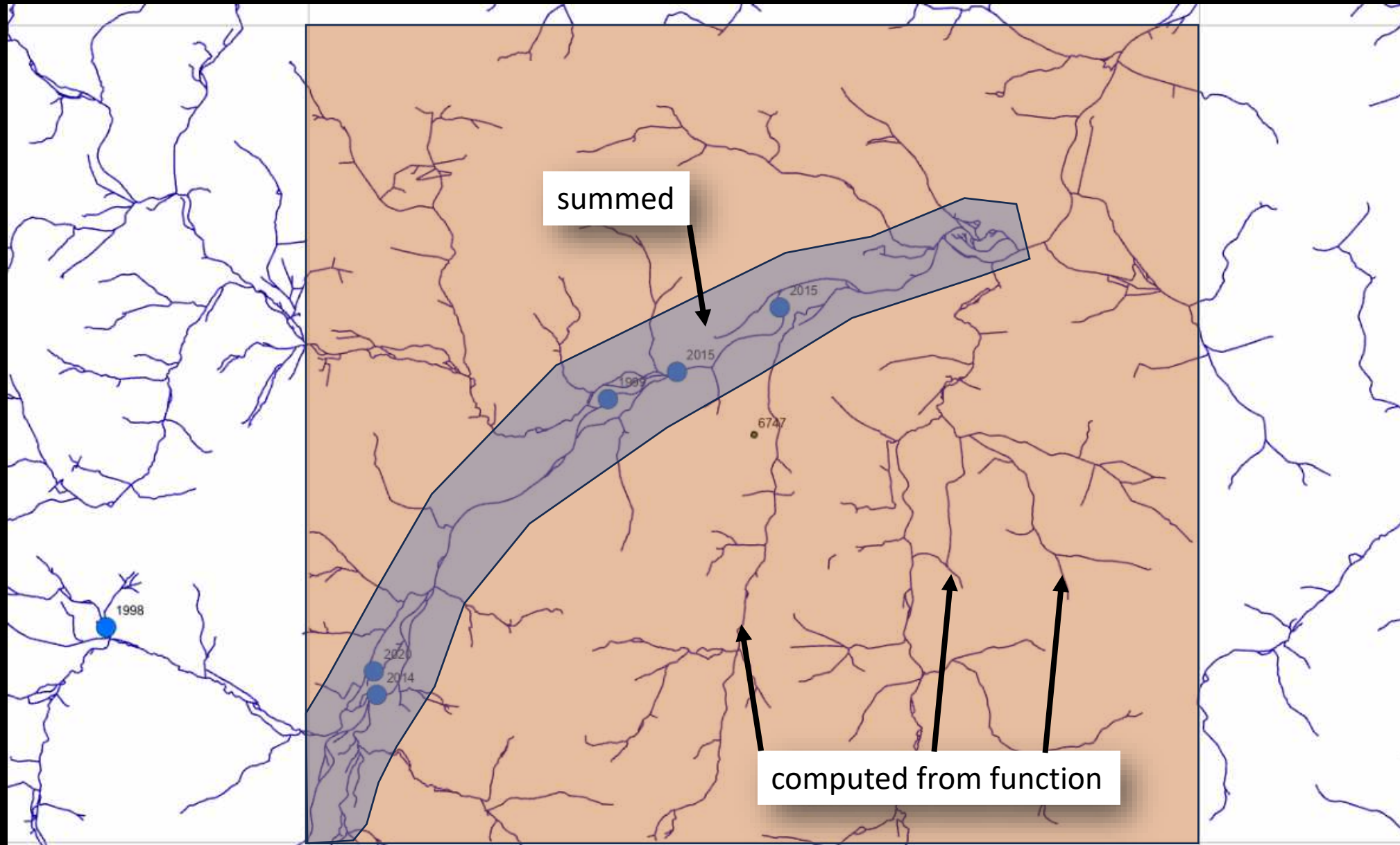
**Recognized only start of occupation**
(occupation quantified during a time on a part of grid)

Methods

computed from function

2008

6746

2007 2016

1998

2020
2014

only known start of occupation (a year)

# Compiling occupancy data

1. **Gathering all data resources:**
   1. long-term monitoring programs
   2. small local projects
   3. public/professional data in national dBase (NDOP)

2. **Separation of grid cells acc. to data quality**

3. **Determination of pop. density as a function of age of occupation (validation of model)**
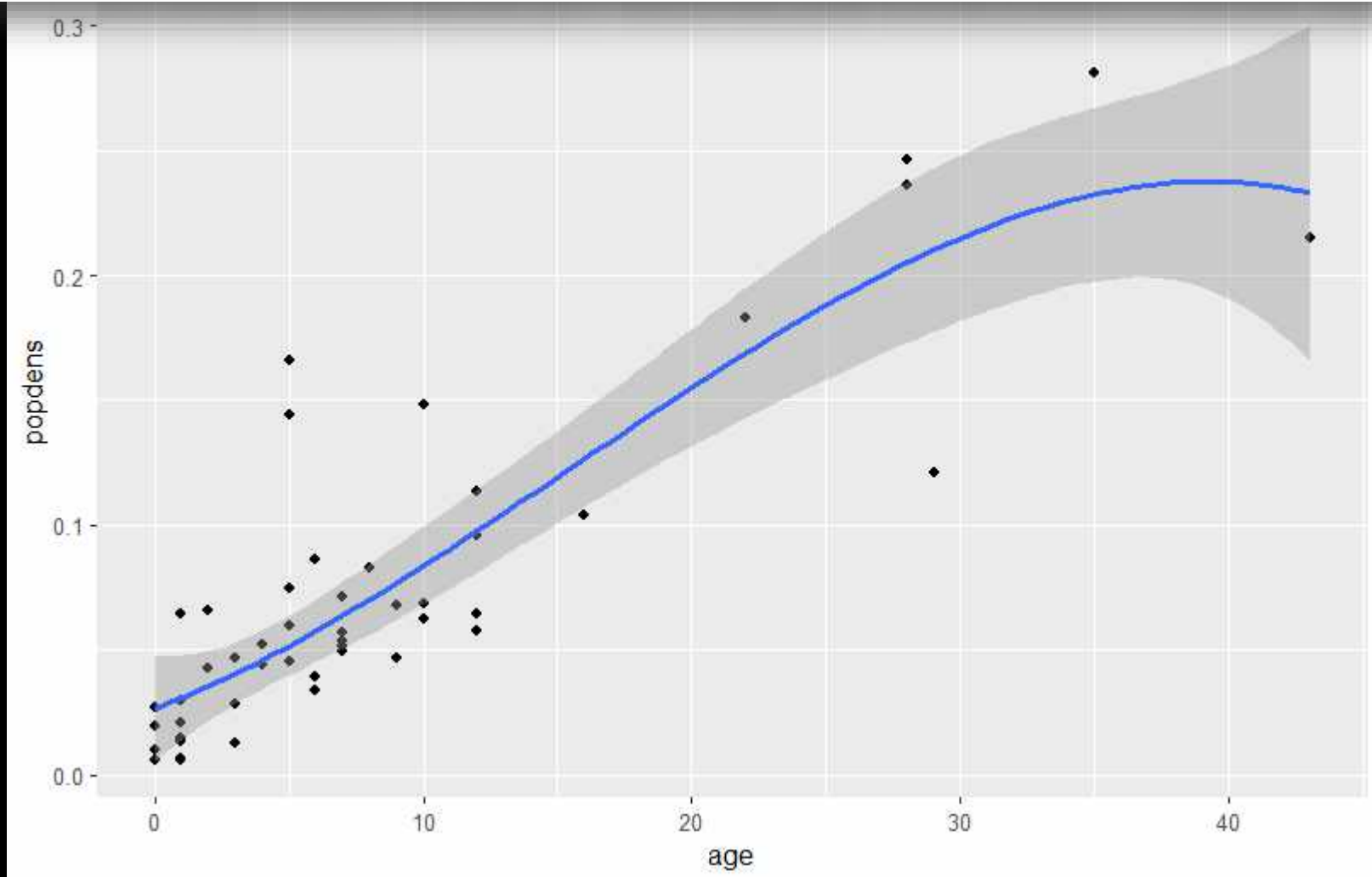
# Determination of pop. density as a function of age of occupation



Methods
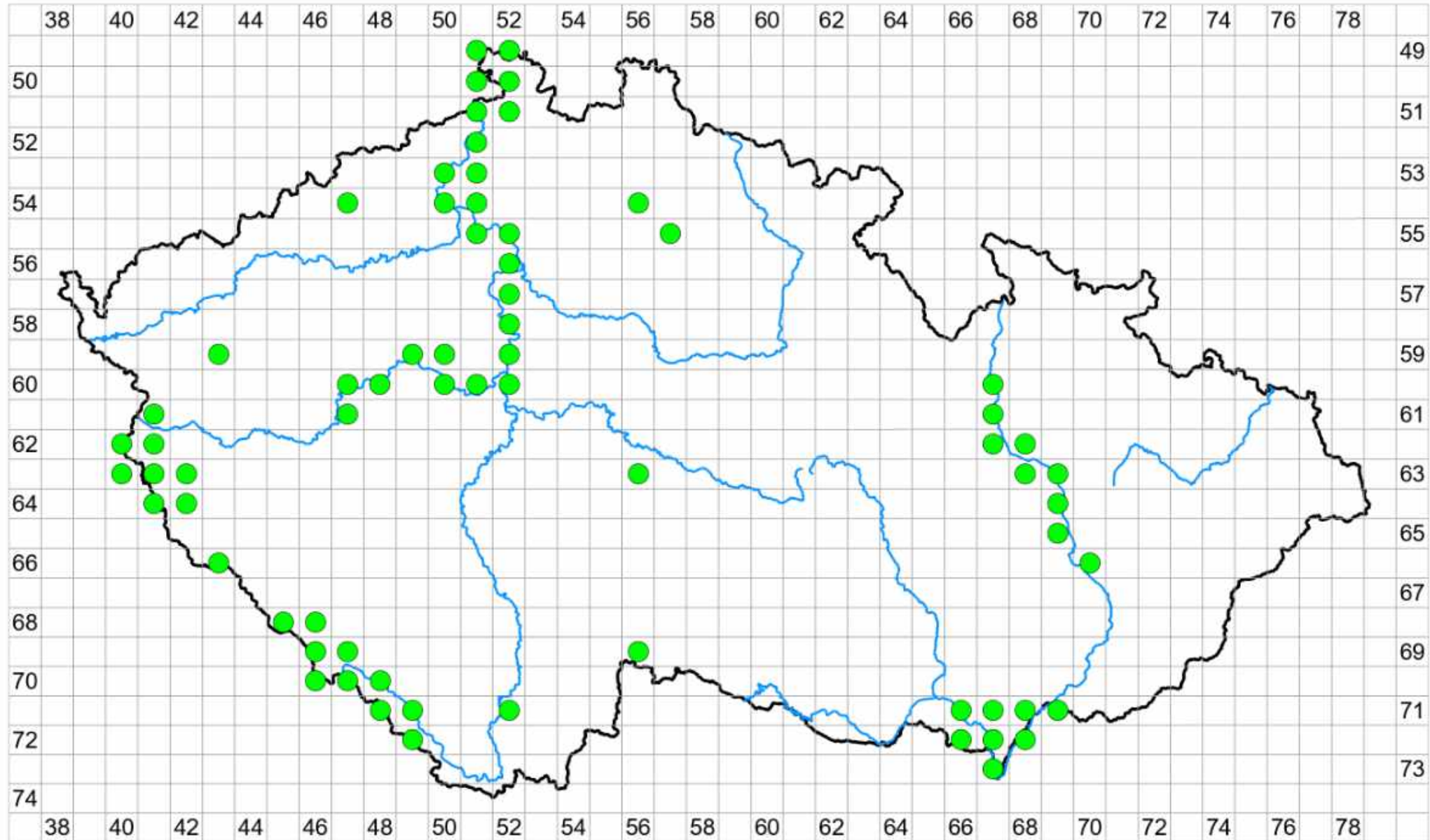
# We derived population density appropriate for length of occupation
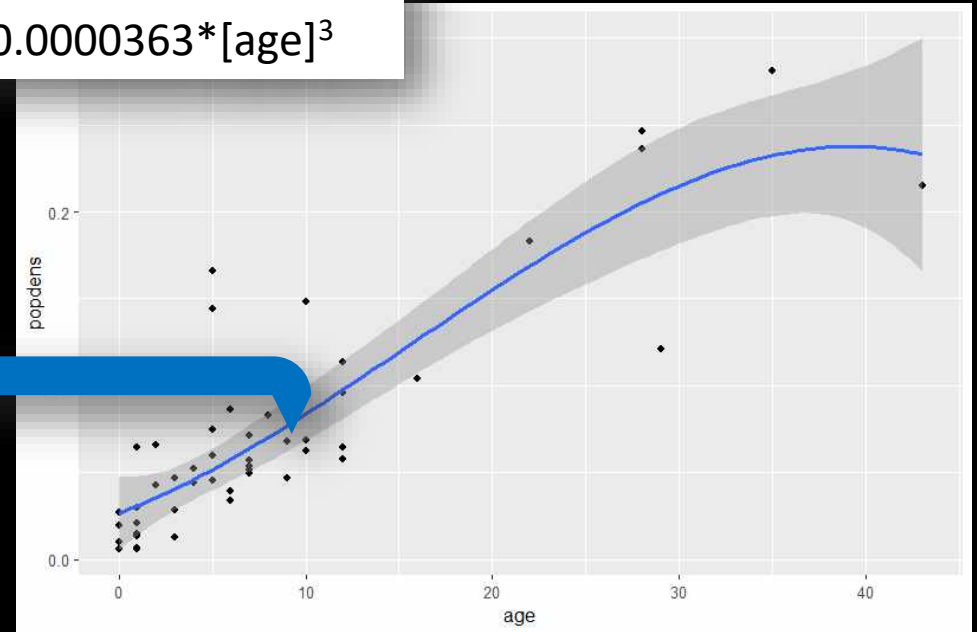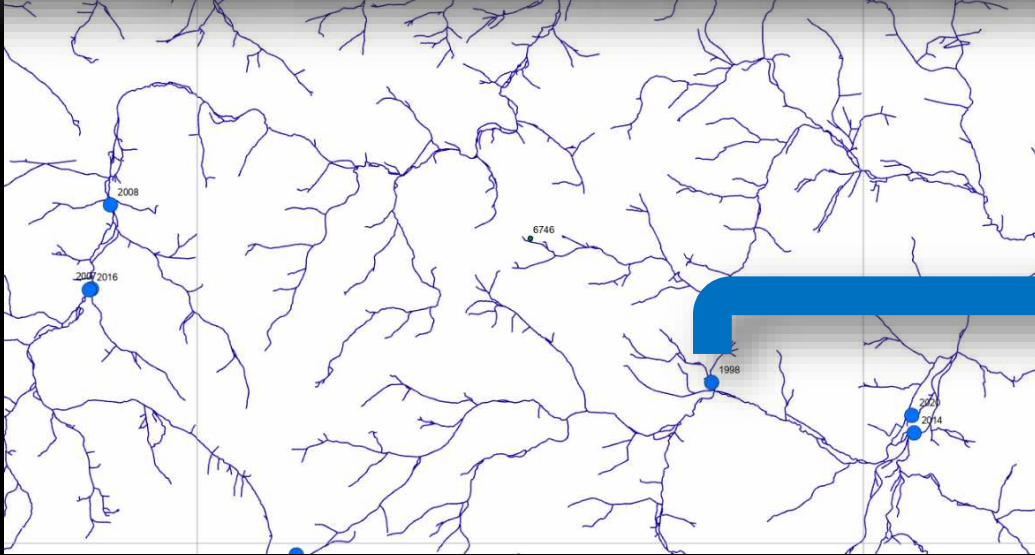


function:
population density (popdens) corresponds to the length of settlement in the cell (age)

Methods

# We derived population density appropriate for length of occupation

Nonlinear regression (polynom of 3rd order) :
  $[popdens] = 0.02087*[age] - 0.001452*[age]^2 + 0.0000363*[age]^3$



Parameters:

> age (length of occupation: 2020 – year of first settlement)
> computed population density
> length of water streams in cell

RESULT:

**predicted population density in the grid cell**

**Methods**

# Compiling occupancy data

1. **Gathering all data resources:**
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# Data processing

**Three types grid cells with different occupation knowledge**

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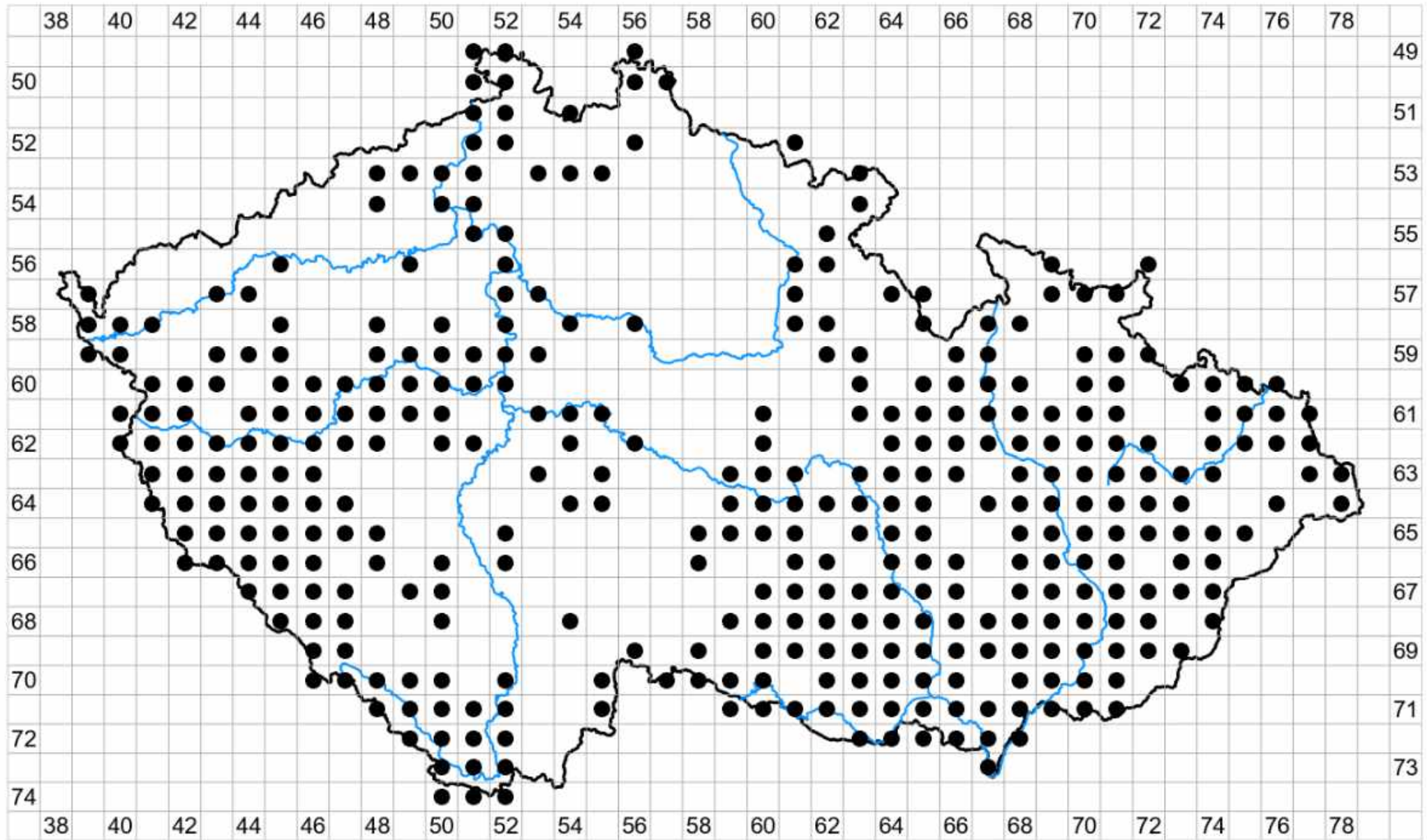
   -> summed existing territories per cell
2. cells surveyed in part
   - only several territories are known

   -> summed existing terr. and added computed by function
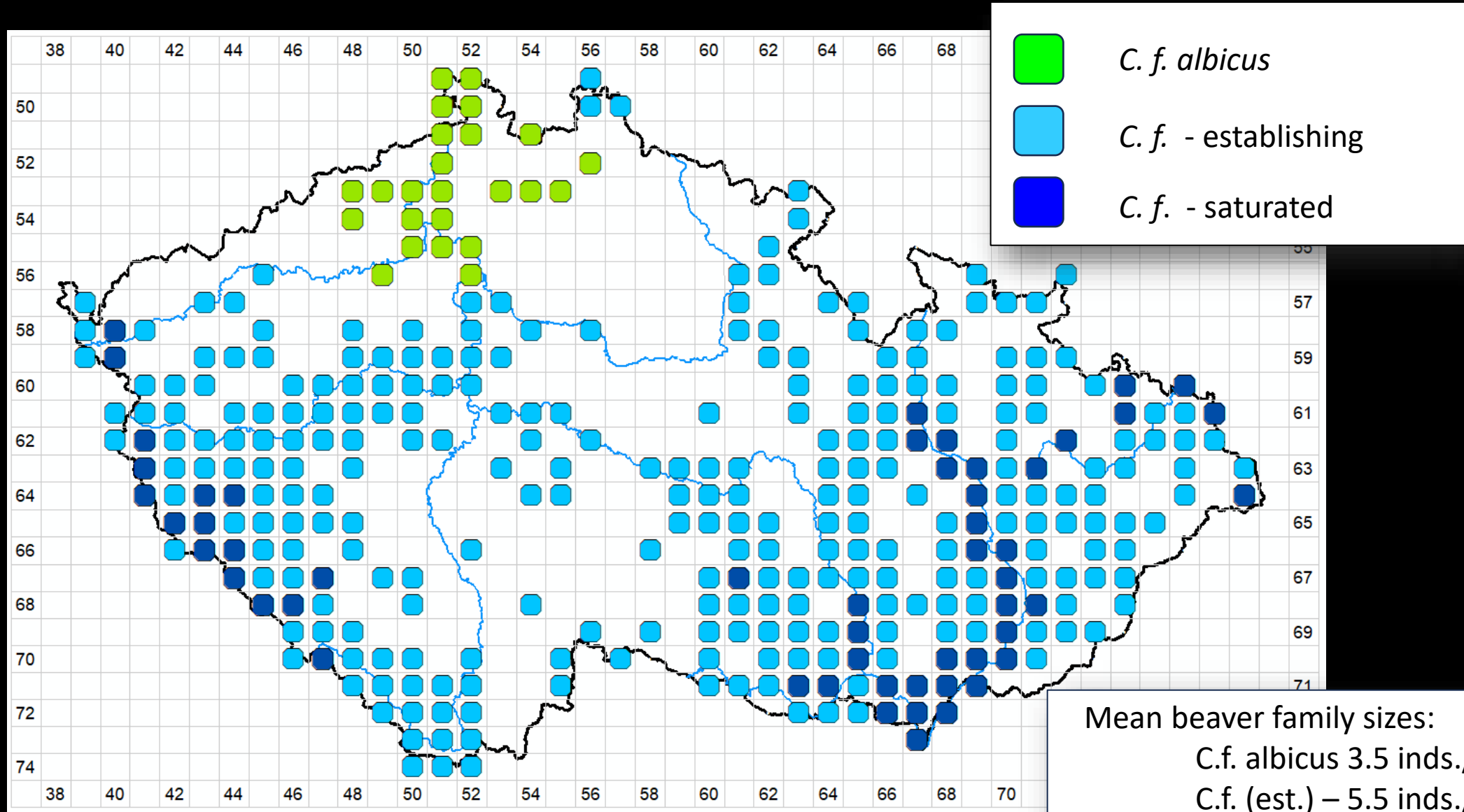3. recognized start of occupation
   - without any info how many cells exist here

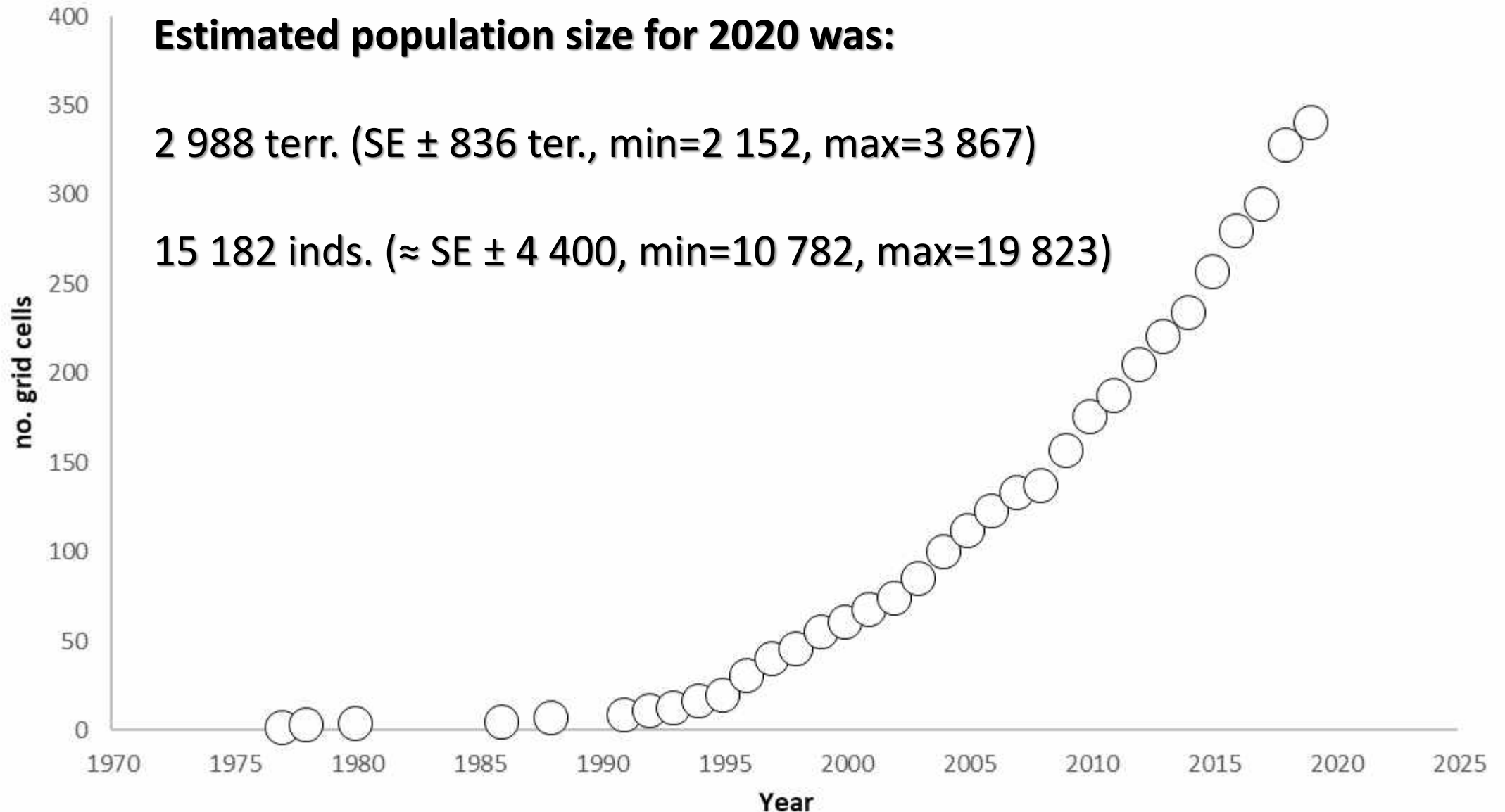   -> computed by function

Current distribution in CZE in 2020

# Population size in CZE



Legend:
- **C. f. albicus** (green)
- **C. f. - establishing** (light blue)
- **C. f. - saturated** (dark blue)

Mean beaver family sizes:
- C.f. albicus 3.5 inds./terr
- C.f. (est.) – 5.5 inds./terr.
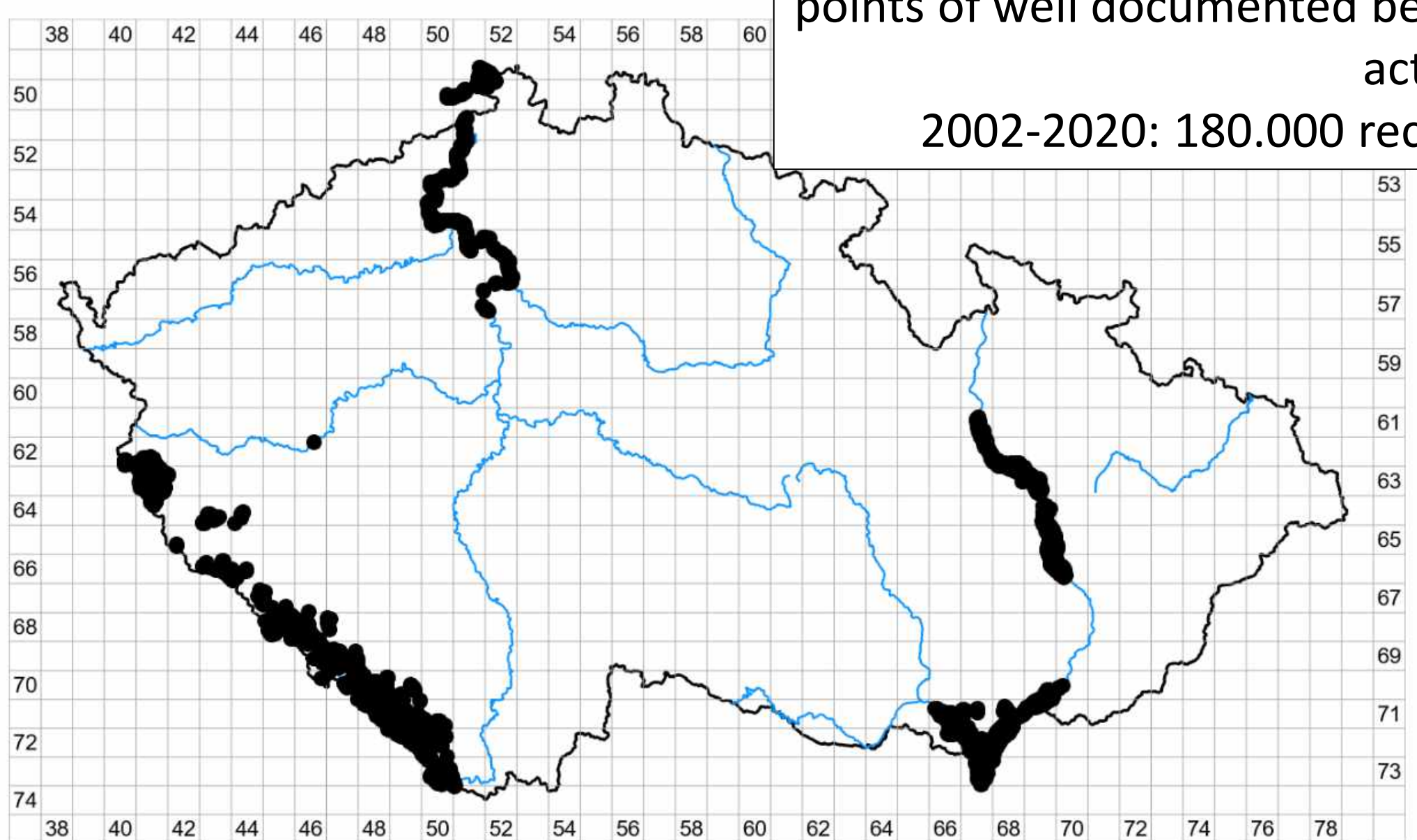- C.f. (sat.) – 4.5 inds./terr.

Results

# Population size in CZE

**Estimated population size for 2020 was:**

2 988 terr. (SE ± 836 ter., min=2 152, max=3 867)

15 182 inds. (≈ SE ± 4 400, min=10 782, max=19 823)
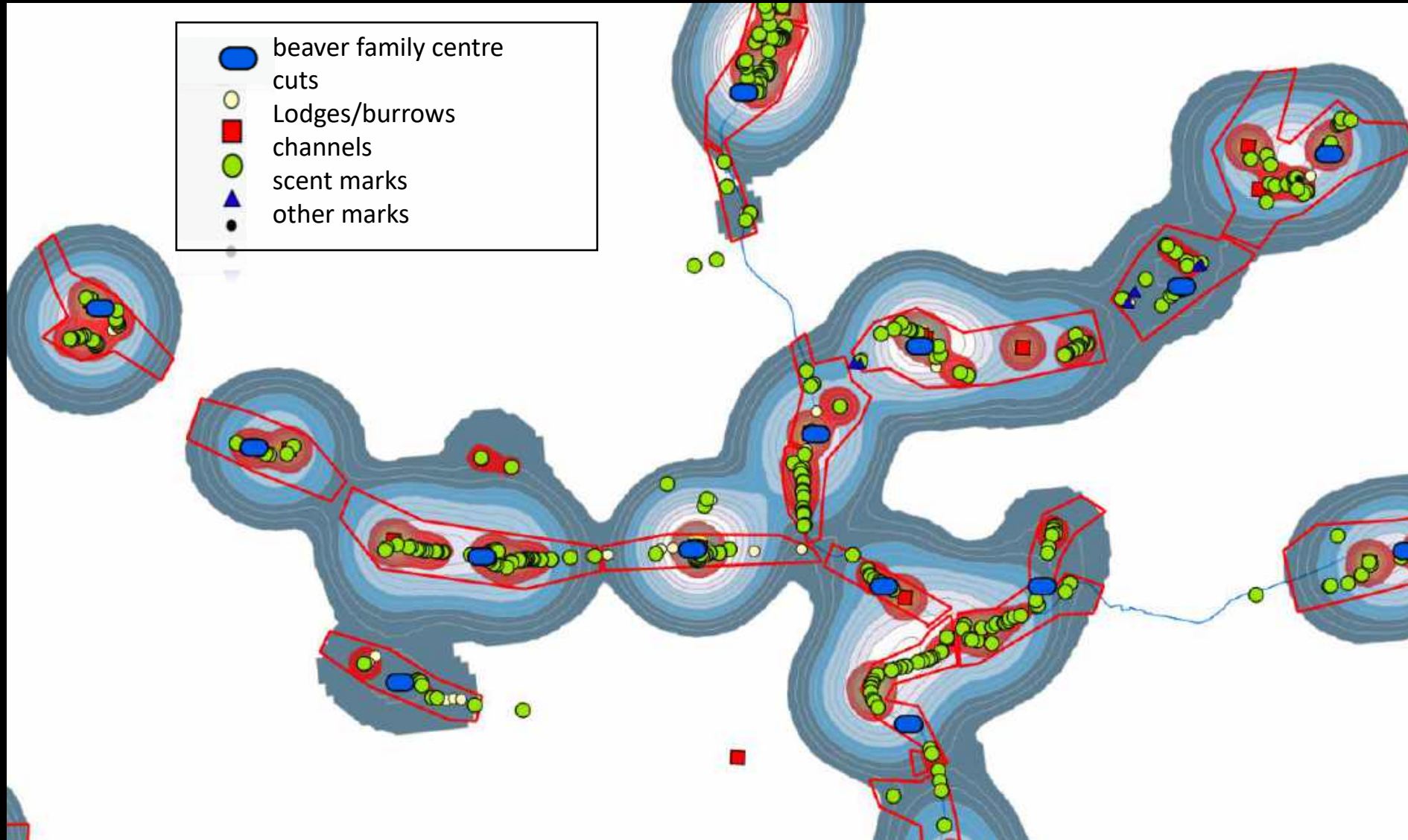
# Task II

# Population dynamics

# Used precise field data

Results



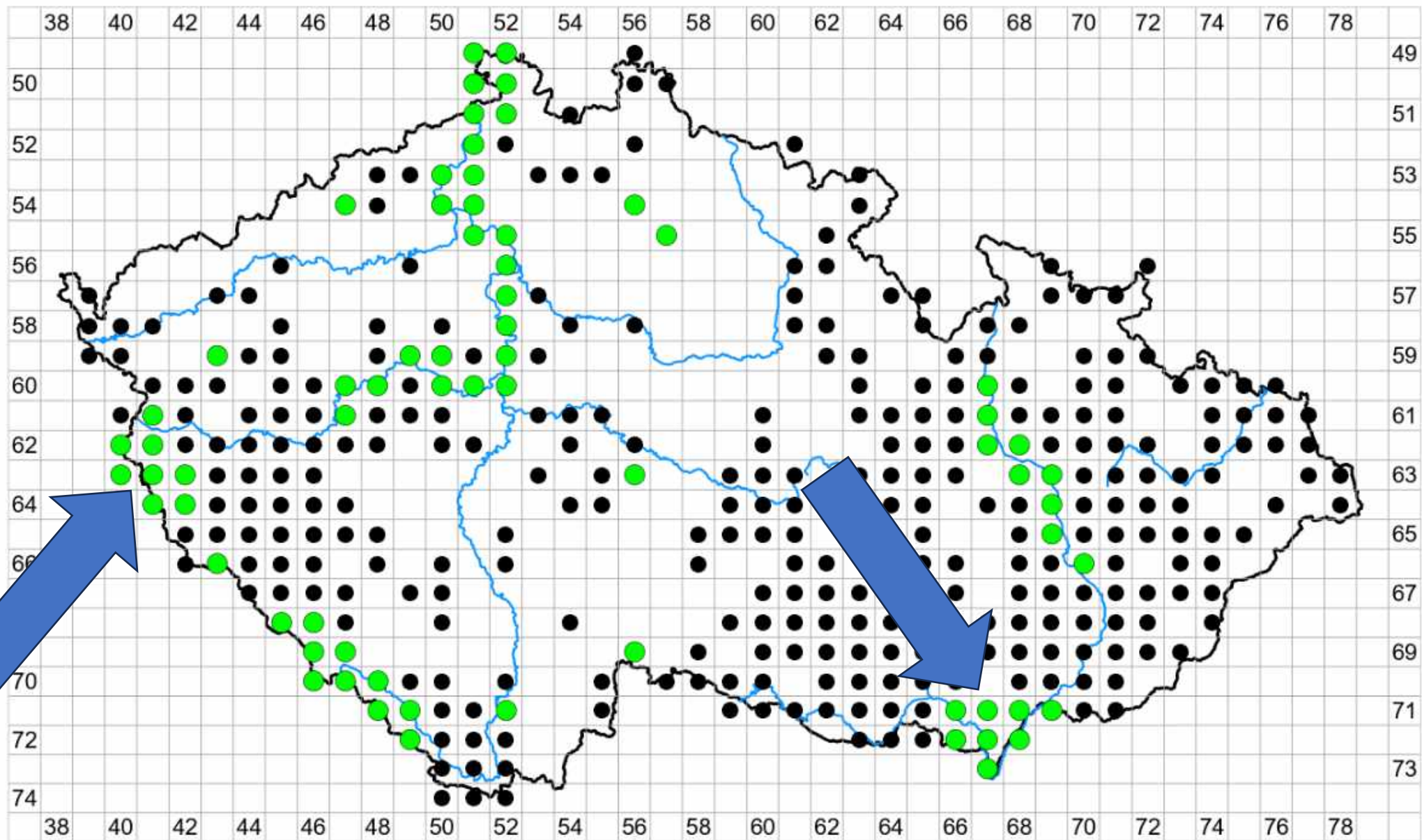points of well documented beaver activity

2002-2020: 180.000 records

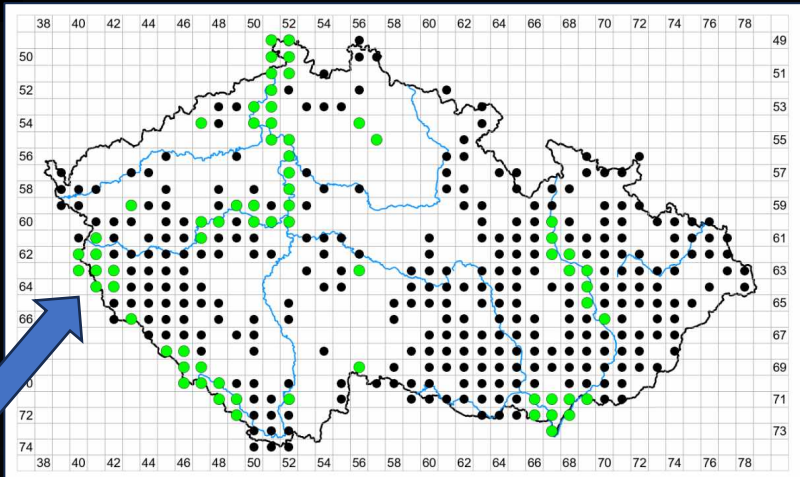**Used precise field data and application of KDE models**
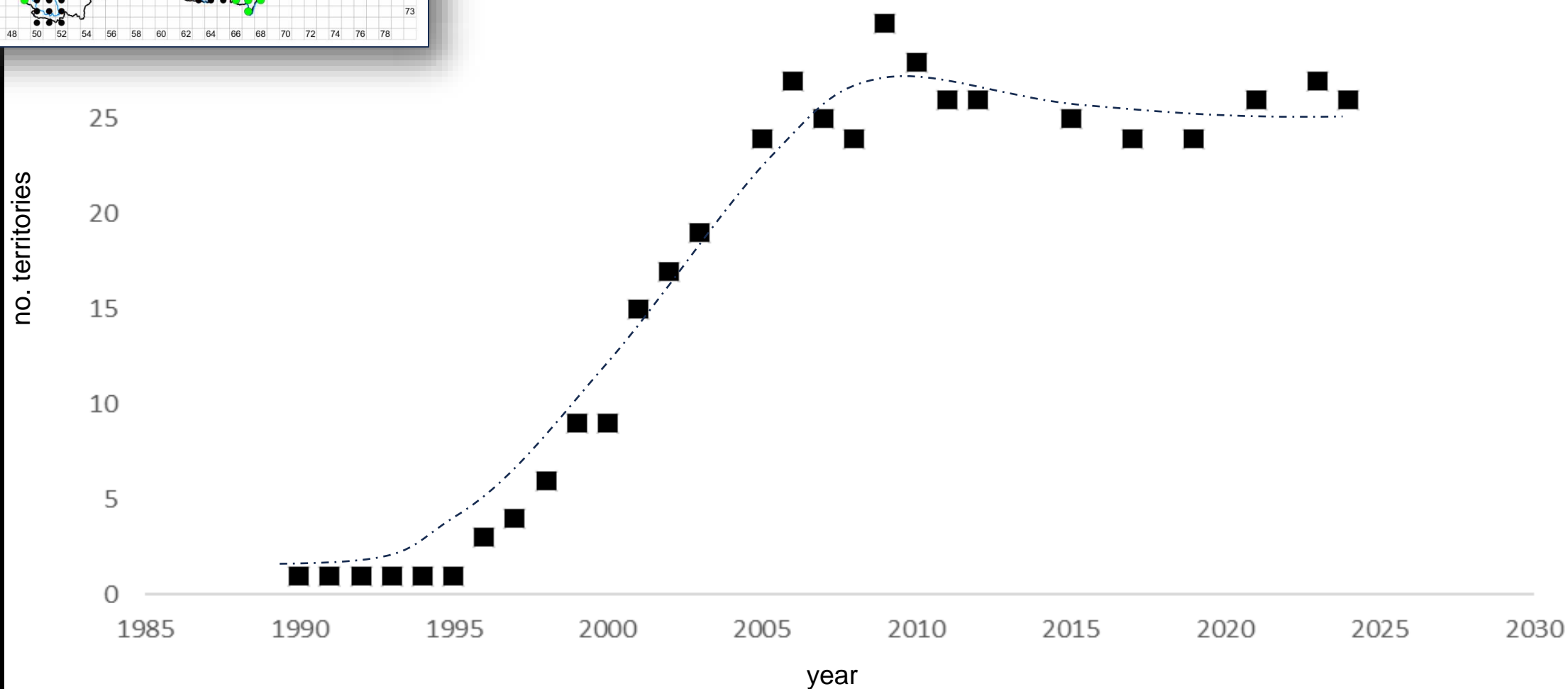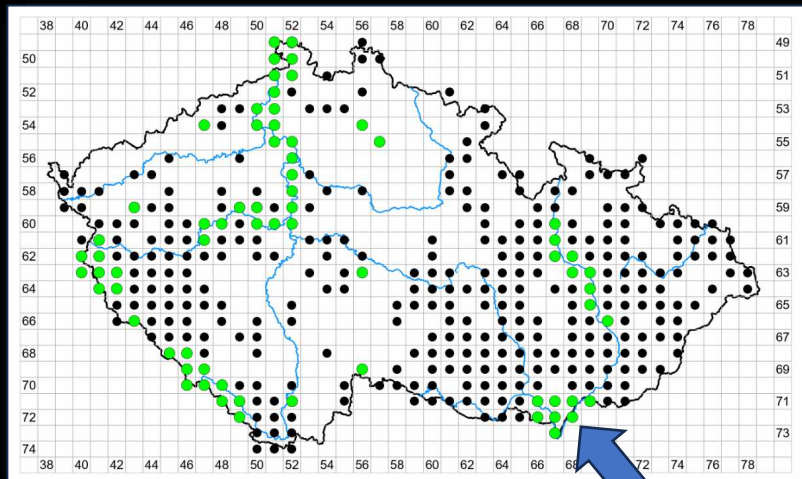
Results

# Development of the oldest subpopulations

# Development of the oldest subpopulations

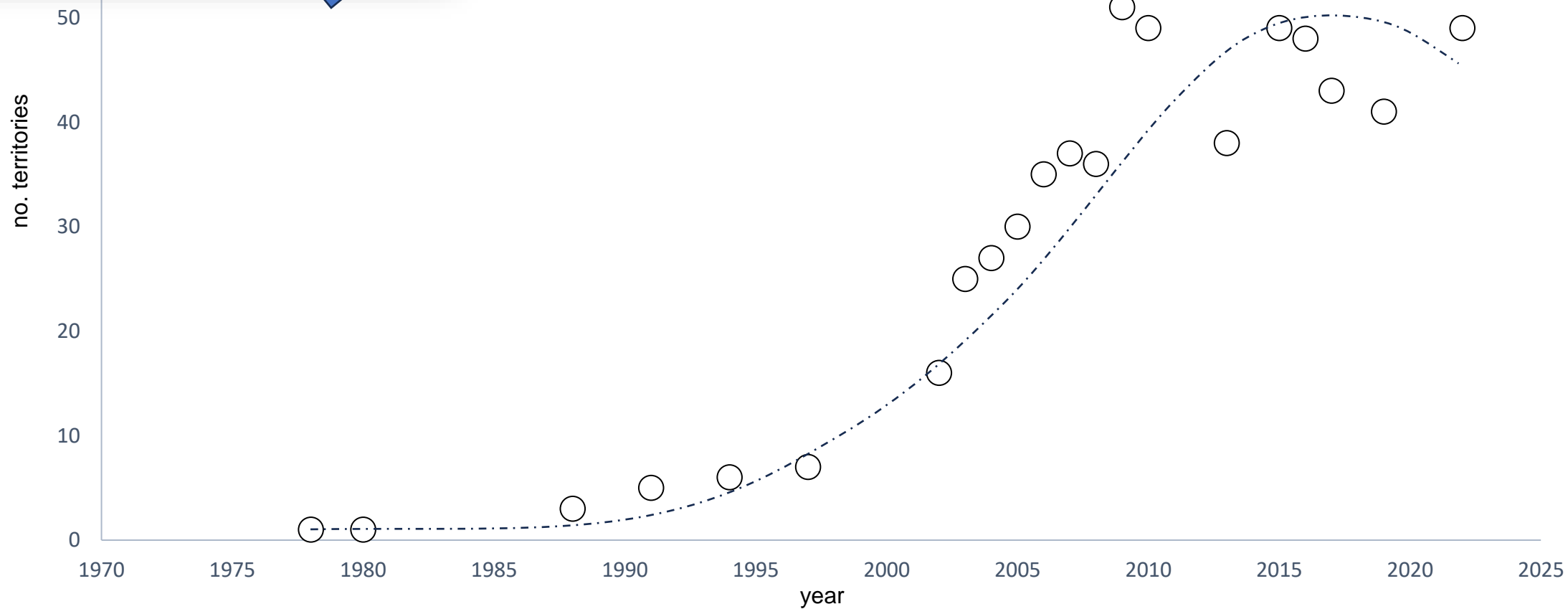Cesky les (PLA/NATURA 2000 site)

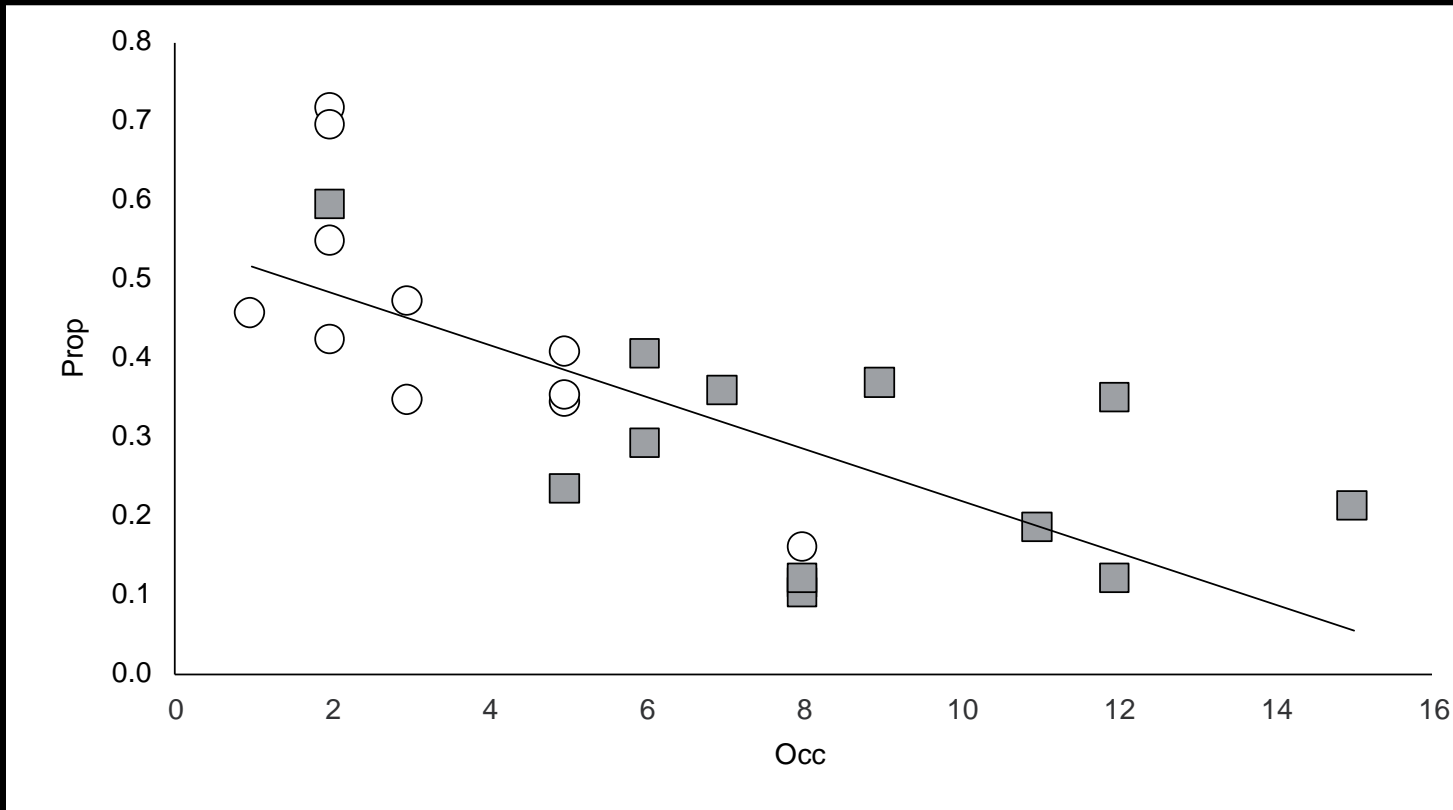Results

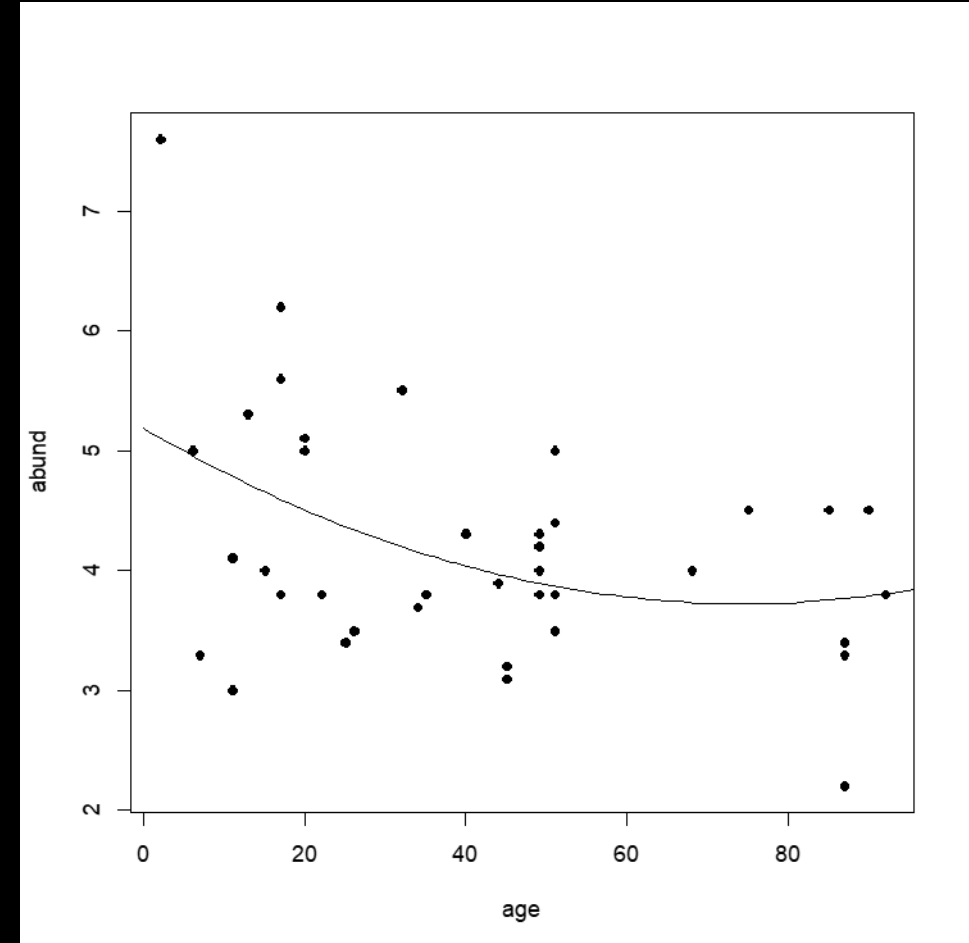# Development of the oldest subpopulations

**Results**

Soutok (PLA/NATURA 2000 site)

# What does compensate the pop. decline?

Proportion of dec. trees (main critical diet source) in territories

Decline of family size



Šimůnková & Vorel, (2016)

Rosell, Parker, Vorel, (in prep.)

# Conclusion

- beaver populations continue in expansions
- we are able to evaluate (not count!) population size
- in the oldest populations is ongoing self-regulation via:

  depletion of food

  decrease of mean litter size

Comming soon...

# Thanks for your attention

Thanks to our partners