Completing a 1km² global species distribution EBV for all taxa: progress and challenges

B.E. Gerstner, S. Sharma, K. Winner, J. Wilshire, E. Lyu, W. Jetz

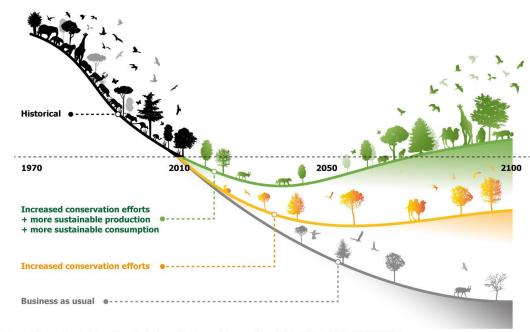
Yale University

Center for Biodiversity and Global Change



BIODIVERSITY CRISIS

- Possible to "bend the curve" of biodiversity loss by increasing conservation efforts
- Need for dynamic species distribution models that ensure conservation areas are resilient and adaptive
- 30% protected land by 2030



This artwork illustrates the main findings of the article, but does not intend to accurately represent its results (https://doi.org/10.1038/s41586-020-2705-y)





Species Populations Working Group

Walter Jetz¹, Melodie A. McGeoch2, Robert Guralnick³, Simon Ferrier⁴, Jan Beck⁵, Mark J. Costello⁶, Miguel Fernandez 7,8, Gary N. Geller9, Petr Keil10, Cory Merow¹, Carsten Meyer^{10,11}, Frank E. Muller-Karger¹², Henrique M. Pereira^{10,13,14}, Eugenie C. Regan¹⁵, Dirk S. Schmeller^{16,17}, Eren Turak^{18,19}

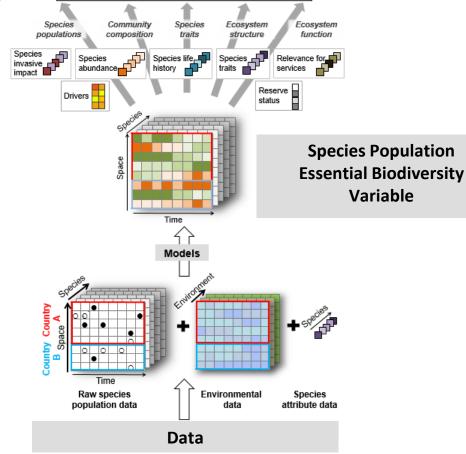
Nature Ecology & Evolution 2019



Indicators



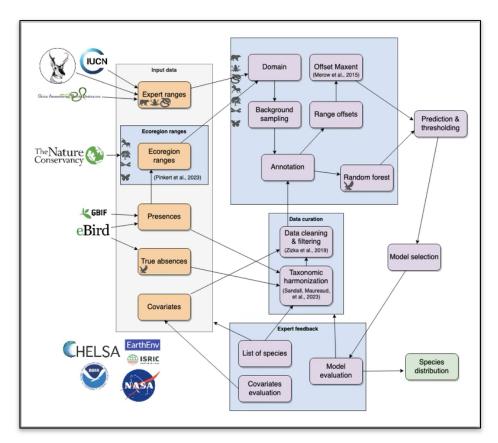
E.g. Species Protection, Extinction Risk, Species Information Status, Invasion Impact, Species Habitat, Ecosystem Condition, Ecosystem Services, Community Function, Impacts of Drivers



Variable

BIODIVERSITY MODELING

- High resolution SDMs at global scale
- Semi-automated workflow
- Caveats of modeling at scale
- Need for models to be assessed by experts to ensure biological realism
 - Expert review, human in the loop



Papers (2019-2024)

Home > Landscape Ecology > Article

Assessing the applicability of binary landcover variables to species distribution models across multiple grains

Global Ecology and Biogeography

Integrated species distribution models to account for sampling biases and improve range-wide occurrence predictions

Jussi Mäkinen X. Cory Merow, Walter Jetz

Global Ecology and Biogeography

Diverse strategies for tracking seasonal environmental niches at hemispheric scale

Jeremy Cohen X, Walter Jetz

Methods in Ecology and Evolution = ECOLOGICAL



Positional errors in species distribution modelling are not overcome by the coarser grains of analysis

Lukáš Gábor X, Walter Jetz, Muyang Lu, Duccio Rocchini, Anna Cord, Marco Malavasi, Alejandra Zarzo-Arias, Vojtěch Barták, Vítězslav Moudrý



Measuring the evolution of *n*-dimensional environmental niches

Shubhi Sharma K, Kevin Winner, Jussi Mäkinen, Walter Jetz

nature communications **Individual environmental niches in mobile organisms**

Ben S. Carlson M., Shay Rotics, Ran Nathan, Martin Wikelski & Walter Jetz

Methods in Ecology and Evolution = ECOLOGICAL



A unifying framework for quantifying and comparing ndimensional hypervolumes

Muyang Lu Kevin Winner, Walter Jetz

Hierarchical multi-grain models improve descriptions of species' environmental associations, distribution, and abundance

FCOLOGICAL

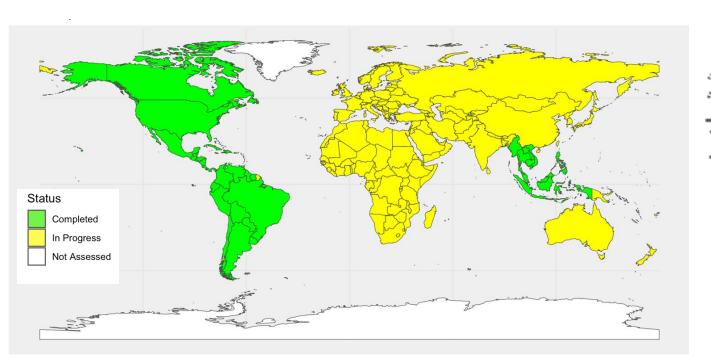
Katherine Mertes X, Marta A. Jarzyna, Walter Jetz

Trends in Ecology & Evolution

Scale-sensitivity in the measurement and interpretation of environmental niches

Muyang Lu¹² 2 M, Walter Jetz¹² 2 M

PROGRESS (2025)

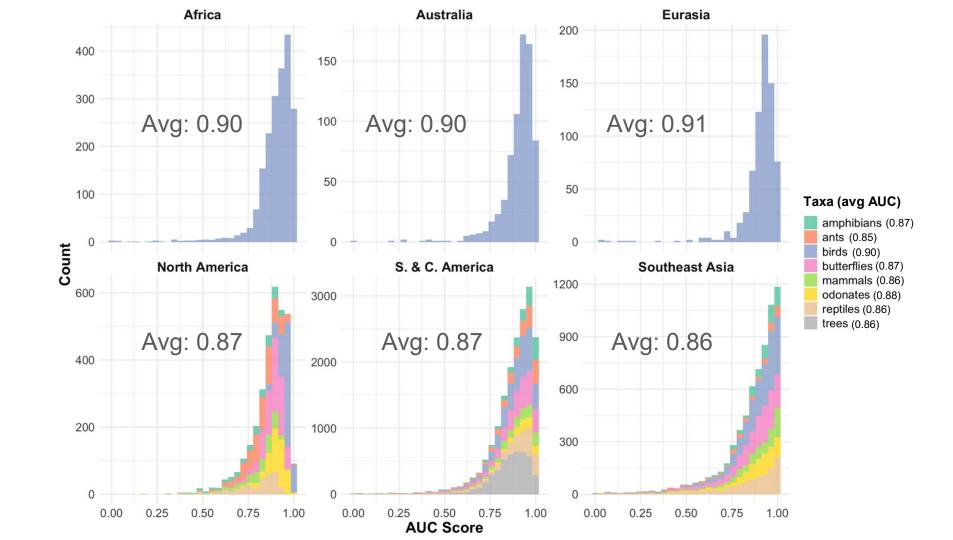


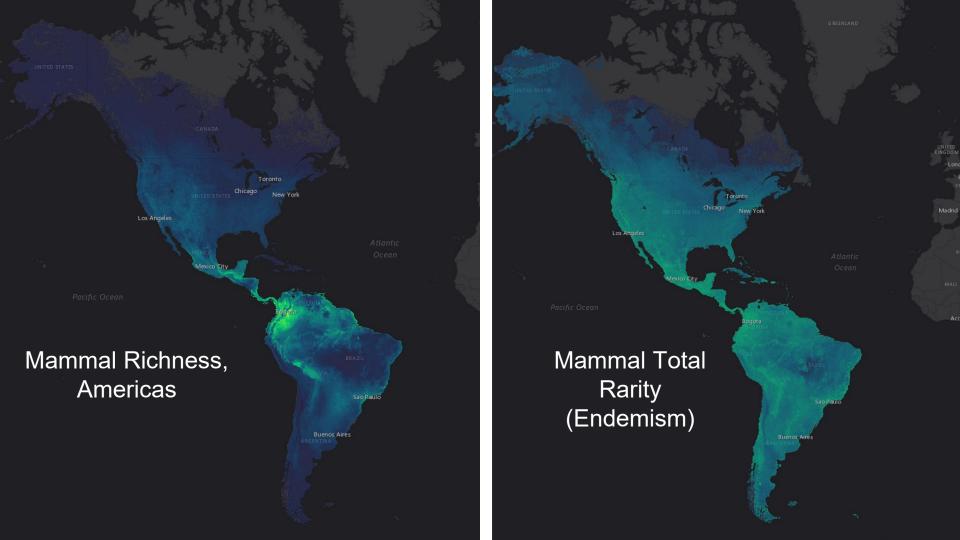


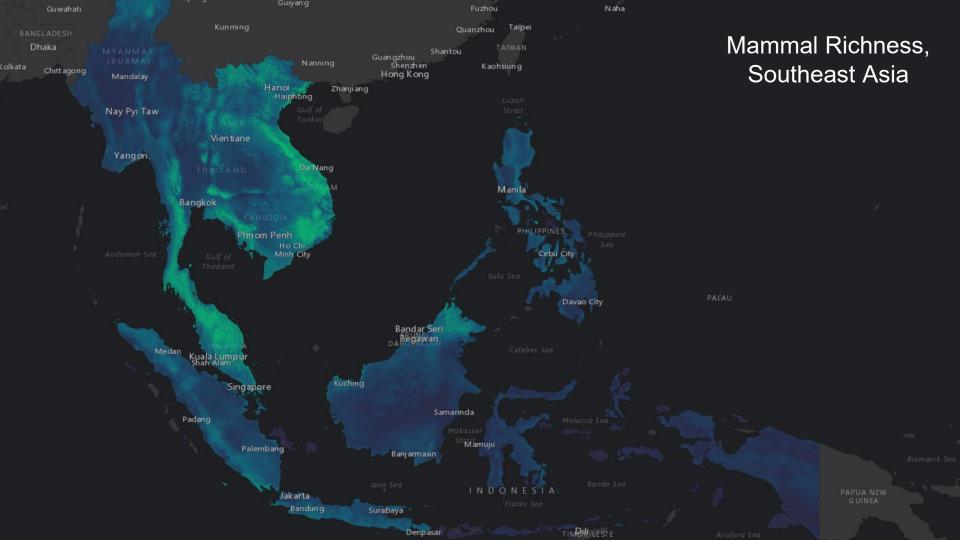




28,203 species!









Challenges

Solutions

- Scalability
 - High processing power; multi-step workflow
- Biases in data
 - Uneven sampling of distributions
- Data-poor species/regions
 - Many remote and tropical regions remain data poor which can
- Assessing spatial performance
 - Need for scalable expert model validation

- Scalability
 - High performance computing; Cloud
 Computing; semi-automation
- Biases in data
 - Target group background sampling
- Data-poor species/regions
 - Multi-modal data (e.g. expert ranges (done) and borrowing strength (Shubhi's talk)
- Assessing spatial performance
 - Created Expert Tools Platform



Bassaricyon neblina PANAMA v2.0.7, Range offset, AUC: 0.9647917 2 Compare with another model Layers (i) Prediction (1) Expert range map* 1 Occurrence Points Show Suitablity False absence **Prediction Rating** Save COLOMBIA Very poor Excellent Feedback Prediction: False Presence (i) Prediction: False Absence (i) Prediction: Alternate presence threshold (i) Prediction: Artificial shapes/lines (i) Prediction: Does not match expert range (i) Occurrences: Erroneous occurrences Other: Species is not native to the region (i) Other: Taxonomic Issue (i) Other: Technical Issue (i) Other (i)

Olinguito

(Bassaricyon neblina)

Expert Feedback

Expert Range Map

Occurrence records

SDM

Prediction

Future Goals

- Model more taxa in Africa, Eurasia, and Australia
- Additional model runs with target group background implemented for all regions
- Complete global bird models by May 2025
- Acquire expert feedback on models for Southeast Asia and reimplement.



THANK YOU!

























THANK YOU!























