INTRODUCTION TO SPECIES DISTRIBUTION MODELING

Elena Razenkova

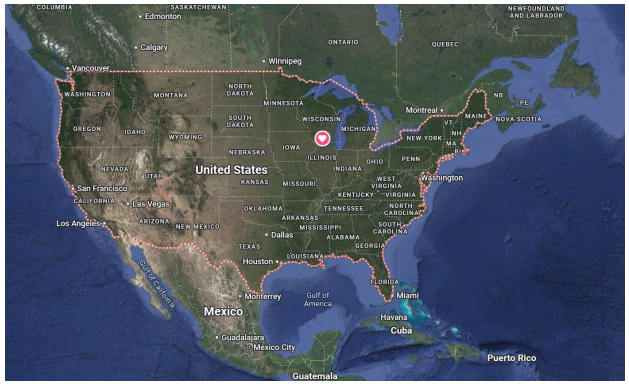
Karaganda, Kazakhstan August 2025

PLAN FOR TODAY

- About me and you
- What is SDM?
- Correlative SDM
- Aims of SDM
- Geographic vs environmental space
- Main assumptions of SDM
- Scale (extend and resolution)
- Potential bias in occurrence data
- Predictors

ABOUT ME

Tomsk State University

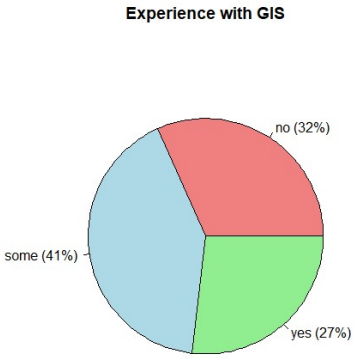


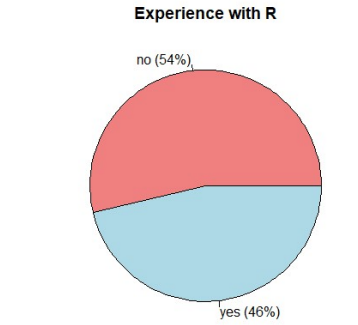
University of Wisconsin - Madison

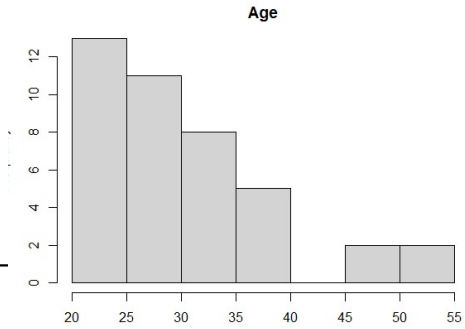
ABOUT YOU

Spatial distribution of participants

- On August 1, 2025
- 42 participates were registered.
- One person was excluded from data.
- Participants are from 5 countries
- 19 cities

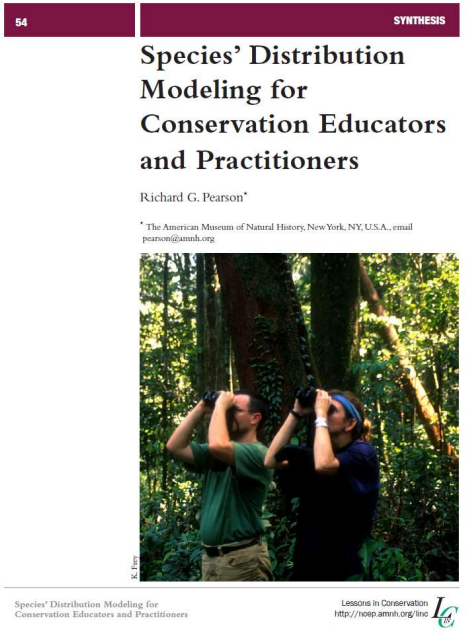






DIFFERENT TERMS FOR SDM

- **Species distribution**
- **Ecological niche**
- **Environmental niche**
- **Habitat Suitability**
- **Bioclimate envelope**



54 SYNTHESIS

Species' Distribution Modeling for Conservation Educators and Practitioners

Richard G. Pearson*

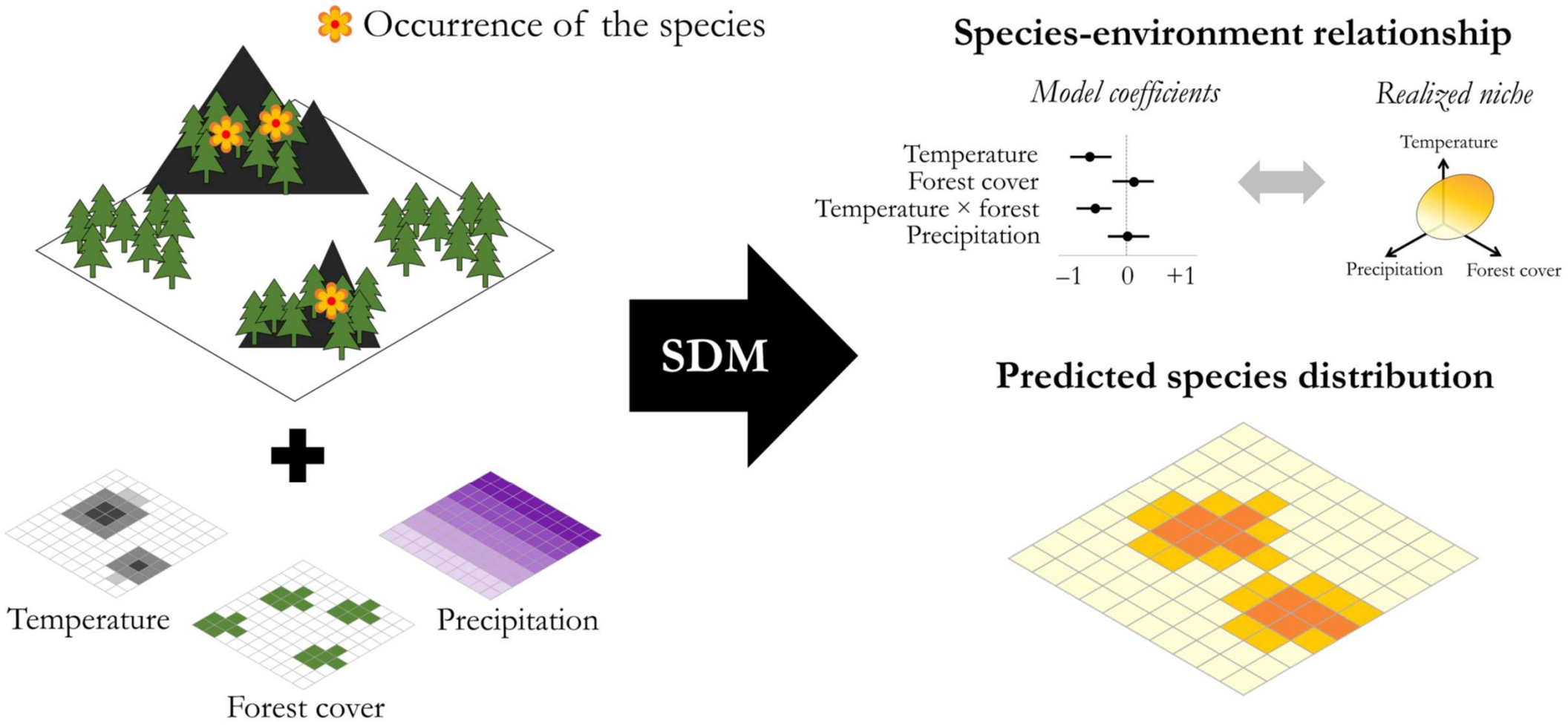
* The American Museum of Natural History, New York, NY, U.S.A., email pearson@amnh.org

E. Fees

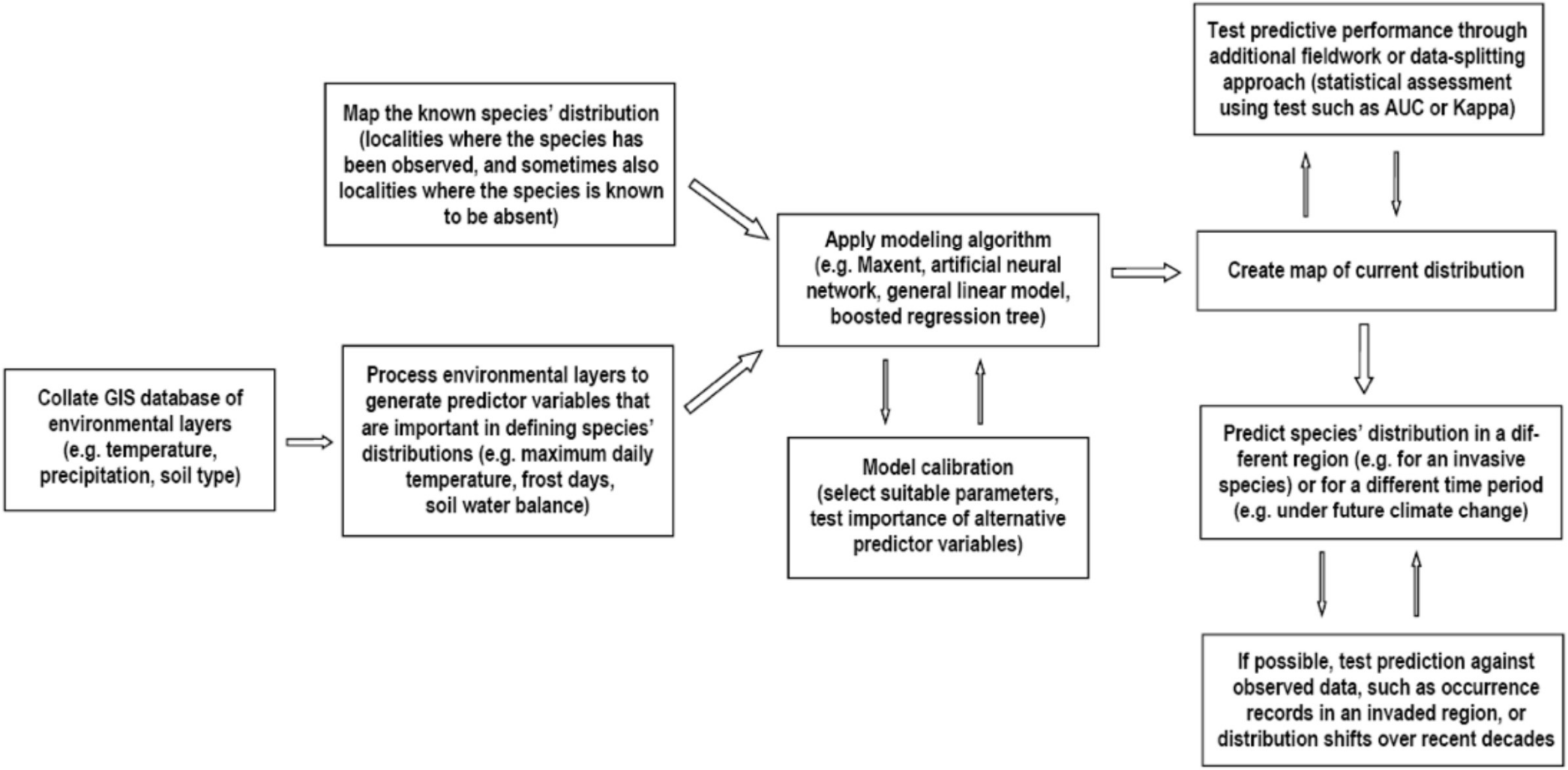
Species' Distribution Modeling for Conservation Educators and Practitioners

Lessons in Conservation http://nsep.amnh.org/line

WHAT IS SDM?


Occurrence of the species
Temperature
Precipitation
Forest cover
SDM
Species-environment relationship
Model coefficients
Realized niche
Temperature
Forest cover
Temperature × forest
Precipitation
−1
0
+1
Temperature
Precipitation
Forest cover
Predicted species distribution

CORRELATIVE SDM



WHAT IS THE AIM OF THE MODELING?

Type of use	Example references
• Guiding field surveys to find populations of known species	Bourg et al., 2005; Guisan et al., 2006
• Projecting potential impacts of climate change	Iverson and Prasad, 1998; Berry et al., 2002; Hannah et al., 2005; Pearson and Dawson, 2003
• Predicting species' invasion	Higgins et al., 1999; Thuiller et al., 2005; Peterson, 2003
• Supporting conservation prioritization and reserve selection	Araújo and Williams, 2000; Ferrier et al., 2002; Leathwick et al., 2005
• Assessing the impacts of land cover change on species' distributions	Pearson et al., 2004
• Guiding reintroduction of endangered species	Pearce and Lindenmayer, 1998
• Assessing disease risk	Peterson et al., 2006, 2007

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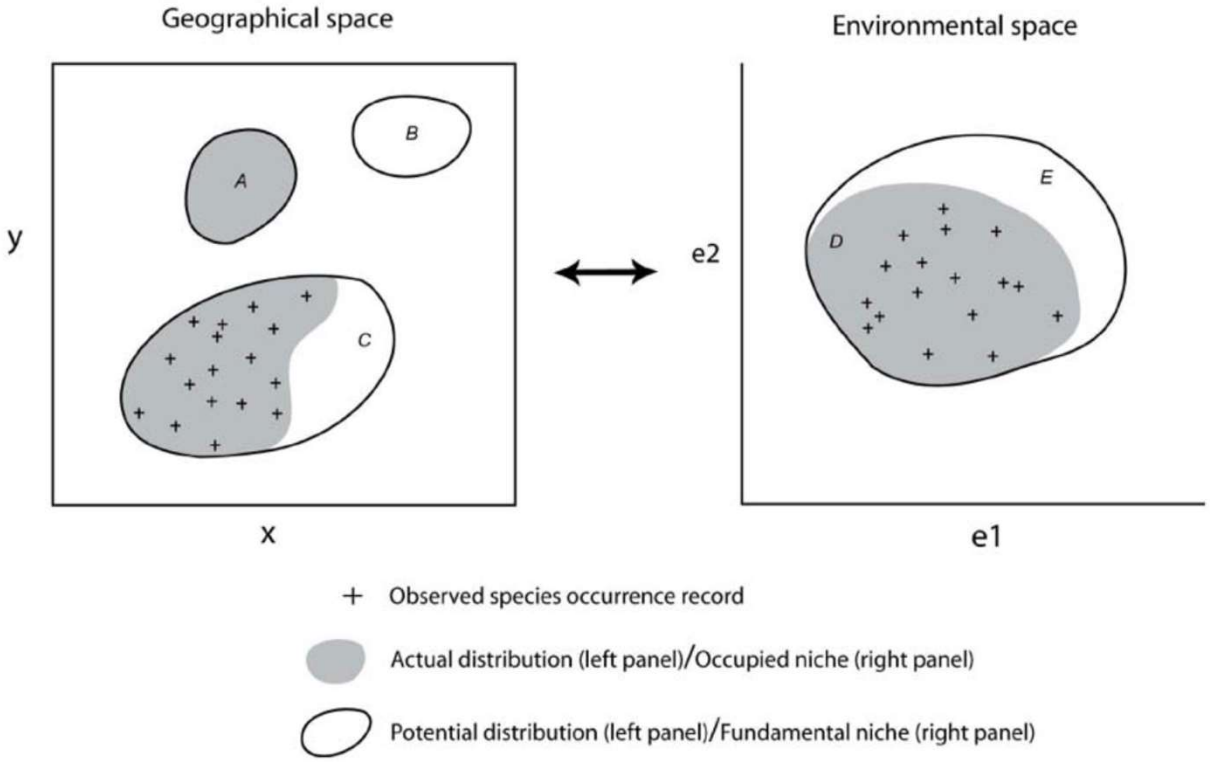
GEOGRAPHIC VERSUS ENVIRONMENTAL SPACE

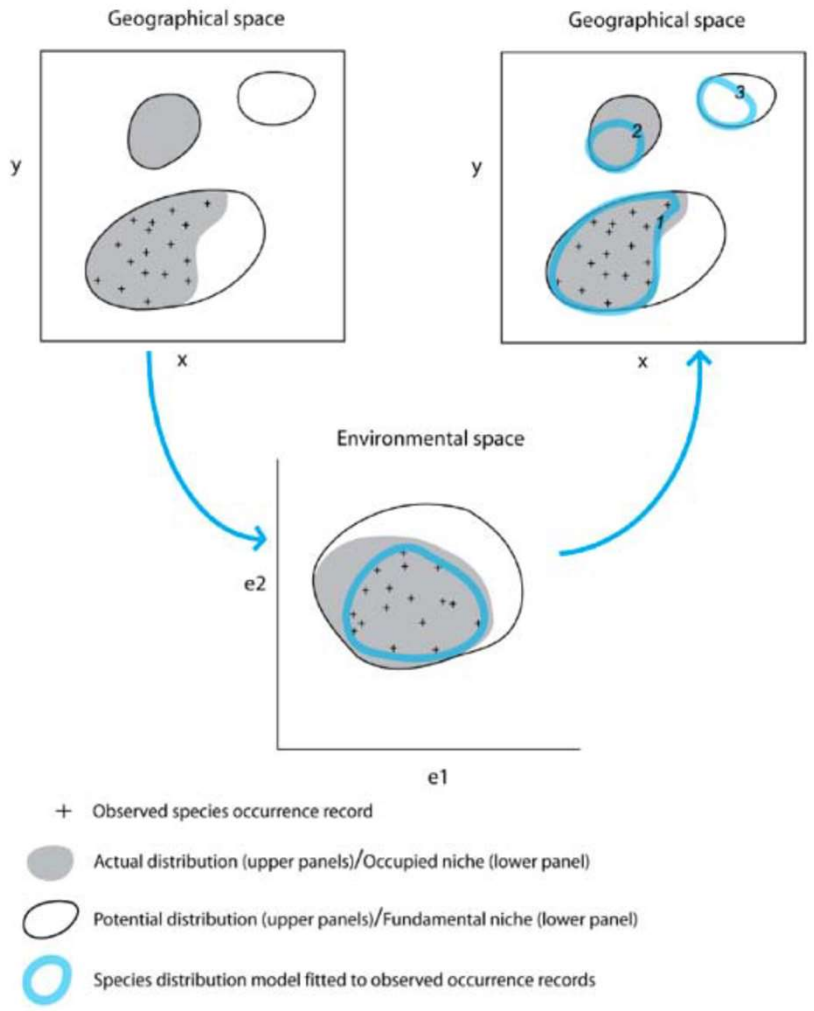


"Source-sink" situation

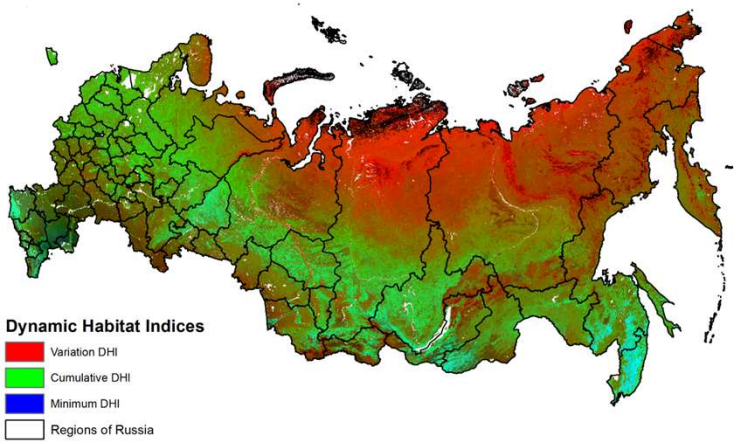
ESTIMATING NICHES AND DISTRIBUTION

Assumptions:

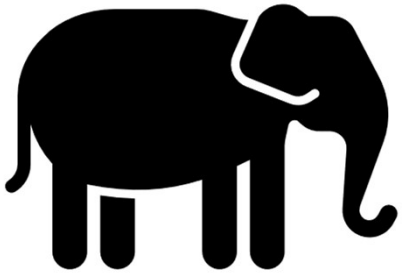
- The degree to which the species is at 'equilibrium' with current environmental conditions.
- The extent to which observed occurrence records provide a sample of the environmental space occupied by the species.



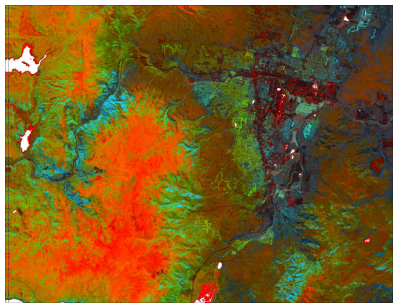
SCALE : EXTENT AND RESOLUTION



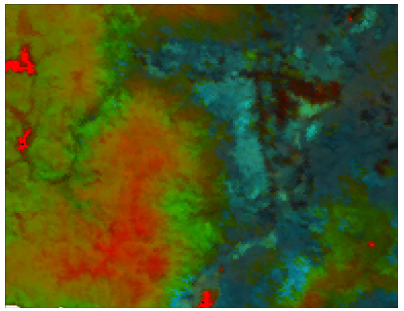
- Extent refers to the size of the region over which the model is run (e.g. region or the whole of Russia)
- Spatial resolution refers to the size of grid cells (e.g. 1 km2 or 10 km2).
- Note that it is common for datasets with large extent to have coarse resolution
- The data resolution should be relevant to the species



30-m Landsat DHIs

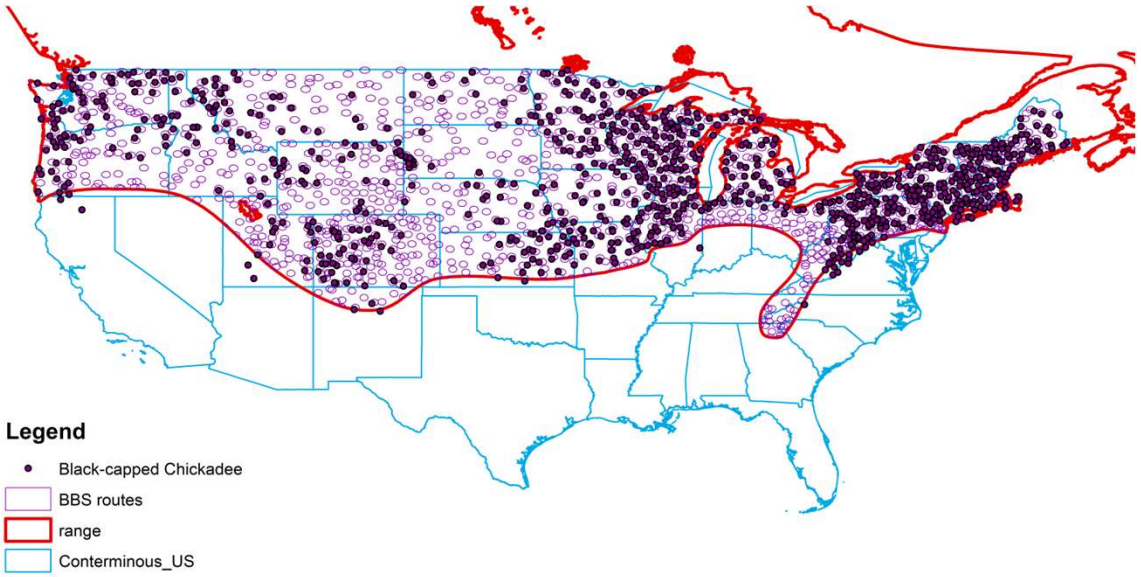


250-m MODIS DHIs



POTENTIAL BIAS IN OCCURRENCE DATA

- Presence-only versus presence/absence data -> false absences
- Incorrect identification of species
- Inaccurate spatial referencing of sample
- Collect samples in easily accessible locations (ex., along roads, near town) -> biased sampling in geographic space may lead to non-representative sampling of environmental conditions.
- Sampling of museum collections tends to be biased toward rare and previously unknown species
- Spatial autocorrelation- > lead to violation of independent observations



ENVIRONMENTAL DATA

Abiotic environment

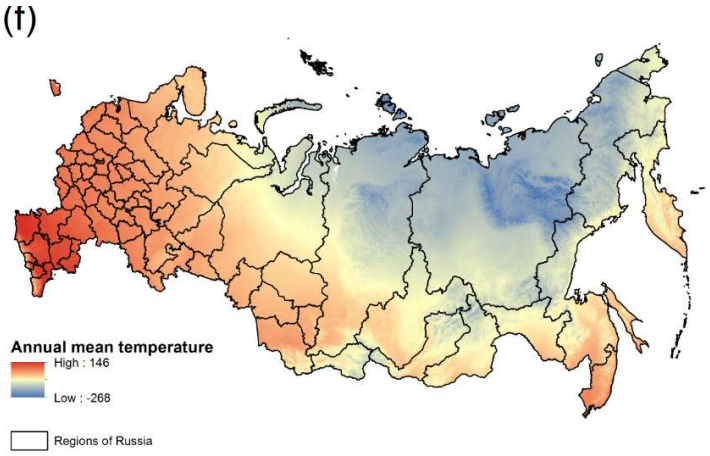
- Climate (e.g., temperature, precipitation)
- Topography (e.g., elevation, aspect, slope)

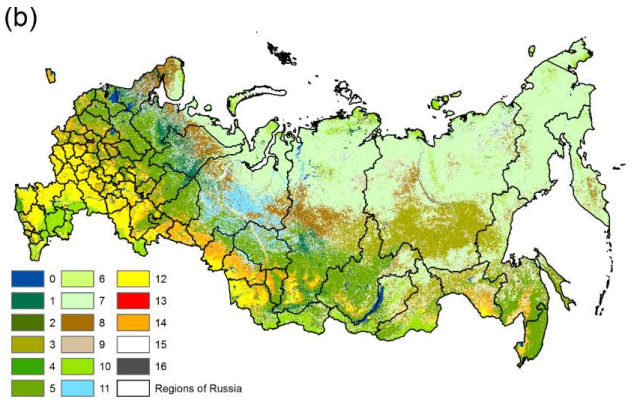
Continuous data

- Land cover
- Biotic interactions

Categorical data

- It is advisable to avoid predictor variables that have an indirect influence on species' distributions, since indirect associations may cause erroneous predictions
- To be aware of multicollinearity





THANK YOU

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