

© Pierrick Bloin



Improving invasion scenarios of *Agrilus* species in Europe through advanced SDMs

Enrico Ruzzier^{1,3} & Luciano Bani^{2,3}

¹ Department of Science, Università Roma Tre, Rome, Italy. Email: enrico.ruzzier@uniroma3.it

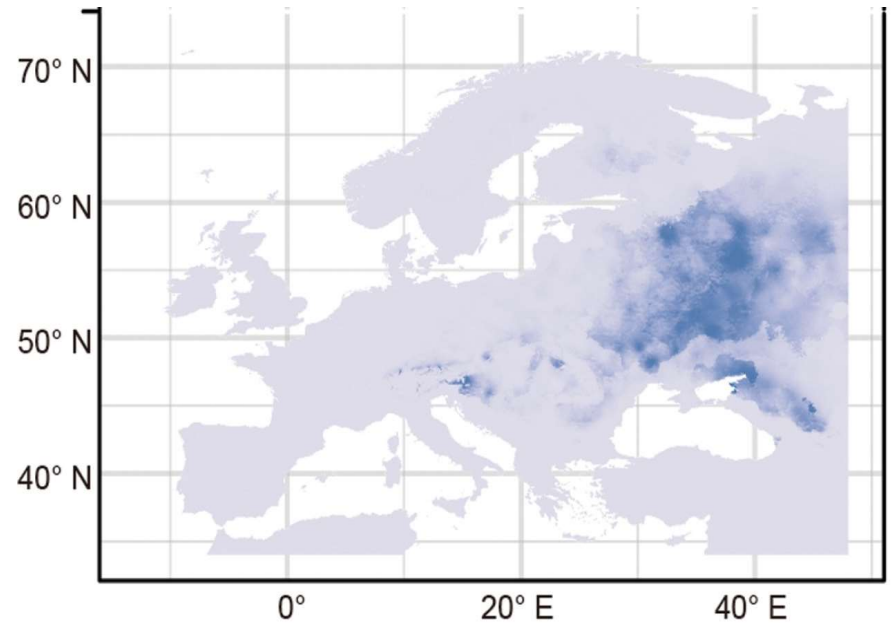
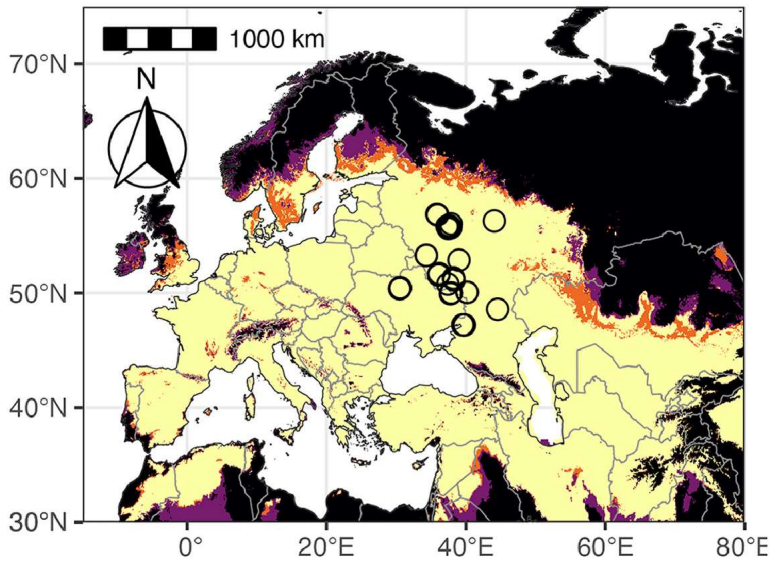
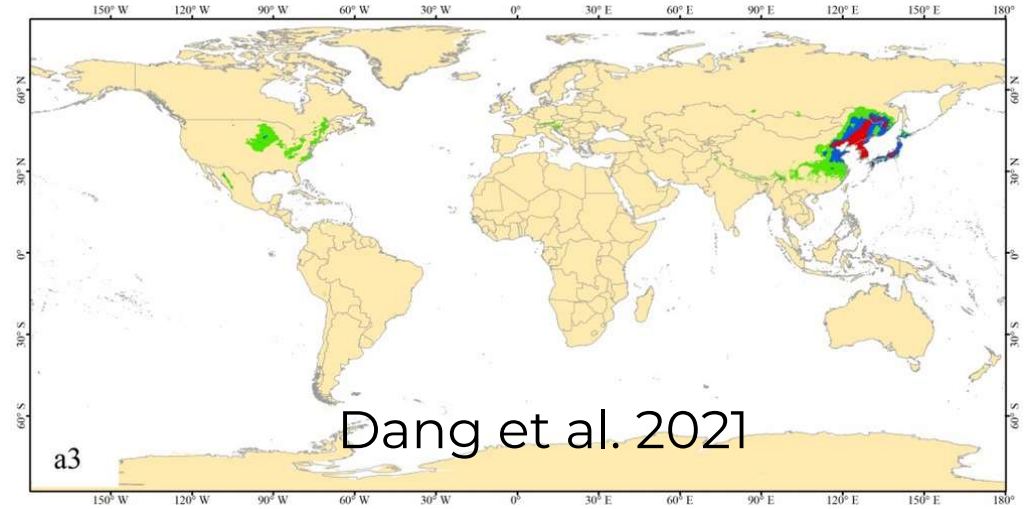
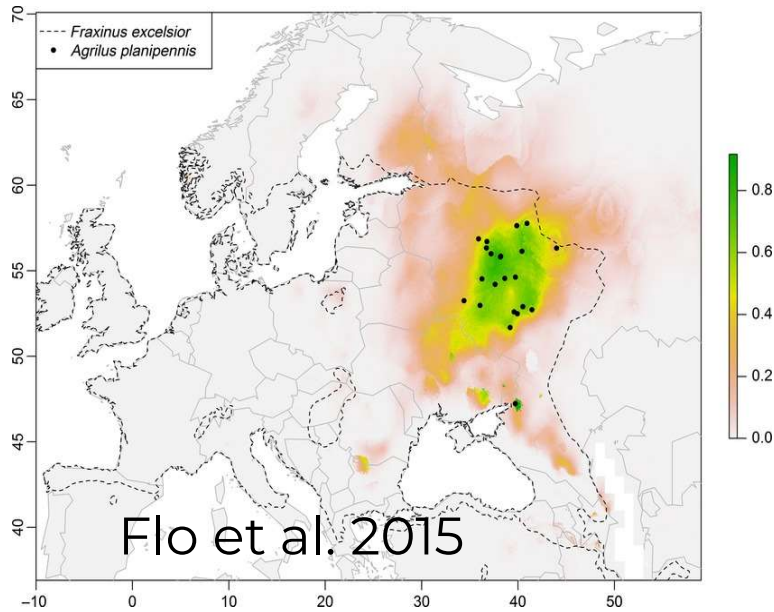
² Department of Earth and Environmental Sciences, University of Milano-Bicocca, Milan, Italy.

³ National Biodiversity Future Center (NBFC), Palermo, Italy.

EPPO-REUFIS-BFW Conference

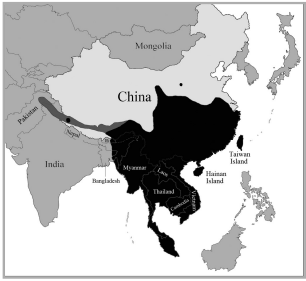
'Safeguarding Forests in Europe: Emerging Risks of Agrilus Wood Borers (Buprestidae)
21–23 April, Vienna

Can SDM help?



«They agree to disagree... at least to some extent»

MODELING CAVEAT



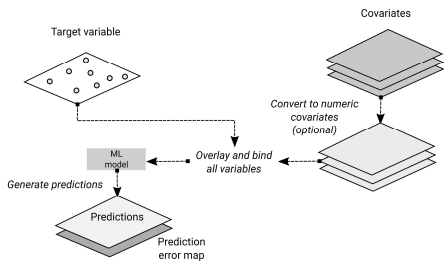
Occurrences selection

- I. Native.
- II. Global (native + invaded).
- III. Accuracy and sampling bias



Zero-like points selection method

- I. Background points selected on a global scale.
- II. Pseudoabsences allocated outside species native range and not considering biogeographic barriers.



Covariates used

- I. Only bioclimatic variables.
- II. Bioclimatic and habitat variables in a single modelling framework

Algorithm used

- I. Single vs multiple (ensemble)
- II. Type of algorithm

Host plants

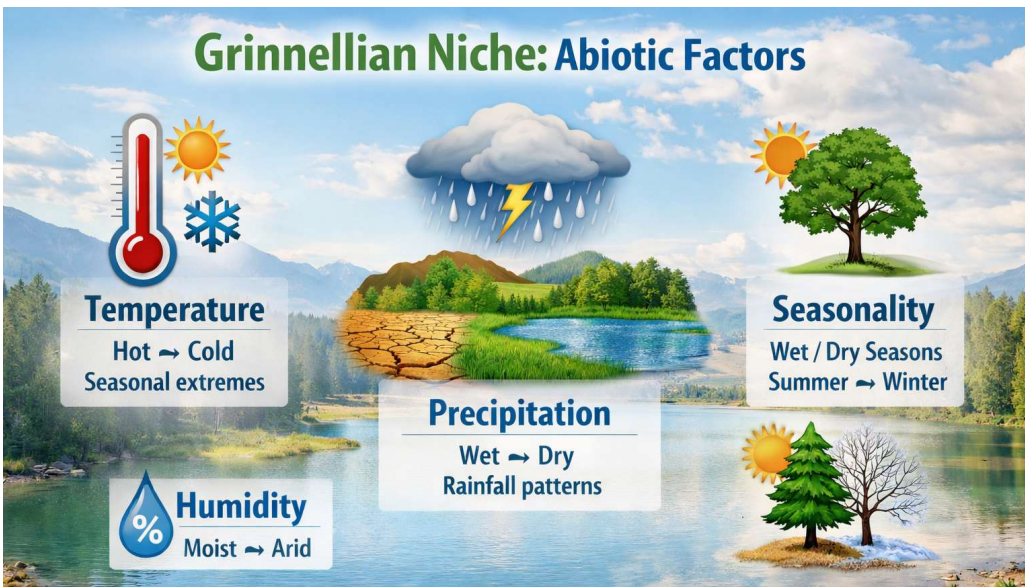
- I. Use vs Not use
- II. Host plants selection
- III. Integration of host plants in the modelling framework

$$g(E[y]) = \beta_0 + \sum_j f_j(x_j)$$



TWO-STEPS MODELLING

Grinnellian Niche: Abiotic Factors



species' niche defined by ABIOTIC environmental factors

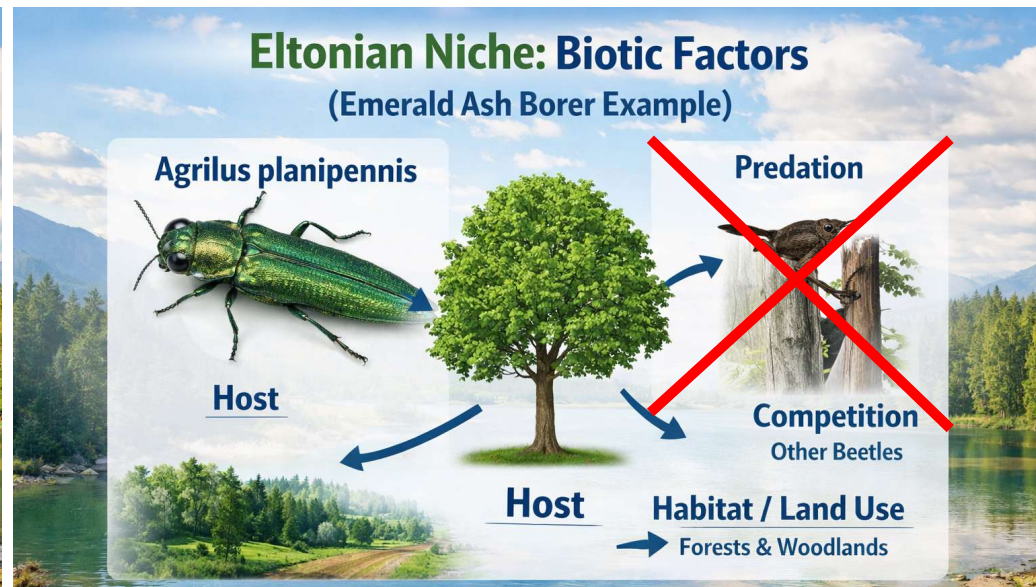
Bioclimatic variables
(scenopoetic)



**Bioclimatic
Suitability Model (BSM)**

Eltonian Niche: Biotic Factors

(Emerald Ash Borer Example)



species' niche defined by BIOTIC interactions and ecological roles

Habitat variables
(local)



**Habitat
Suitability Model (HSM)**

Characterization NATIVE niche

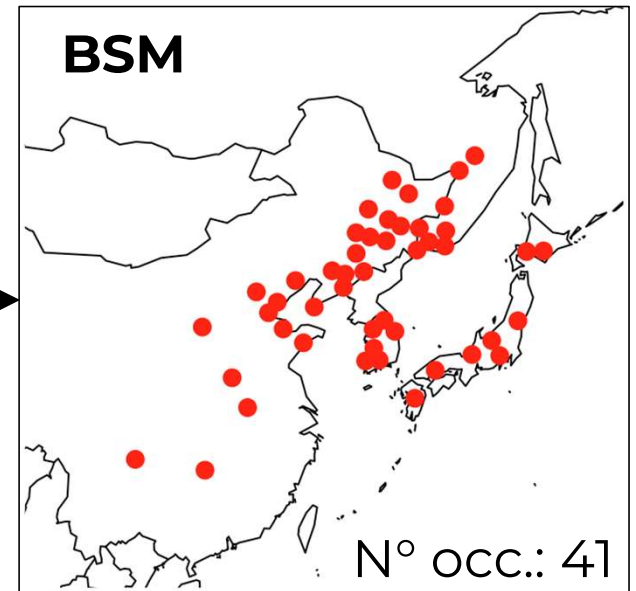
Native occurrences ONLY



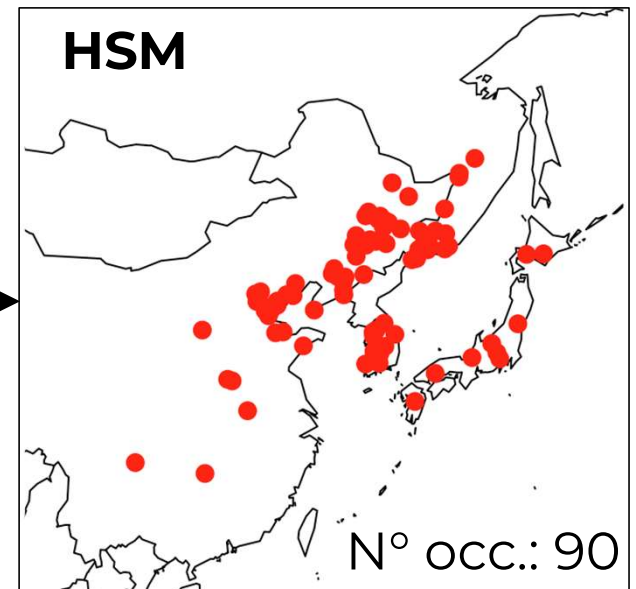
Total N° of occ.: 135 (not that many!!)
Oversampling (spatial aggregated)
Sampling bias towards built-up areas

**SPATIAL
THINNING**

100 km

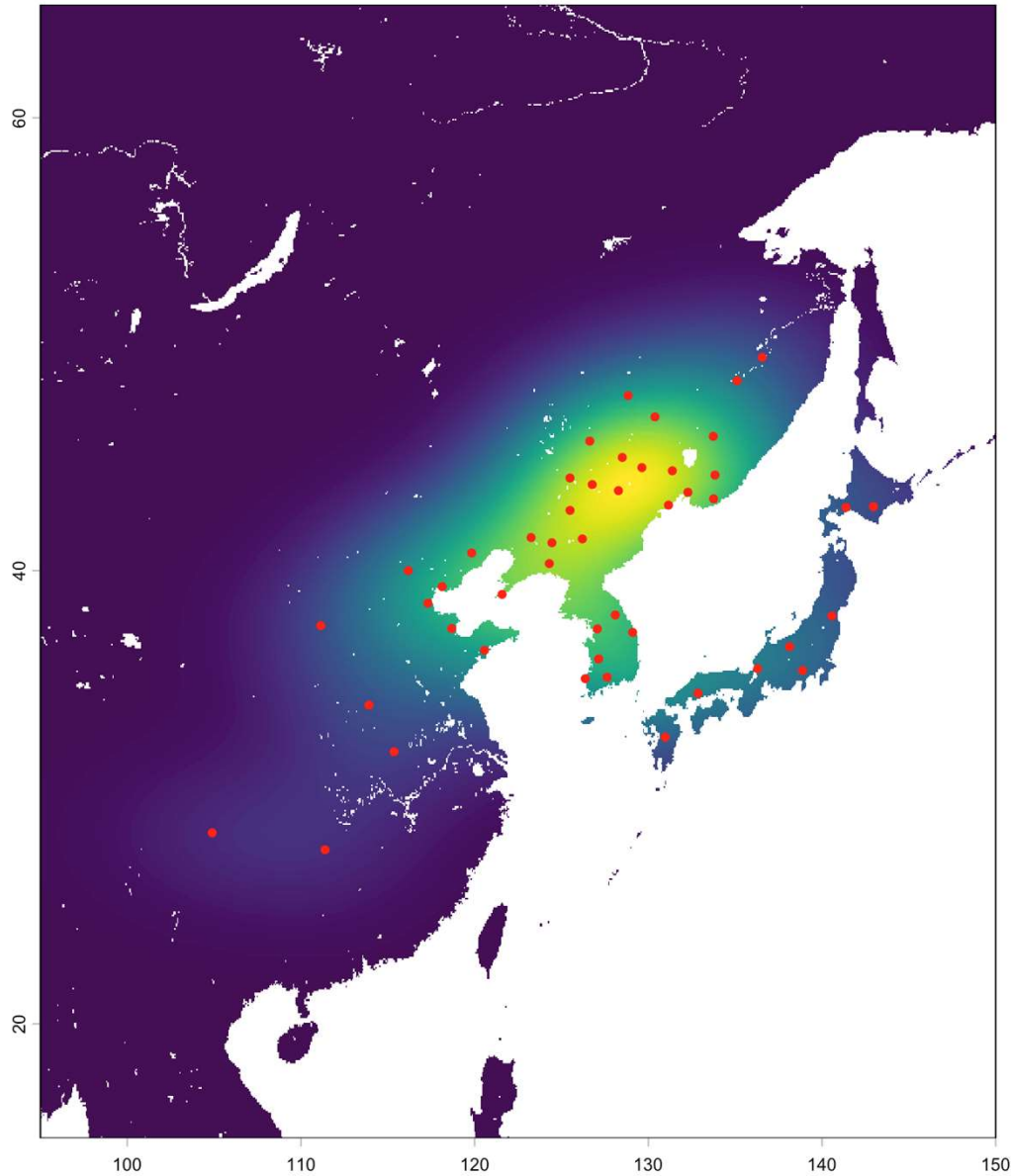


20 km

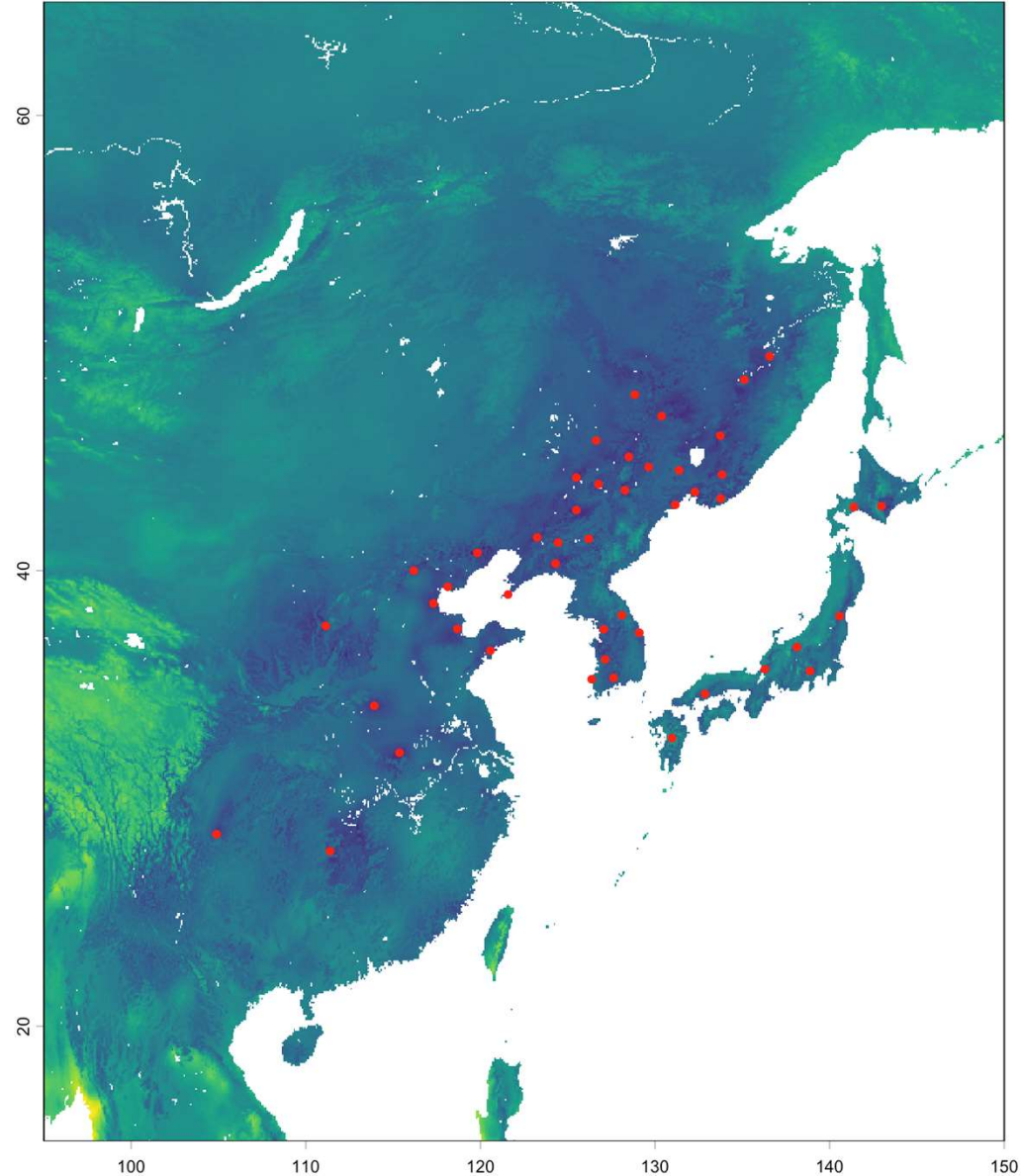


BSM- Occurrences selection and Pseudo-Absences (Pas) allocation

Occurrences Kernel density



Climatic distance



BSM- PAs allocation and modelling

9 sets of data
(occurrences + PAs)

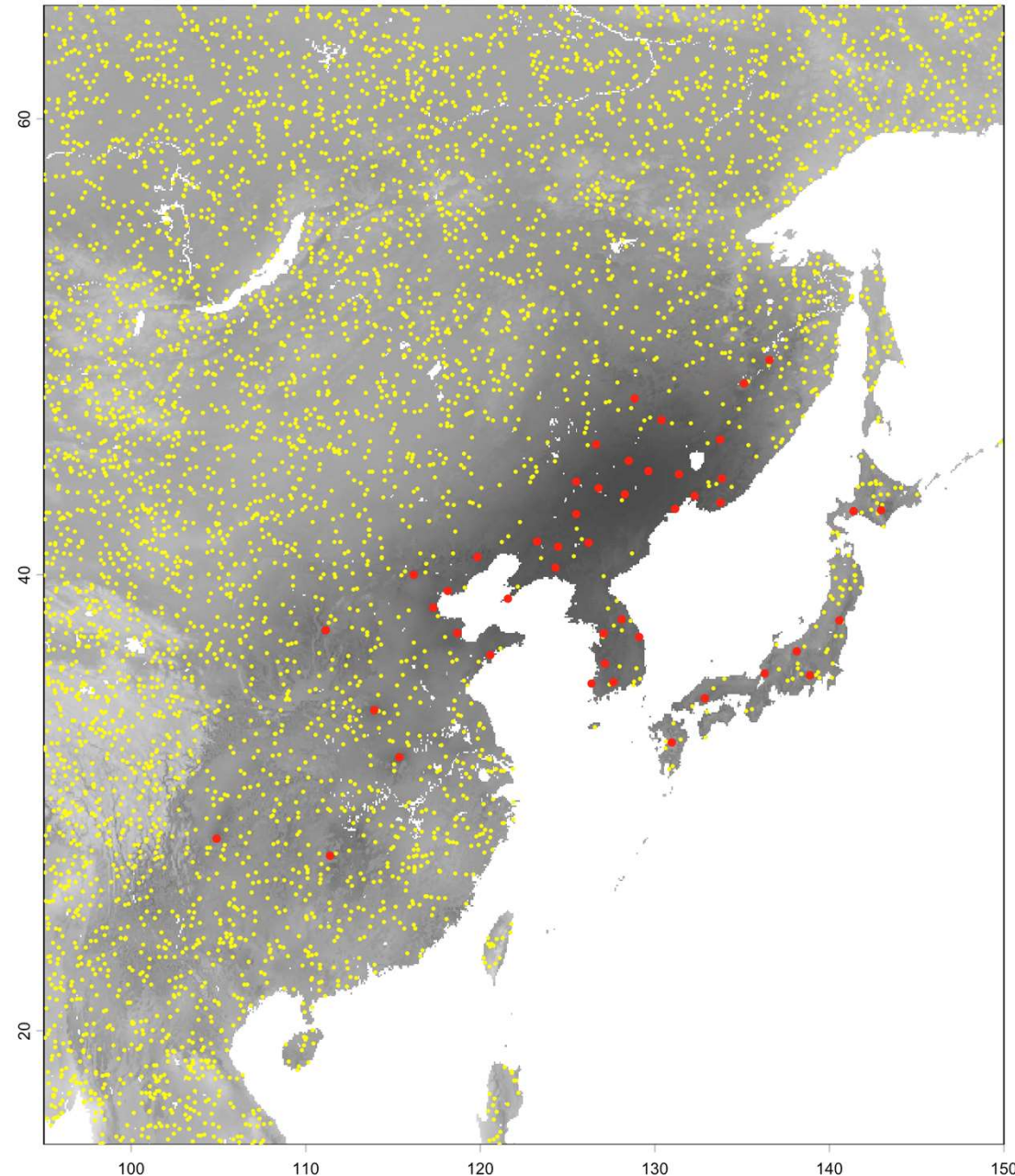
Each set uses 5 PAs for each
occurrence

4 selected bioclimatic variables
(checked for collinearity)

Ensemble approach:
10 different algorithms

Two evaluation metrics:

- Receiver Operating Characteristic curve (ROC)
- True Skill Statistic (TSS)

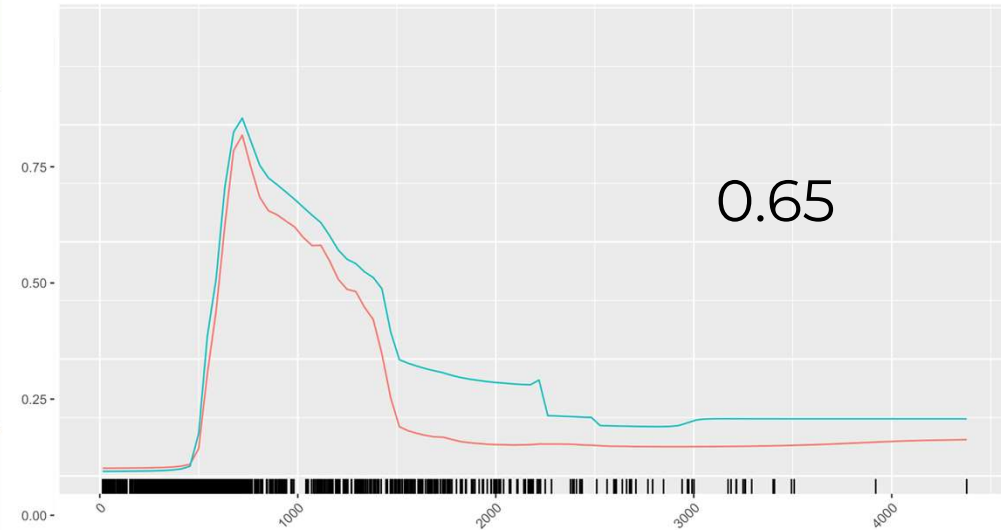
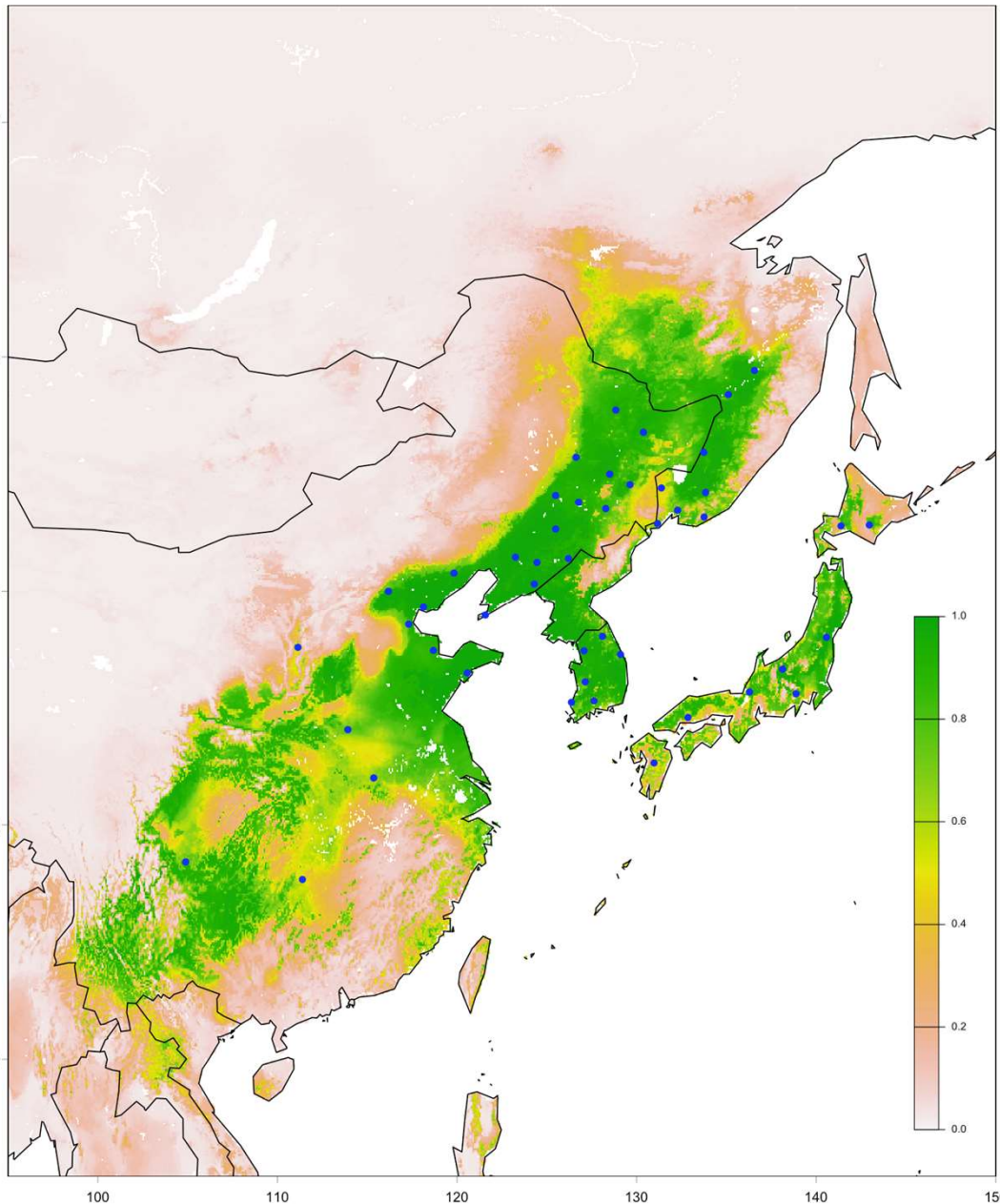


BSM - output

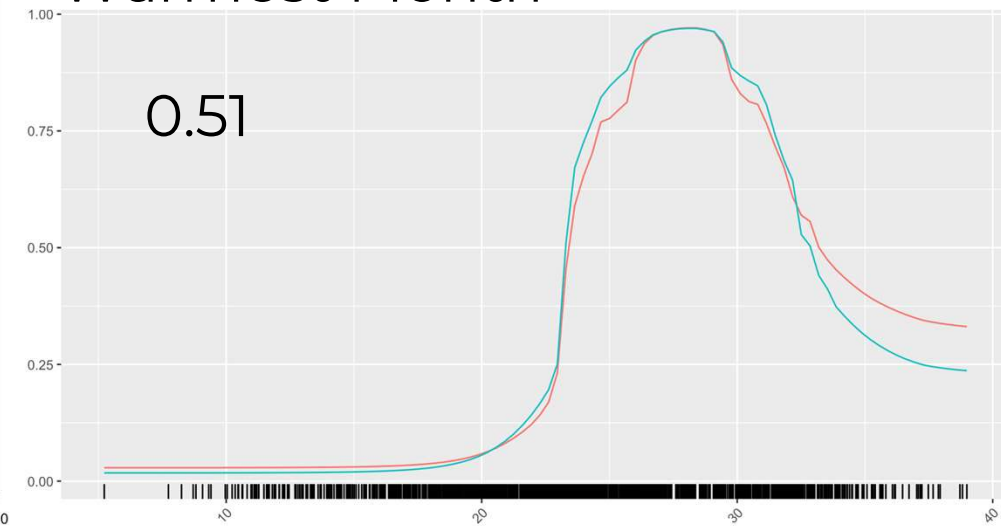
Bioclimatic suitability

Variables importance

Bio12: Annual Precipitation



Bio05: Max Temperature of Warmest Month

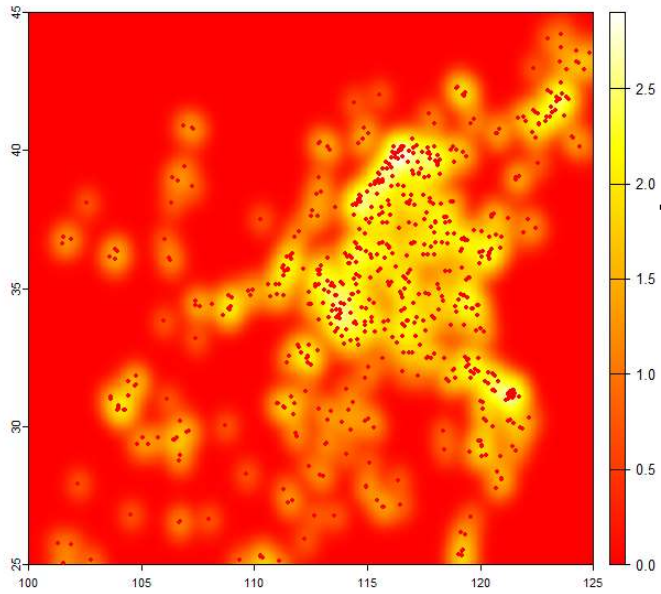


HSM - inclusion of host plants as explanatory variable

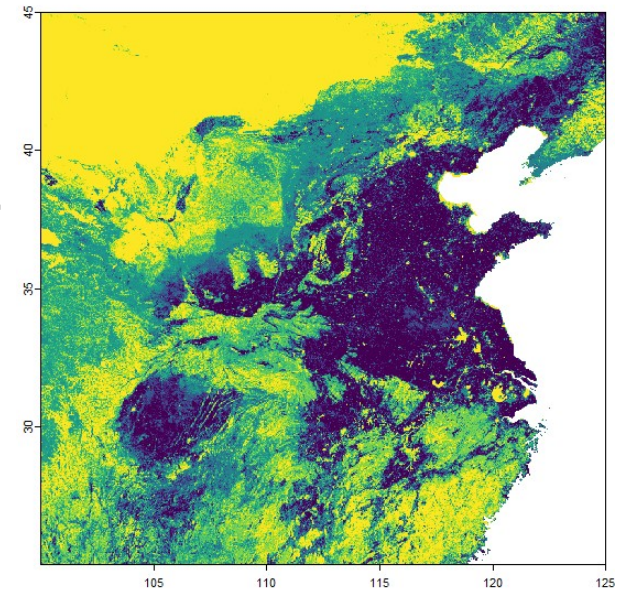
Host plant occurrences
(*Fraxinus* spp. + *Chionanthus* spp.)



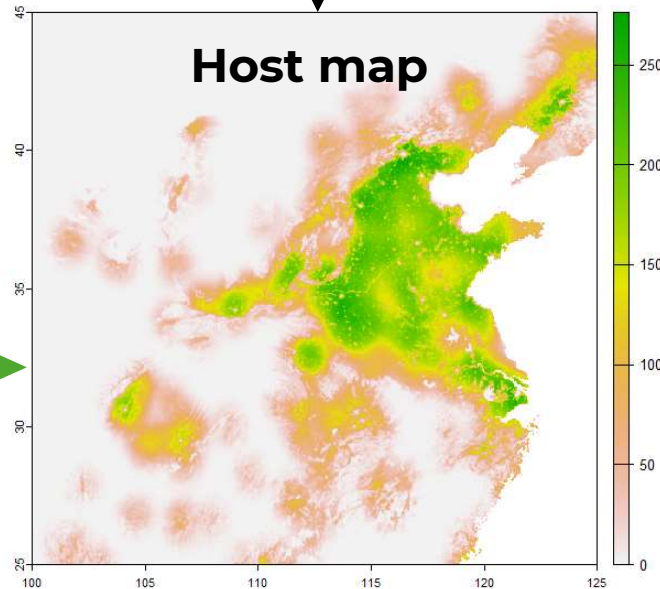
Host plants kernel density



Land use associated to host plants



Host map



Approximation of the actual global distribution of host plants and potential vicariant species

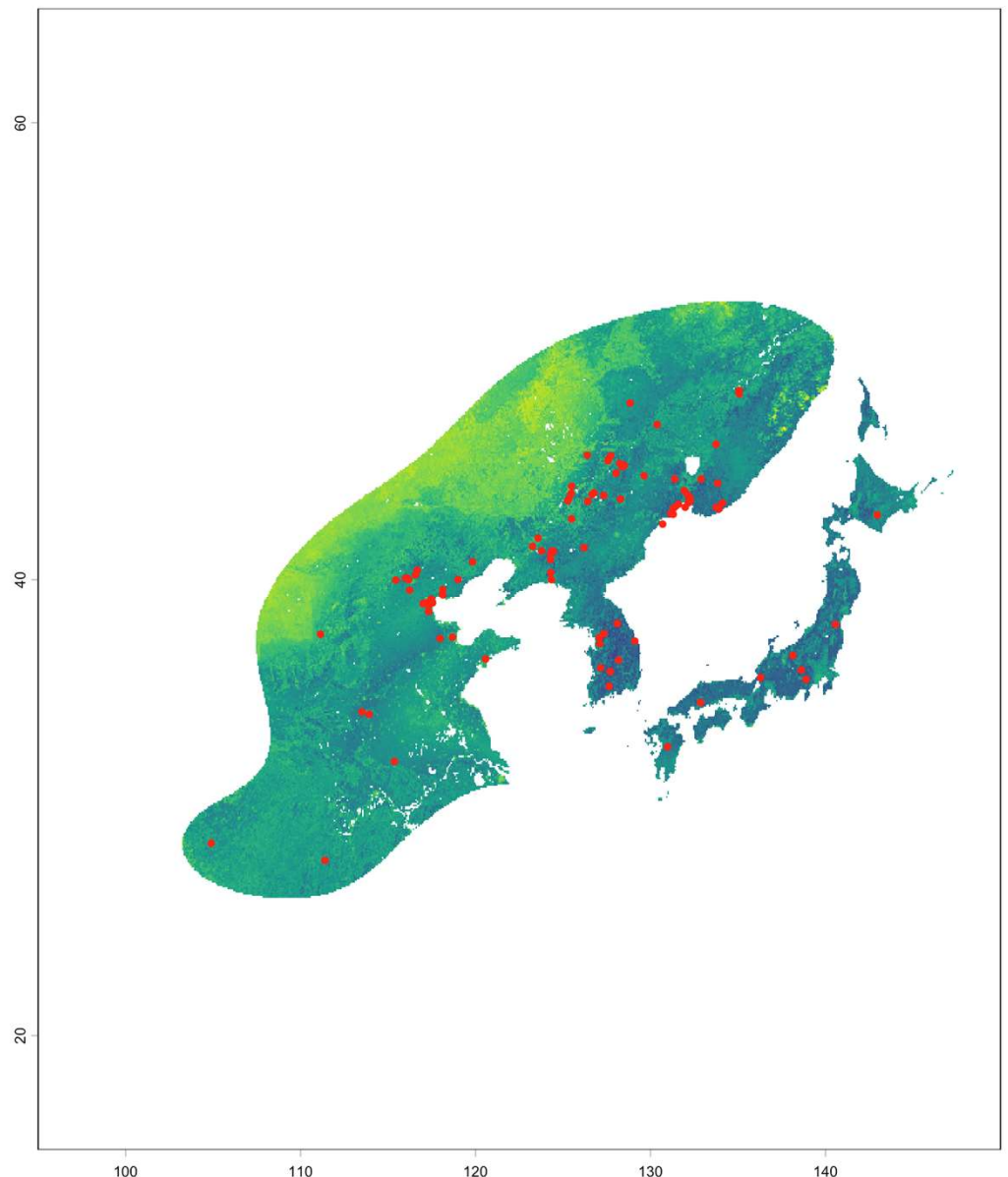


HSM - Occurrences selection and Pseudo-Absences (PAs) allocation

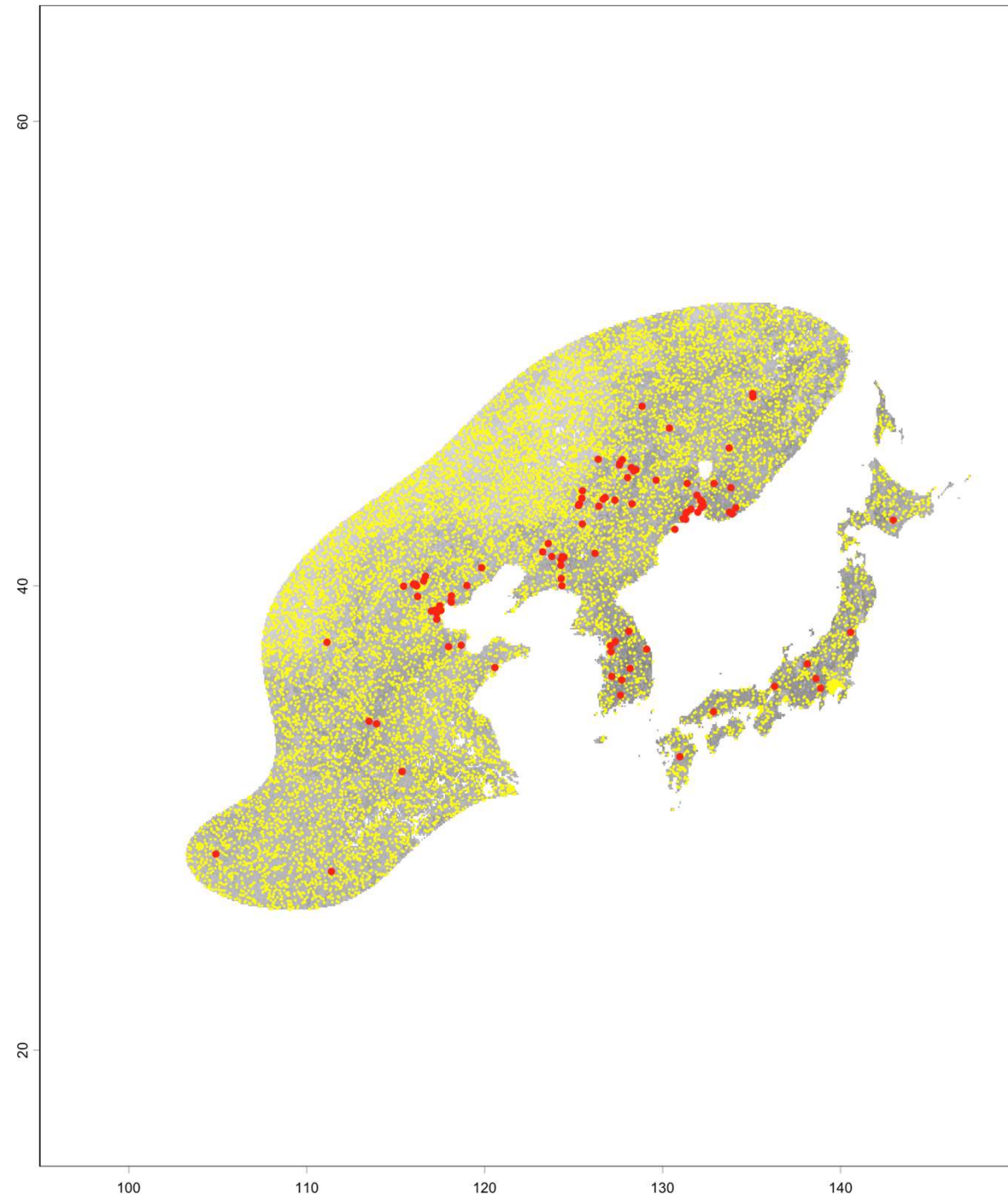
Occurrences Kernel density
(core only)



Habitat distance



HSM - PAs allocation and modelling



PAs allocated in:

1. 5% of all available vacant cells, wighted for habitat distance
→ representativeness
2. 20% of all availave BU>0 vacant cells, weighted for BU cover
→ bias

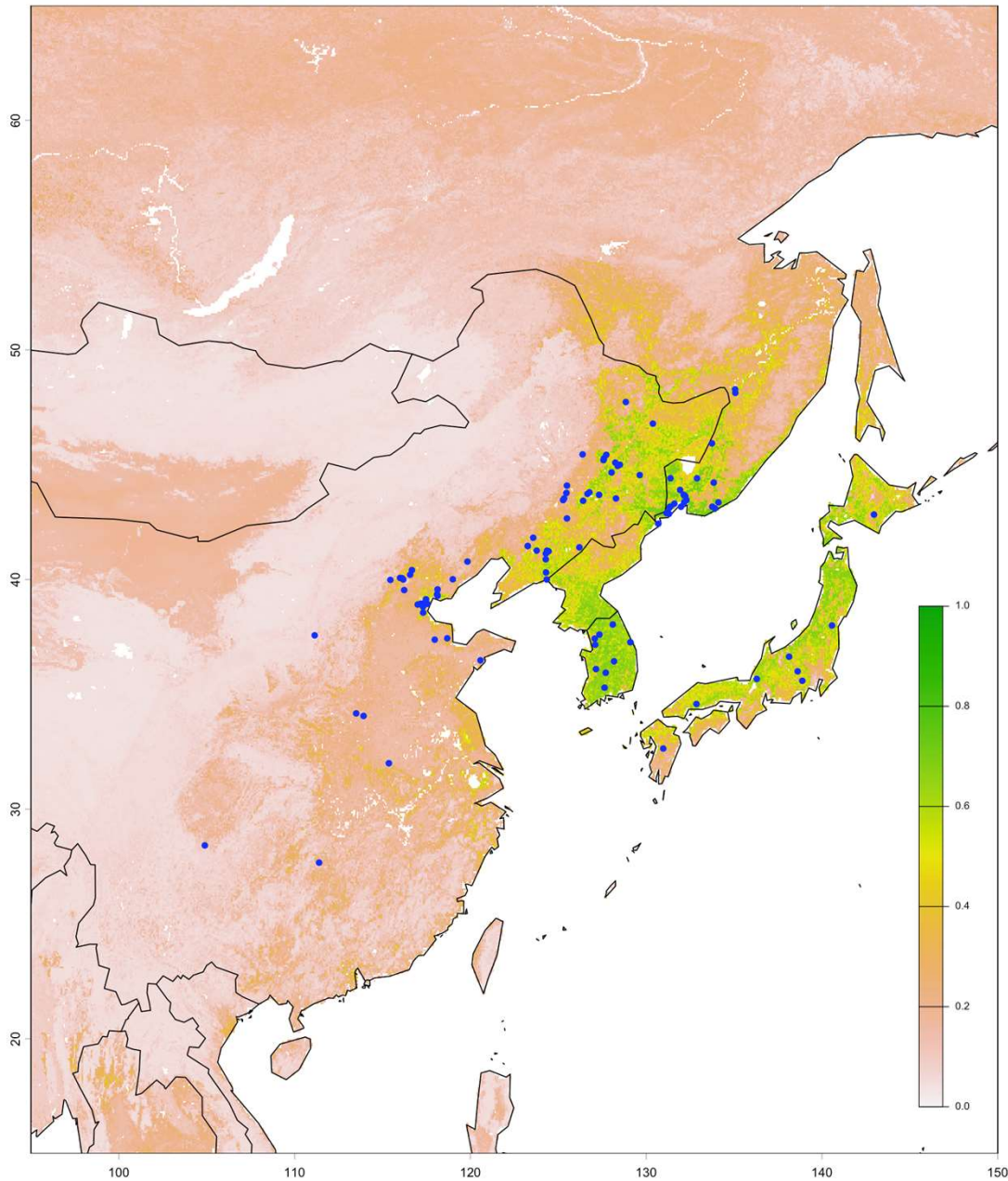
77 sets of data
(occurrences + PAs)

Each set uses 5 PAs for each occurrence

11 selected habitat variables
(checked for collinearity)

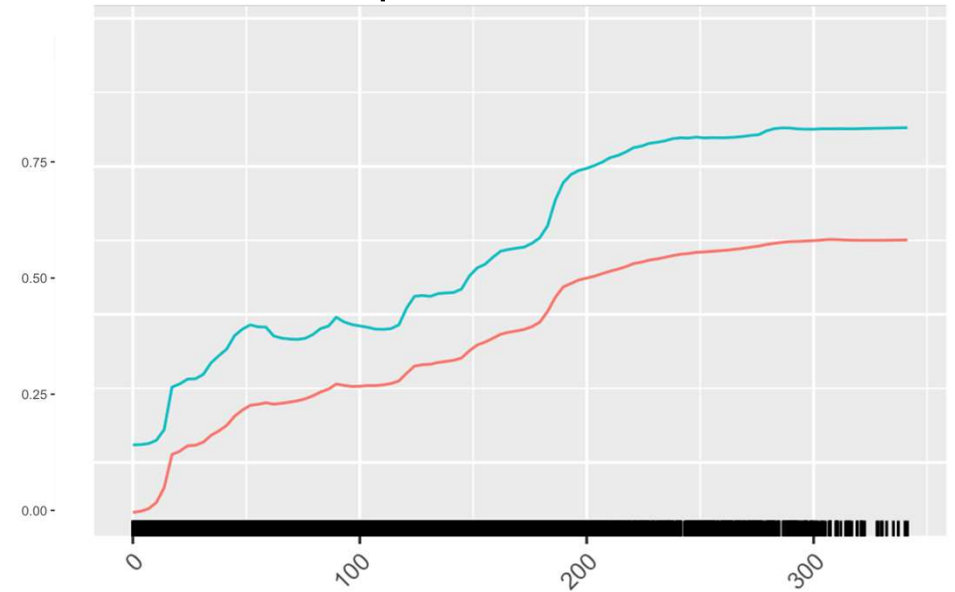
HSM - output

Habitat suitability

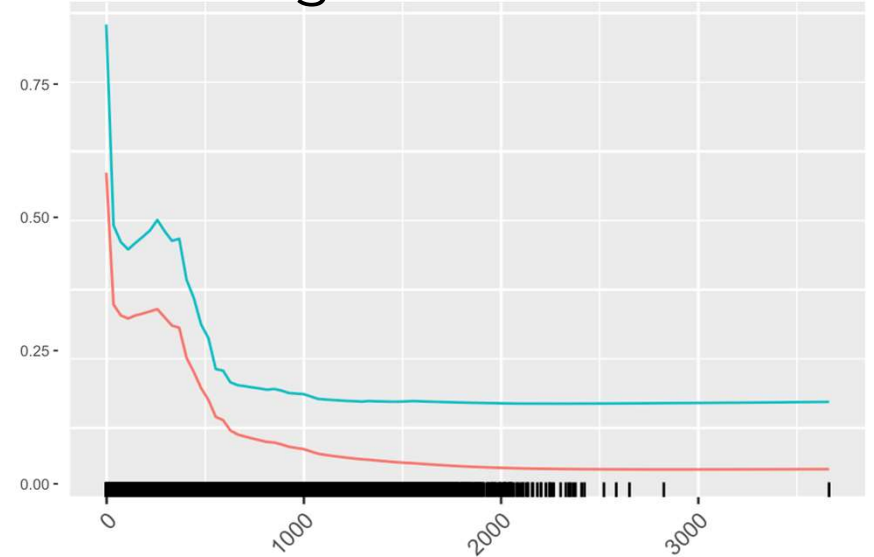


Variables importance

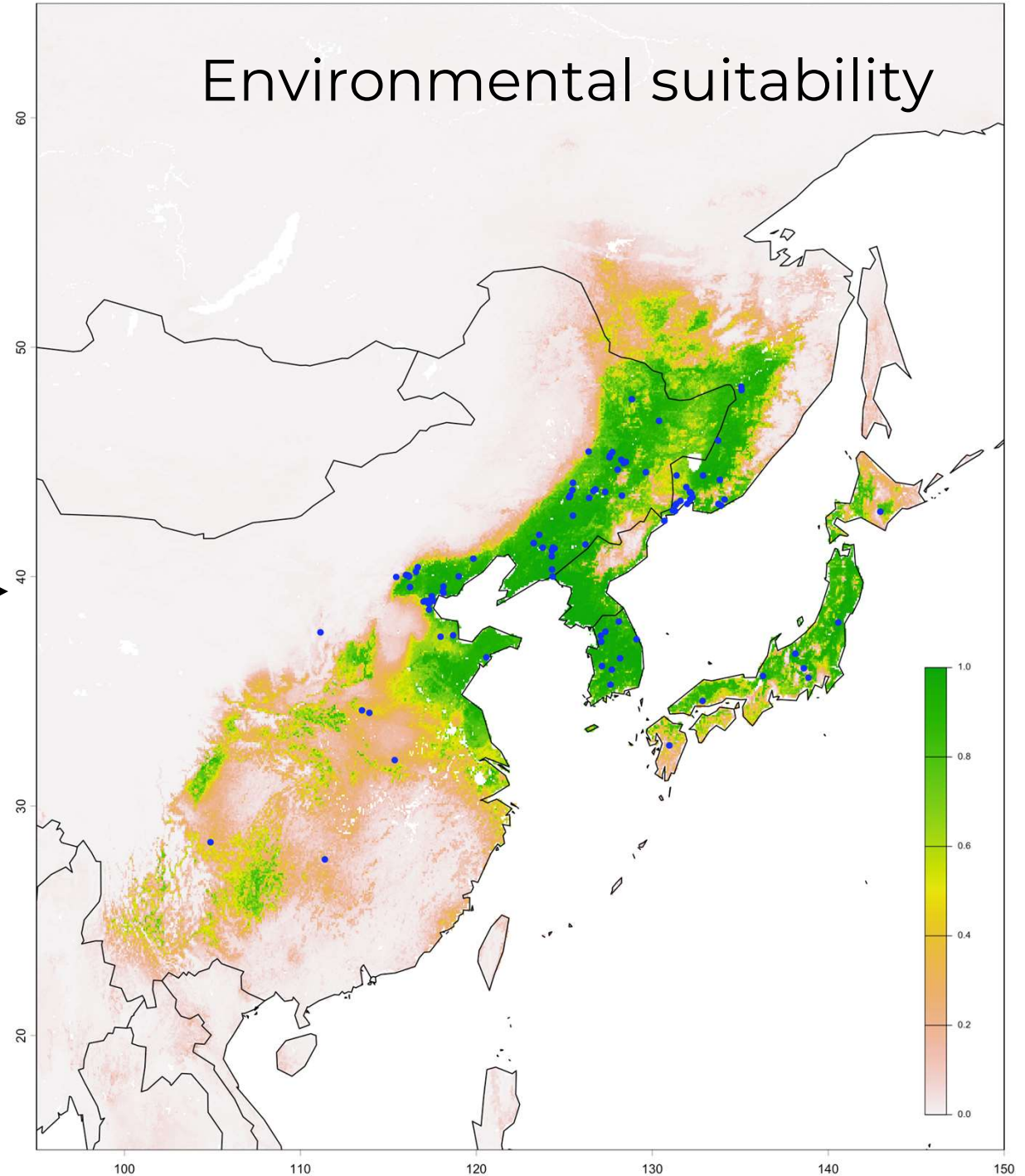
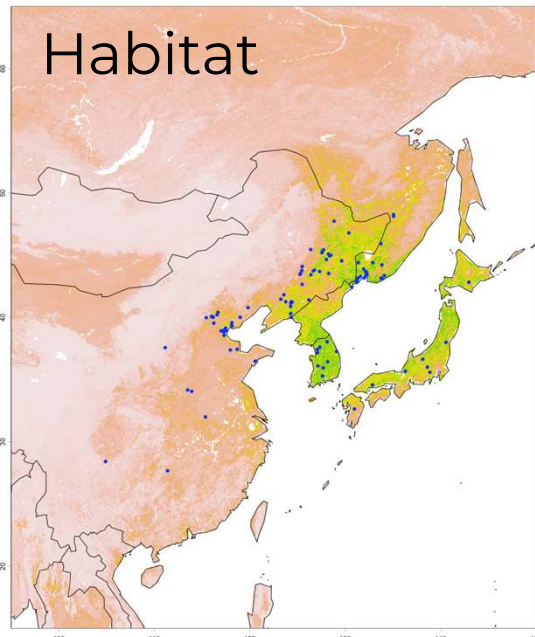
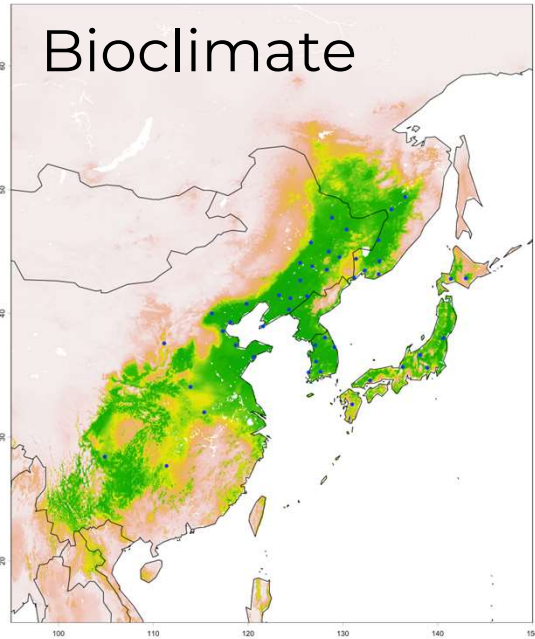
HP: Host plants



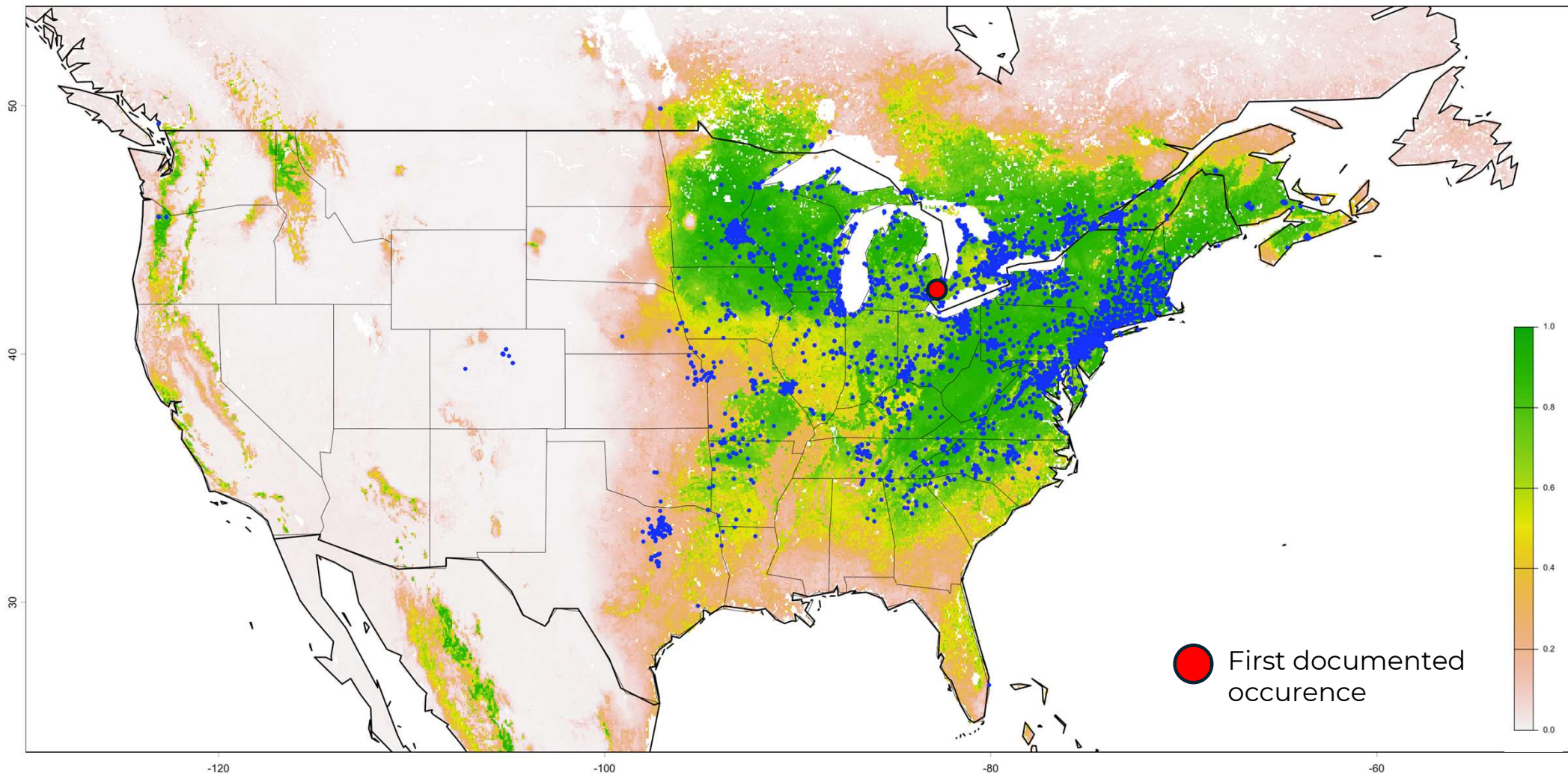
dem: digital elevation model



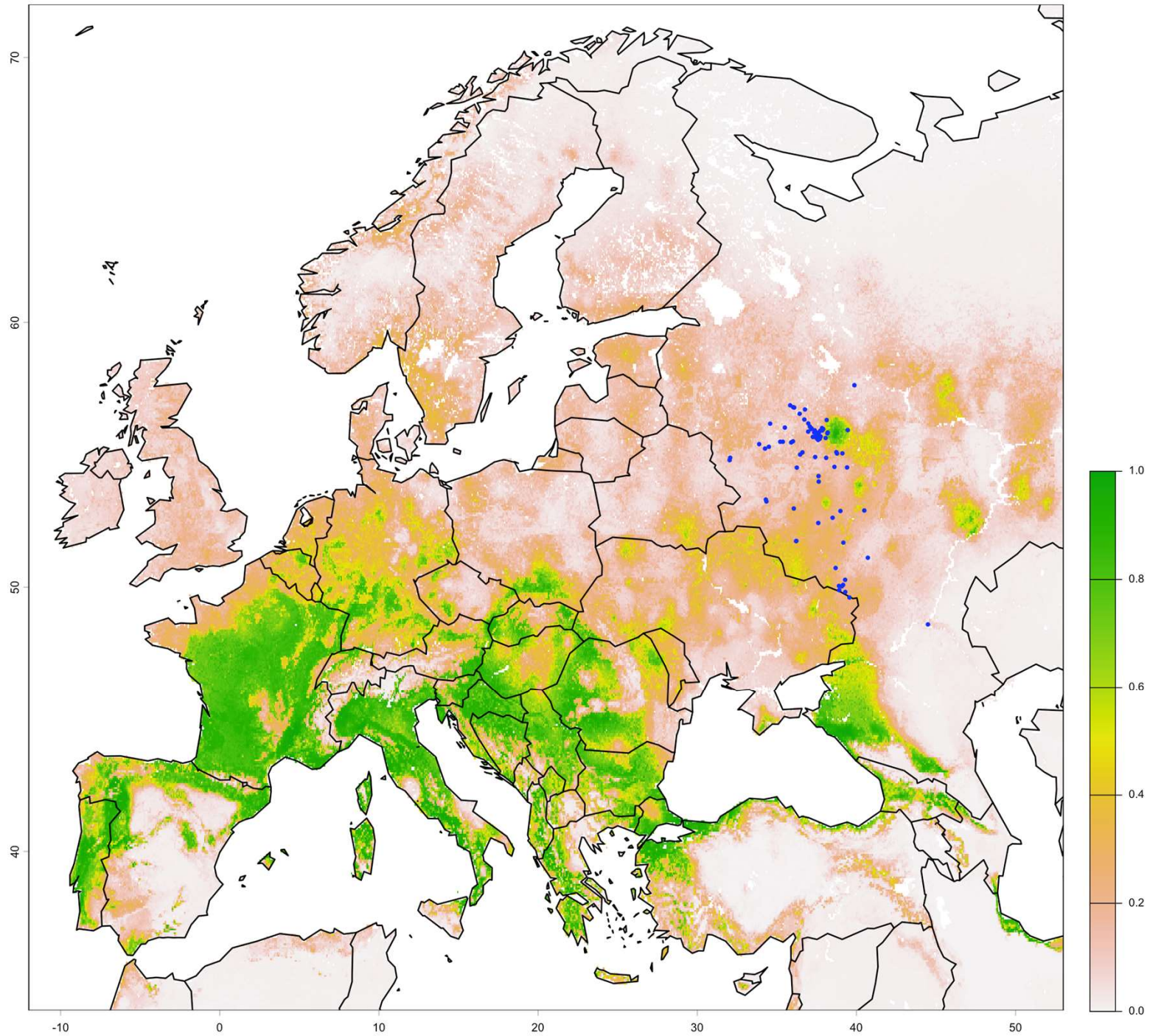
Environmental suitability map - NATIVE



Enviromental suitability map - USA

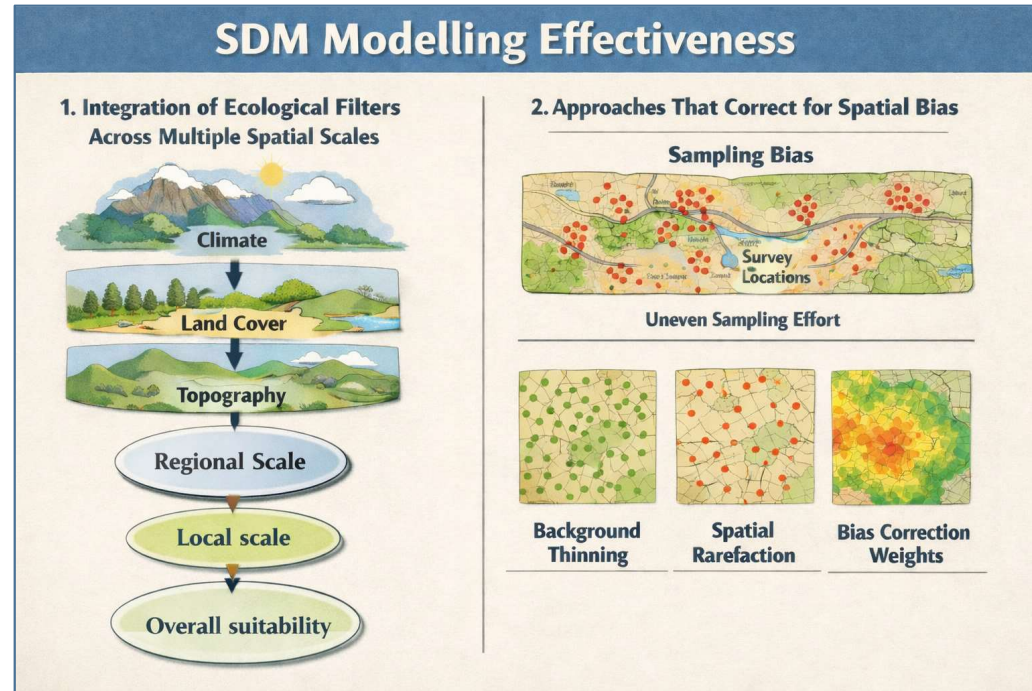


Enviromental suitability map - EUROPE

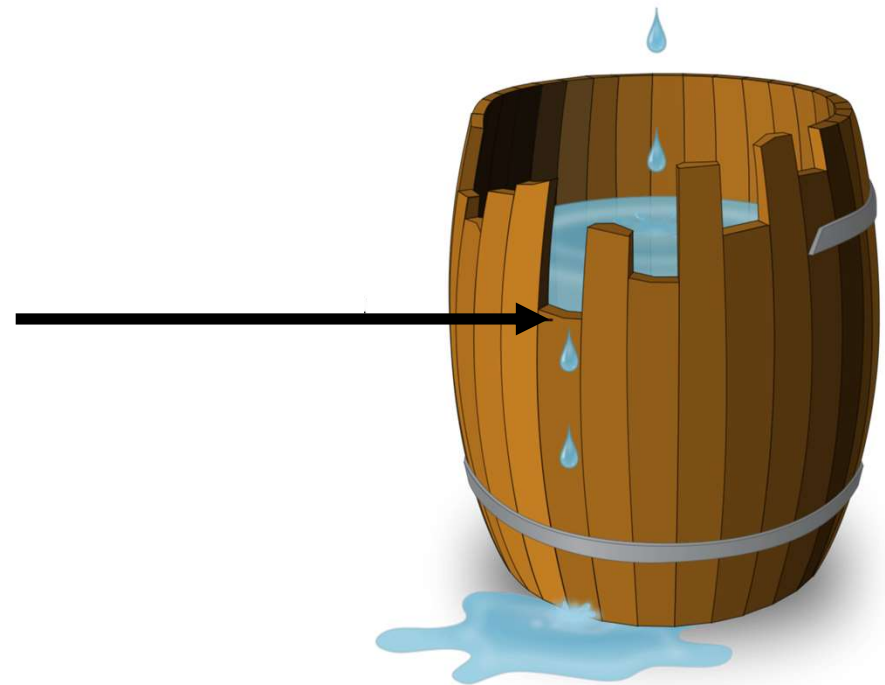


Effective SDM strategy

1. «Two steps» modelling is **ESSENTIAL** for niche reconstruction
2. Bias correction is **CRITICAL**



Limiting factor:
Native occurrences
(quality and quantity)



Call to Action

- Collect new occurrence data on Buprestidae
- Employ more powerful analytical tools



Thank you for the attention

