Improving our understanding of nature-based management of *Ambrosia artemisiifolia*:
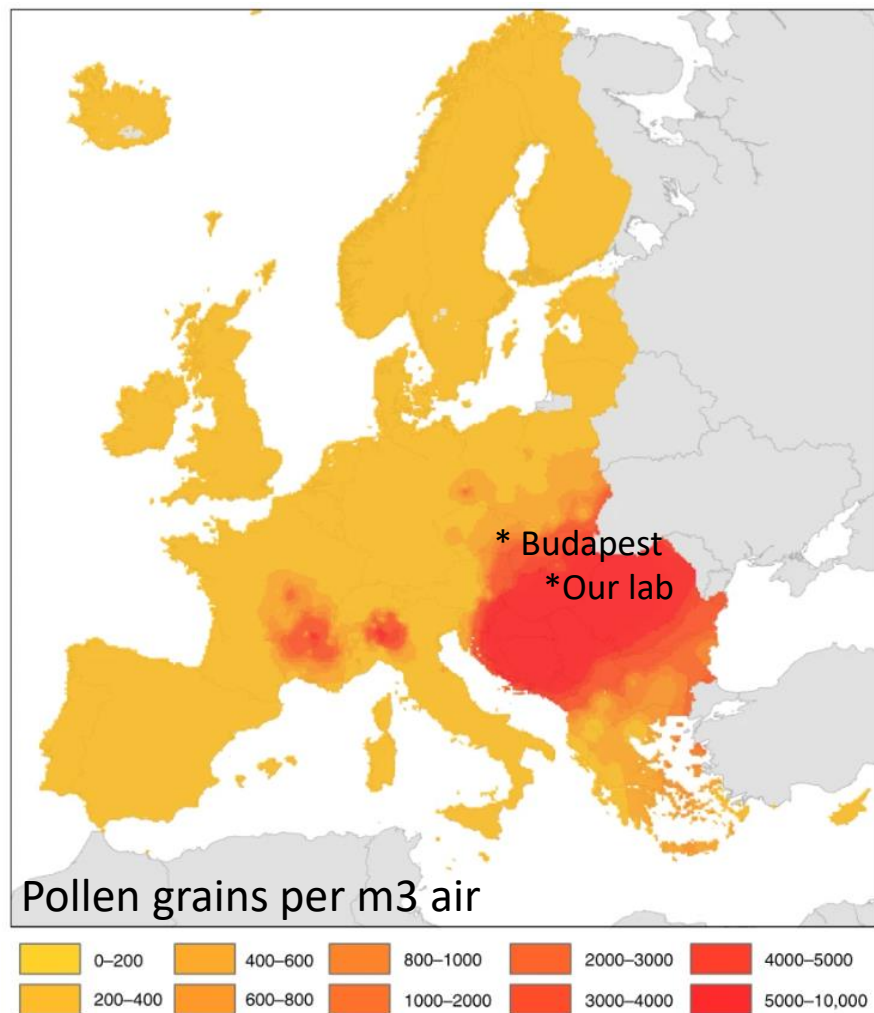# **Testing projections of the impact of *Ophraella communa***

across Central and Southeastern Europe

S. Toepfer, D. Iványi, Z. Dorner, M. Zalai, J. Kontschán, J. Kiss, B. Kiss, Y. Sun, H. Müller-Schärer, U. Schaffner

stefan.toepfer@uni-mate.hu; u.schaffner@cabi.org; dorika100219@gmail.com

Seasonal pollen intensity by *Ambrosia* across Europe

The problem

Pollen grains per m3 air

| | 0–200 | | 400–600 | | 800–1000 | | 2000–3000 | | 4000–5000 |
| | 200–400 | | 600–800 | | 1000–2000 | | 3000–4000 | | 5000–10,000 |

* Budapest
*Our lab

Ref: Schaffner U., Steinbach S., Sun Y., et al (2020): Biological weed control to relieve millions from *Ambrosia* allergies in Europe. Nature Communications

A possible solution

- The leaf beetle: ***Ophraella communa*** (Coleoptera: Chrysomelidae), a native to North America

- Successfully used in China as a **classical biocontrol agent against *A. artemisiifolia***

- **In 2013**, *O. communa* was also detected in **northern Italy and southern Switzerland**

- Since then, airborne pollen concentrations in the Milano region has dropped by 80%

- More **recently, the beetle has has been reported also from Hungary, Slovenia, Croatia, Serbia, Romania, BiH,..**

Horvath D, Lukatsi M, 2020. First record of Ophraella communa in Hungary (Coleoptera: Chrysomelidae). Folia Entomol. Hungarica 81, 73–79.

Jenő Kontschán Viktor Kerezsi, Gábor Bozsik, and Balázs Kiss 2021 New occurrences of the ragweed leaf beetle (Ophraella communa LeSage, 1986) (Coleoptera, Chrysomelidae) in Hungary. Acta Phytopathologica et Entomologica Hungarica

Ophraella communa

Photo D Ivanyi

Photo D Ivanyi

Photo D Ivanyi

Photo D Ivanyi

2 mm

Ref: Vesna Vidović,Snježana Hrnčić,Branimir Nježić (2022): Occurrence of *Ophraella communa* LeSage (Coleoptera: Chrysomelidae) in Bosnia and Herzegovina. https://doi.org/10.1111/epp.12850
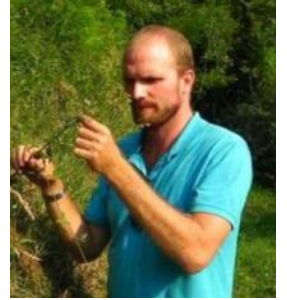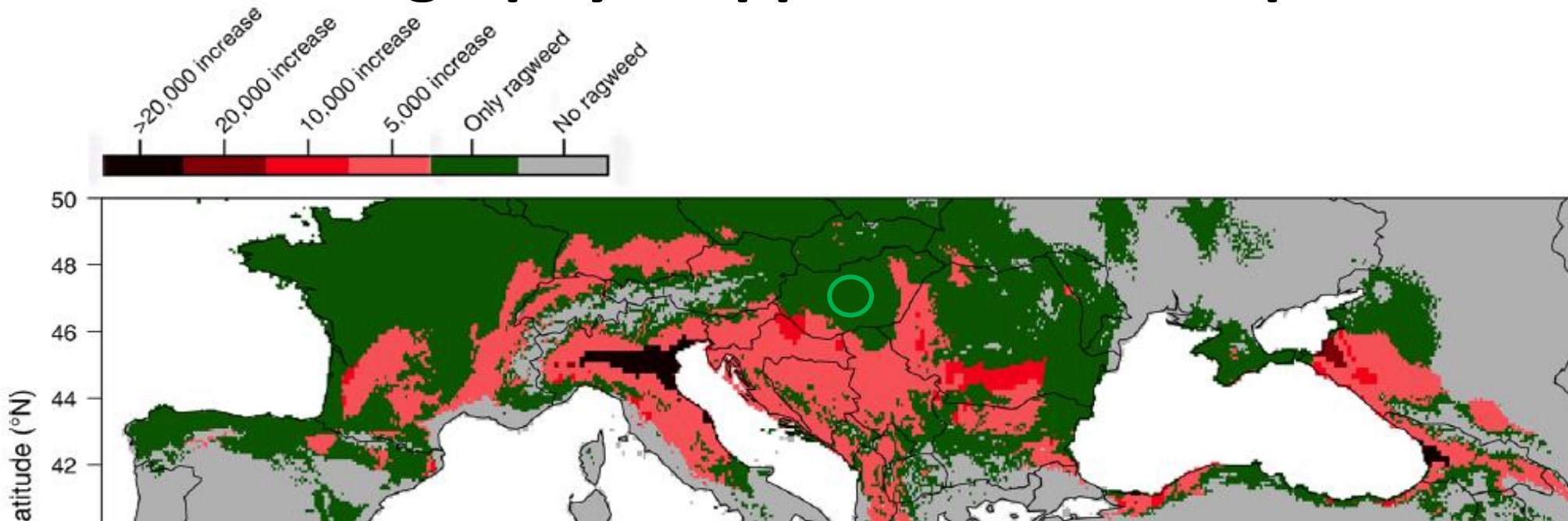
Ambrosia – Ophraella demographic models

- PhD Thesis (2017-2020) – Benno Augustinus

- Field studies on climate-dependent population build-up in Italy

- Field cage experiment to relate *O. communa* demography to impact on *A. artemisiifolia* pollen and seed production

- Lab and field experiments to assess the effect of temperature and humidity on development, oviposition rate and egg hatching success

> Temperature: mainly influences the number of generations

> Humidity: mainly influences egg hatching success

- Temperature and humidity-dependent demographic model of *O. communa*

Augustinus BA, Blum M, Citterio S, Gentili R, Helman D, Nestel D, Schaffner U, Müller-Schärer H, Lensky IM, 2022. Ground-truthing predictions of a demographic model driven by land surface temperatures with a weed biocontrol cage experiment. Ecol. Modell. 466.
Augustinus B, Yan S, Beuchat C, Schaffner U, Müller-Schärer H, 2020. Predicting impact of a biocontrol agent: integrating distribution modeling with climate-dependent vital rates. Ecol. Appl. 30.

Ophraella demography mapped across Europe

- Models suggest that parts of central Europe, e.g. parts of Hungary, are less suitable for *O. communa*; this needs to be validated.

- For example, *O. communa* has established permanent populations near Budapest; was the expected suitable range for *O. communa* underestimated?

temperatures with a weed biocontrol cage experiment. Ecol. Modell. 400.

Augustinus B, Yan S, Beuchat C, Schaffner U, Müller-Schärer H, 2020. Predicting impact of a biocontrol agent: integrating distribution modeling with climate-dependent vital rates. Ecol. Appl. 30.

New PhD research objectives (2022 to 2026)

- Validate the projections made by laboratory and field studies for northern Italy on the case of Central Europe
  - Assess the demography and impact of the biocontrol agent *O. communa* on *A. artemisiifolia* in hot spots in Central Europe differing in climatic conditions, and <u>updating and validating</u> existing demographic models

Dora Ivanyi

- Other topics
  - Design and test an improved biological based integrated weed management approach against *Ambrosia* (e.g. cutting with and without *O.communa*)
  - Contribute to the European-wide risk assessment of *O. communa* for biocontrol of *A. artemisiifolia*, e.g. testing Pannonian asteraceaen non-targets. E.g. choice tests in lab or field

➢ *Final goal:* We hope to help reducing airborne pollen concentrations in Central Europe to a similar extent as currently observed in northern Italy

New PhD research objectives (2022 to 2026)

- Validate the projections made by laboratory and field studies for northern Italy on the case of Central Europe
  - Assess the demography and impact of the biocontrol agent *O. communa* on *A. artemisiifolia* in hot spots in Central Europe differing in climatic conditions, and <u>updating and validating</u> existing demographic models

Dora Ivanyi

Example of hypothesis

Number of generations

- The number of *O. communa* generations (which depends on temperature) may be less in Central and Northern Hungary than along the Dalmatian coast and in southern Romania/northern Bulgaria
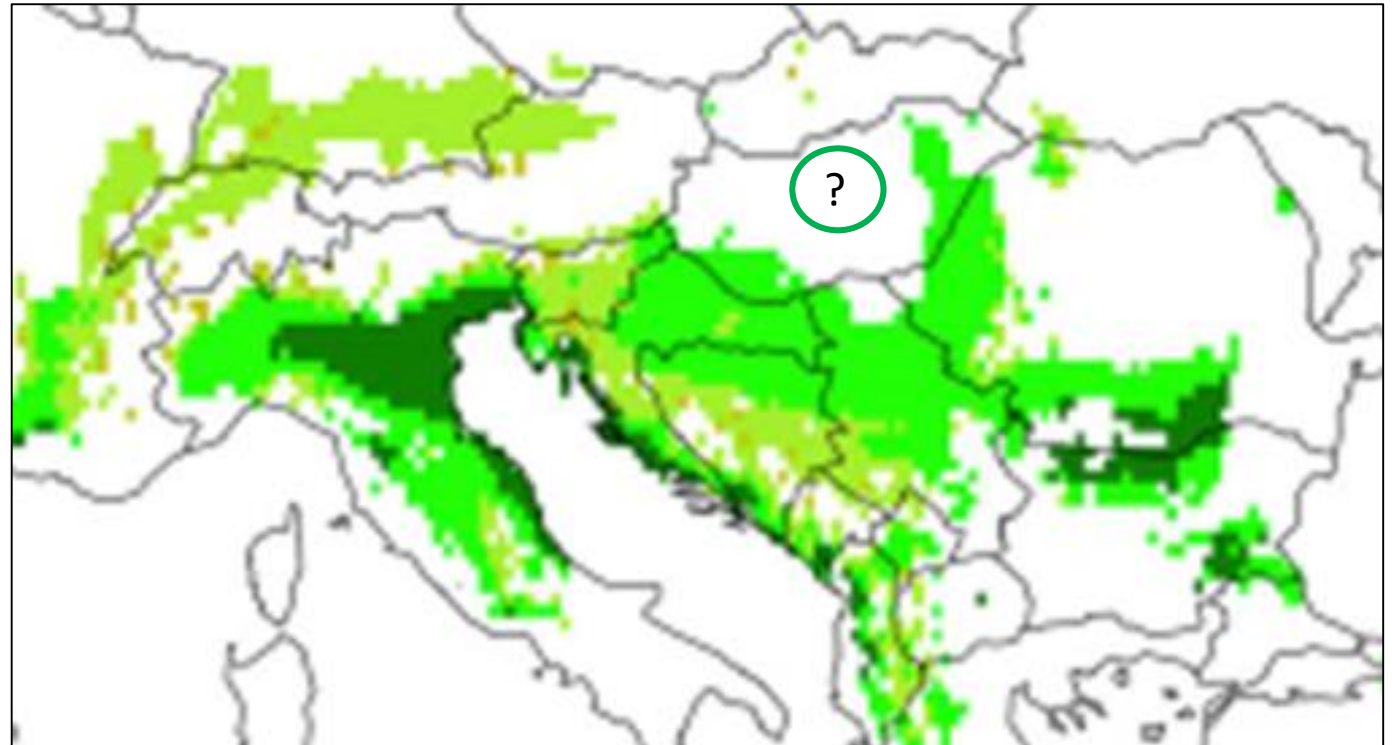
Augustinus BA, Blum M, .., Schaffner U, Müller-Schärer H, Lensky IM, 2022. Ground-truthing predictions of a demographic model driven by land surface temperatures with a weed biocontrol cage experiment. Ecol. Modell. 466.
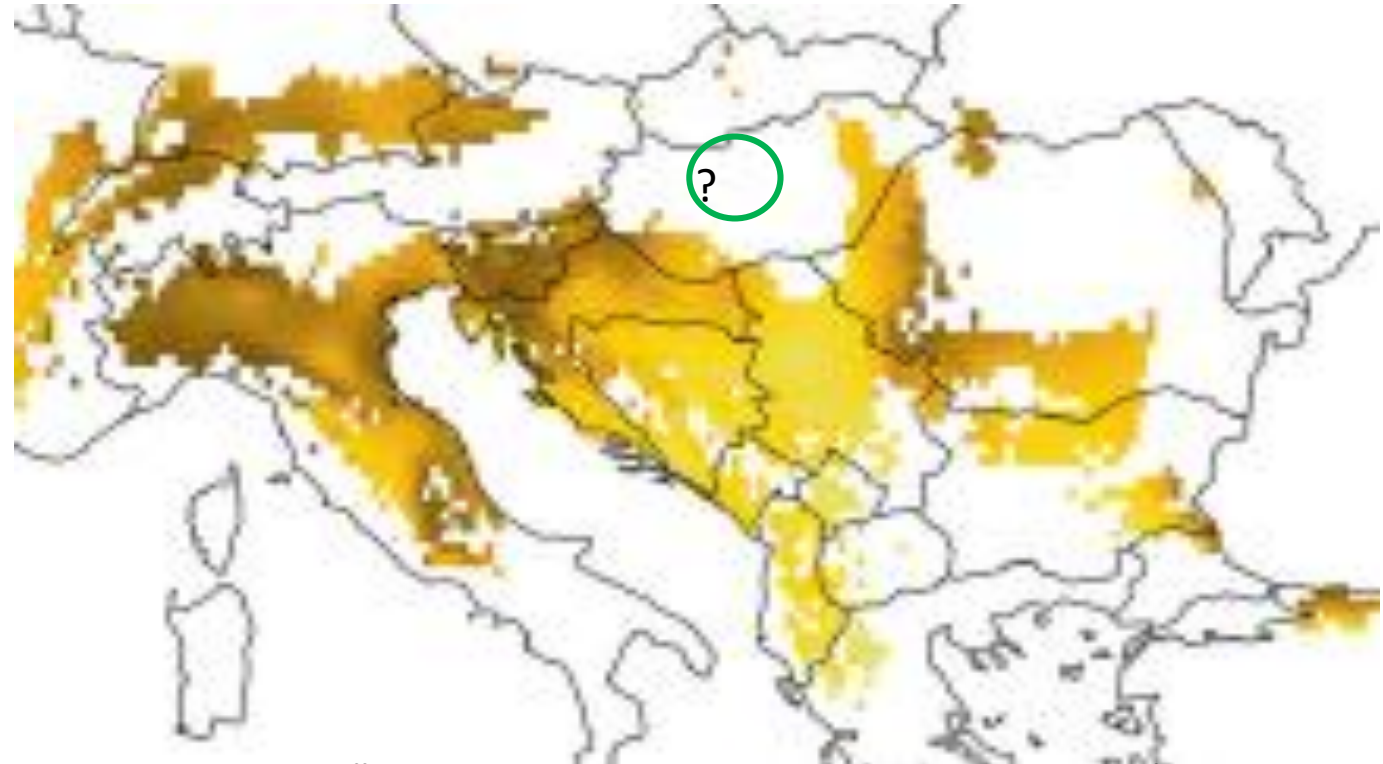Augustinus B, Yan S, Beuchat C, Schaffner U, Müller-Schärer H, 2020. Predicting impact of a biocontrol agent: integrating distribution modeling with climate-dependent vital rates. Ecol. Appl. 30.

Example of hypothesis

- Egg hatching success (which depends on high relative humidity) may be lower in Serbia or Hungary than in northern Croatia and Slovenia

Egg hatching success

Augustinus BA, Blum M, .., Schaffner U, Müller-Schärer H, Lensky IM, 2022. Ground-truthing predictions of a demographic model driven by land surface temperatures with a weed biocontrol cage experiment. Ecol. Modell. 466.
Augustinus B, Yan S, Beuchat C, Schaffner U, Müller-Schärer H, 2020. Predicting impact of a biocontrol agent: integrating distribution modeling with climate-dependent vital rates. Ecol. Appl. 30.

Planned methods

- Combination of
  - field cages experiments ,
  - laboratory experimentation
  - modelling
- Feld cage experiments may be implemented in Hungary, Croatia, Slovenia, and/or Serbia, and/or other countries. **We need help with sites and data collection.**
- Choosing dryer and warmer-summer areas or other climates in Central Europe, as compared to data from Italy
  - 5 to 10 sites, at least 2 *O. communca* generations to follow
  - Fine weather data needed
  - Assessing vital rates *of A. artemisiifolia* and *O. communa*
  - Weekly data
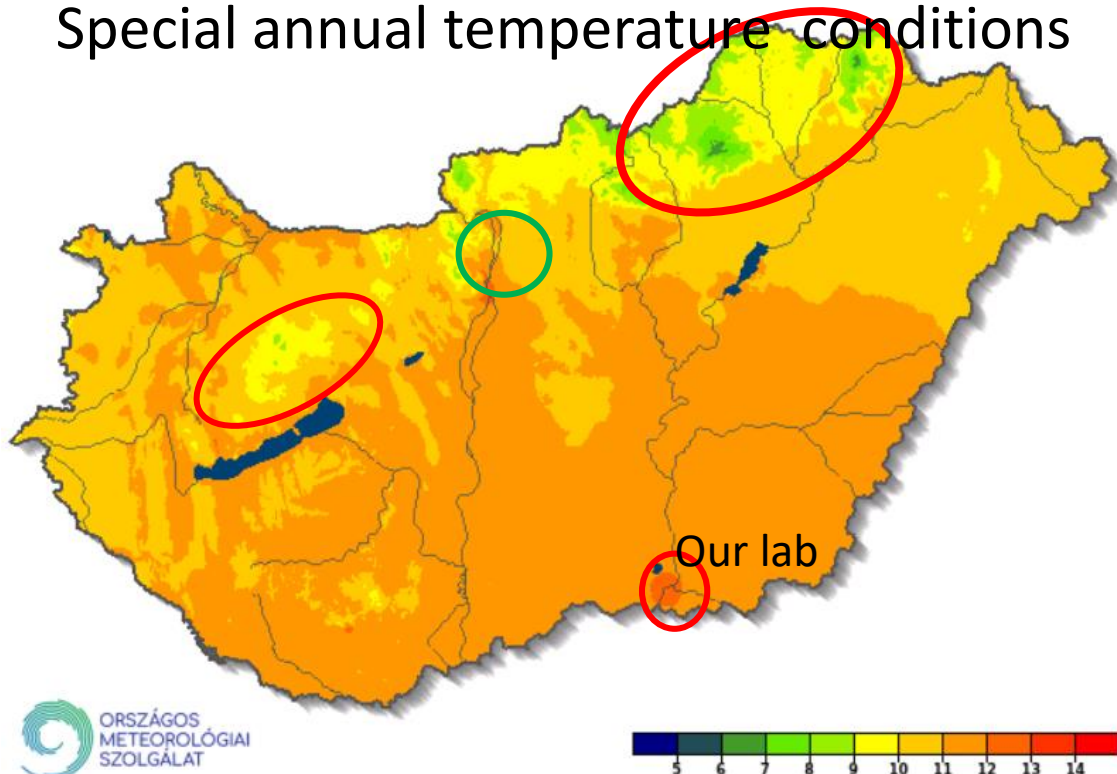 - Maybe combining with pollen data. **We need your help**

Field cage with Ambrosia and with or without Ophraella. Also containing climate data logger (Photo. B. Augustinus)
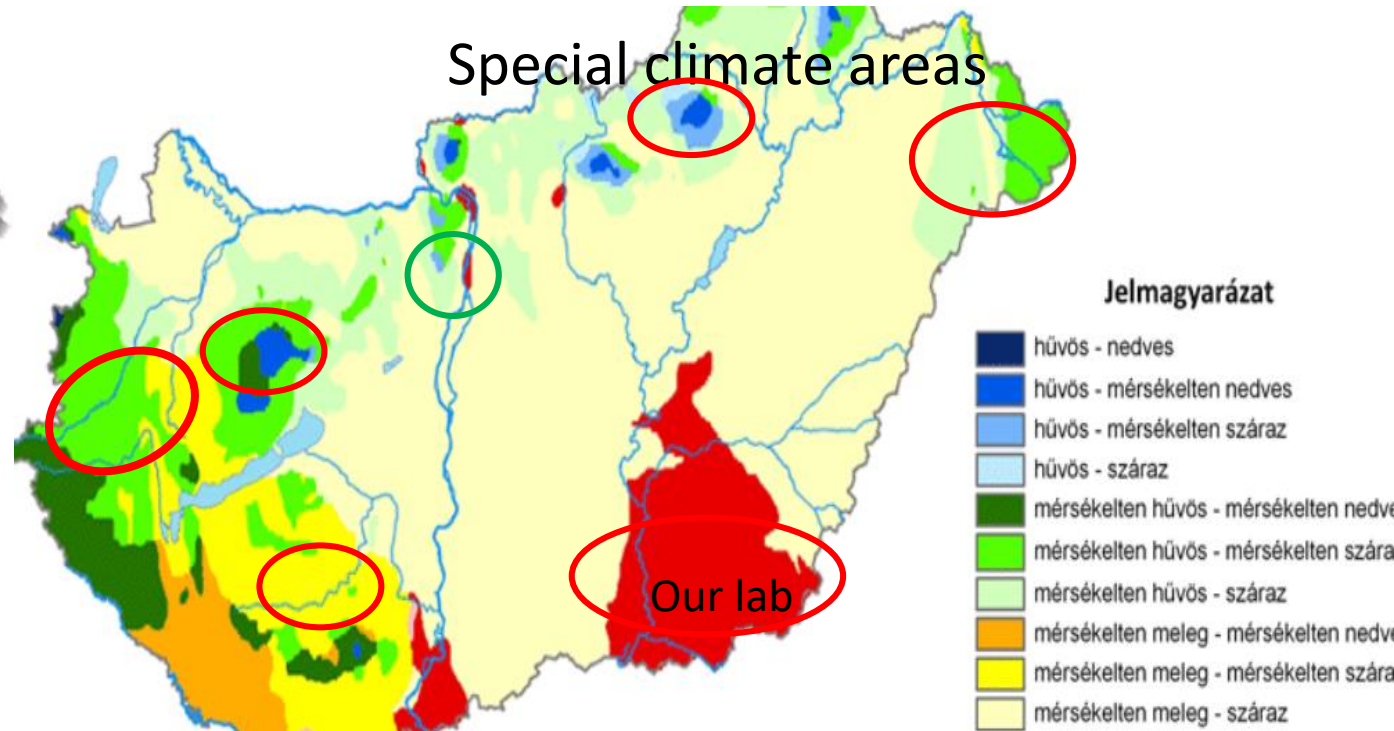
Planned methods

- Some potential areas of interest in Hungary
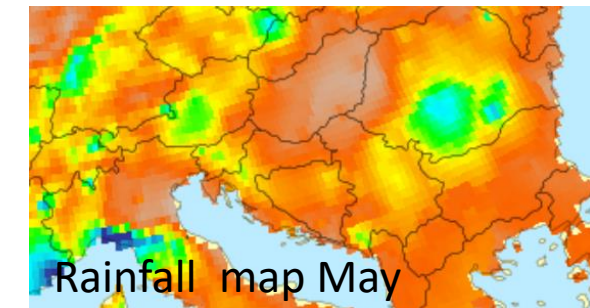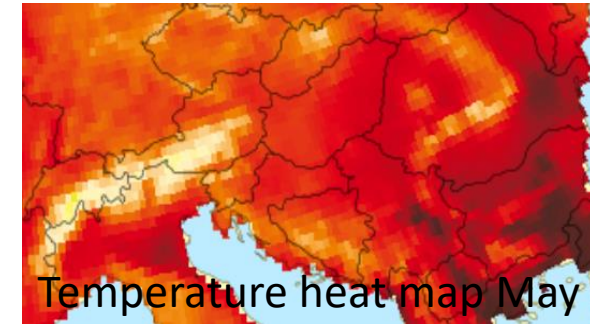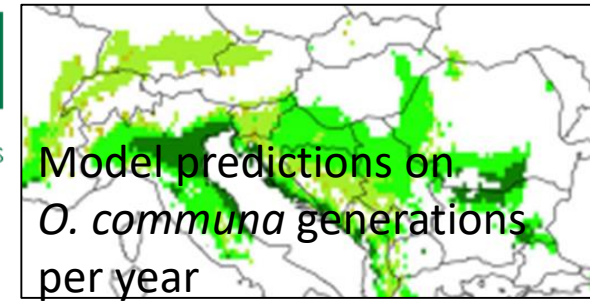

Special annual temperature conditions

Special climate areas

Our lab

Our lab

Jelmagyarázat

- hüvös - nedves
- hüvös - mérsékelten nedves
- hüvös - mérsékelten száraz
- hüvös - száraz
- mérsékelten hüvös - mérsékelten nedve
- mérsékelten hüvös - mérsékelten száraz
- mérsékelten hüvös - száraz
- mérsékelten meleg - mérsékelten nedve
- mérsékelten meleg - mérsékelten szára
- mérsékelten meleg - száraz

Ref: Országos Meteorológiai Szolgálat

Planned methods

- Which are potential areas of interest   ?

Model predictions on *O. communa* generations per year

Temperature heat map May

Rainfall map May

Motorway map

Who is interested to collaborate ?

1. We need help with places and data collection in different regions to place gauze cages with A. *artemisiifolia* and *O. communa*

2. We like to collaborate with pollen experts

3. We like to collaborate with non target risk assessment exerpts (e.g. Which non target plants are not yet been tested, and not yet been planned to be tested by others ?)

contacts:

- Dóra Iványi – dorika100219@gmail.com (+36 30/656-68-40)

- Urs Schaffner – u.schaffner@cabi.org

- Stefan Toepfer – stefan.toepfer@uni-mate.hu; s.toepfer@cabi.org

- Zita Dorner – zita.dorner@uni-mate.hu

Acknowledgements

- Thanks in advance to everybody who likes to collaborate

- Hungarian state scholarship for the plant science PhD school of MATE

- ADOPT-IPM: EU-China joint action to increase development and adoption of IPM tools (HORIZON-CL6-2021-FARM2FORK-01-19 – EU-China international cooperation on integrated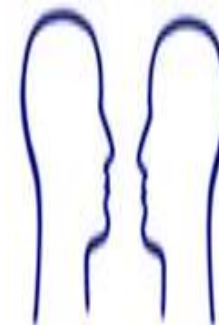 pest management in agriculture).