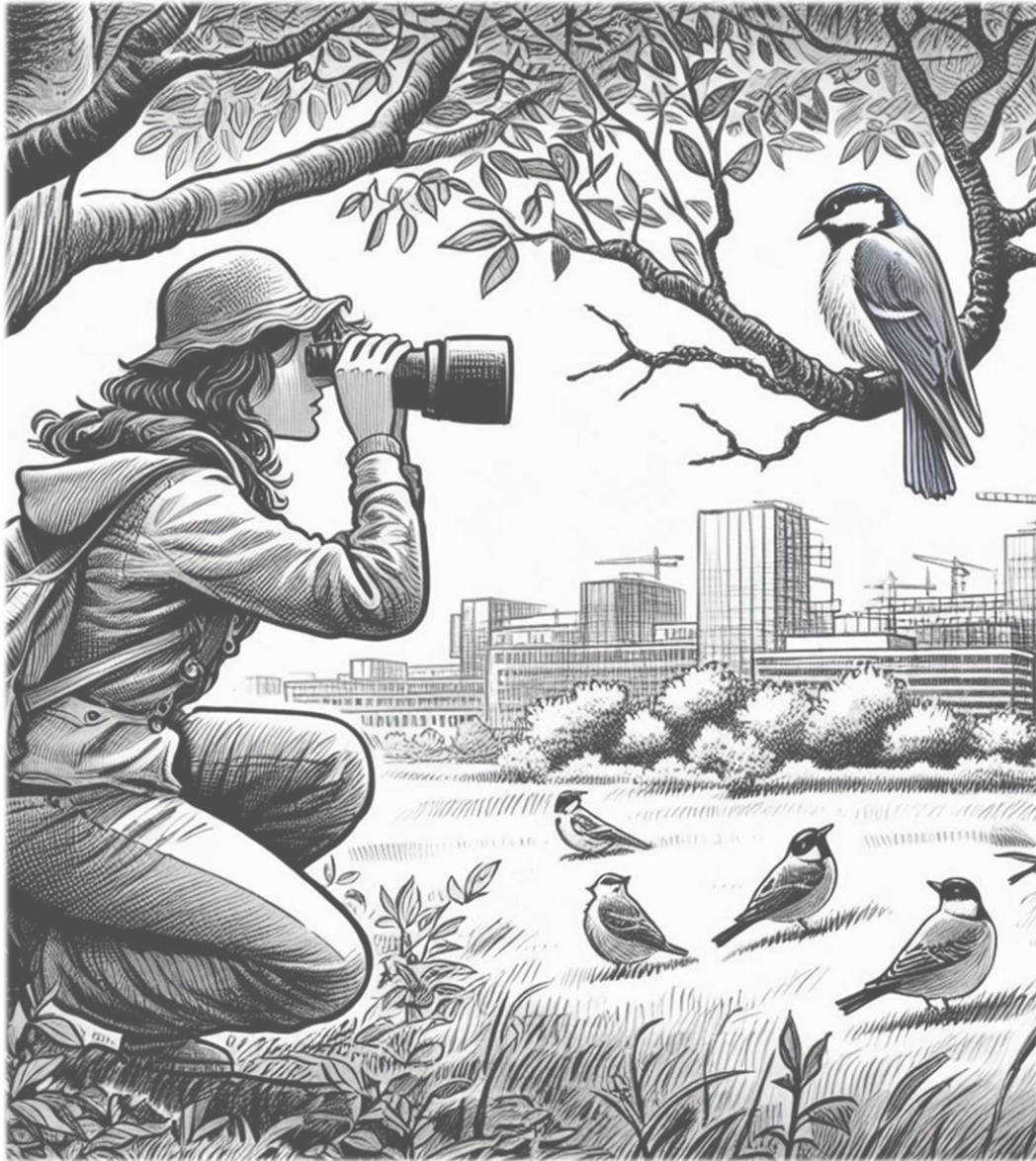




## Zwischen Beton und Biodiversität: Planungsrelevante Vogelarten und ihre Habitate im Ruhrgebiet

Malte Bührs, Harald Zepp, Thomas Schmitt



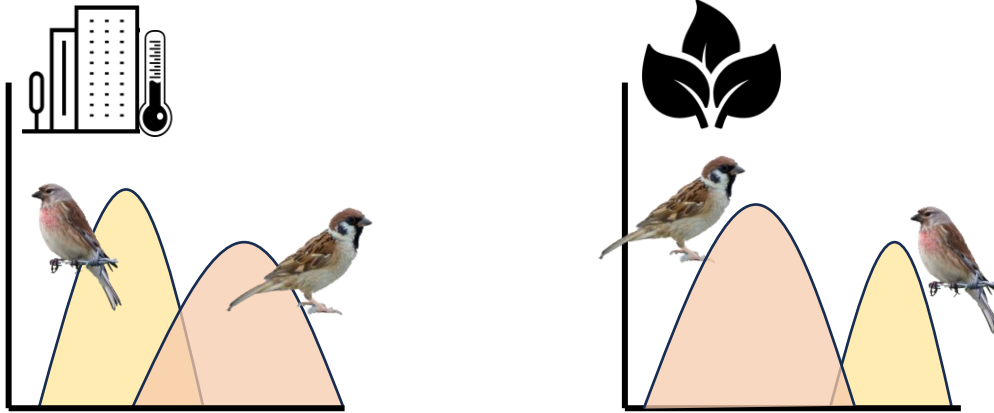
KI generiert (Microsoft Designer)

- Heterogene Mosaike aus urbaner Grüner, Blauer and Grauer Infrastruktur beherbergen eine hohe Anzahl an (nicht-) bedrohten Arten ( z.B. McDonald et al. 2020, Knapp et al. 2021; Spotswood et al. 2021)
- Urbane Grüne Infrastruktur ist unter Druck durch (Über-)Nutzung, (Nach-)Verdichtung und Baulückenschluss (Pauleit et al. 2005, Rafiee et al. 2009, Byomkesh et al. 2012)
- Auch dem Ruhrgebiet fehlt eine flächendeckende Habitatpotentialanalyse für (planungs-)relevante Arten (Wirth et al. 2024, Keil & Hering 2022, Keil et al. 2021)

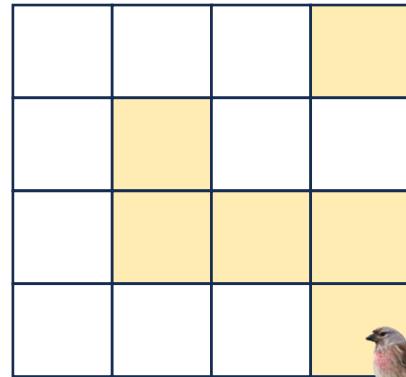
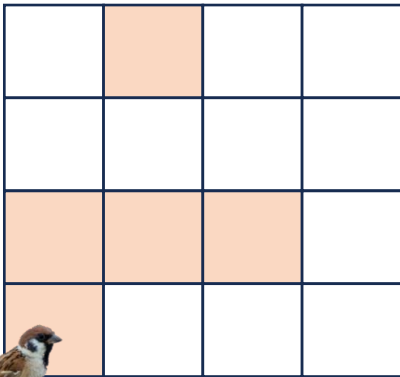
**Können Modelle mit *Citizen Science* & Fernerkundungsdaten Netzwerke und Muster der Biodiversität im Ruhrgebiet aufdecken?**



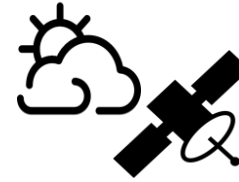
(Elith & Leathwick 2009)



Ökologische Nische



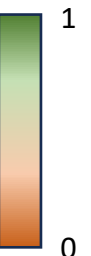
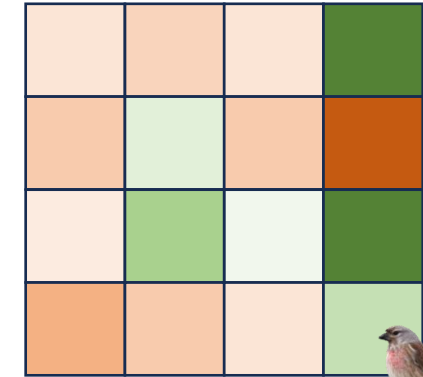
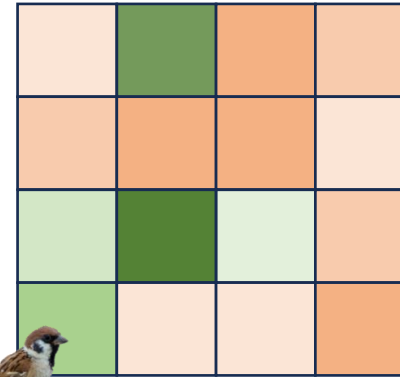
Umweltdaten



Citizen Science-Daten



AVM



Wahrscheinlichkeit des Vorkommens



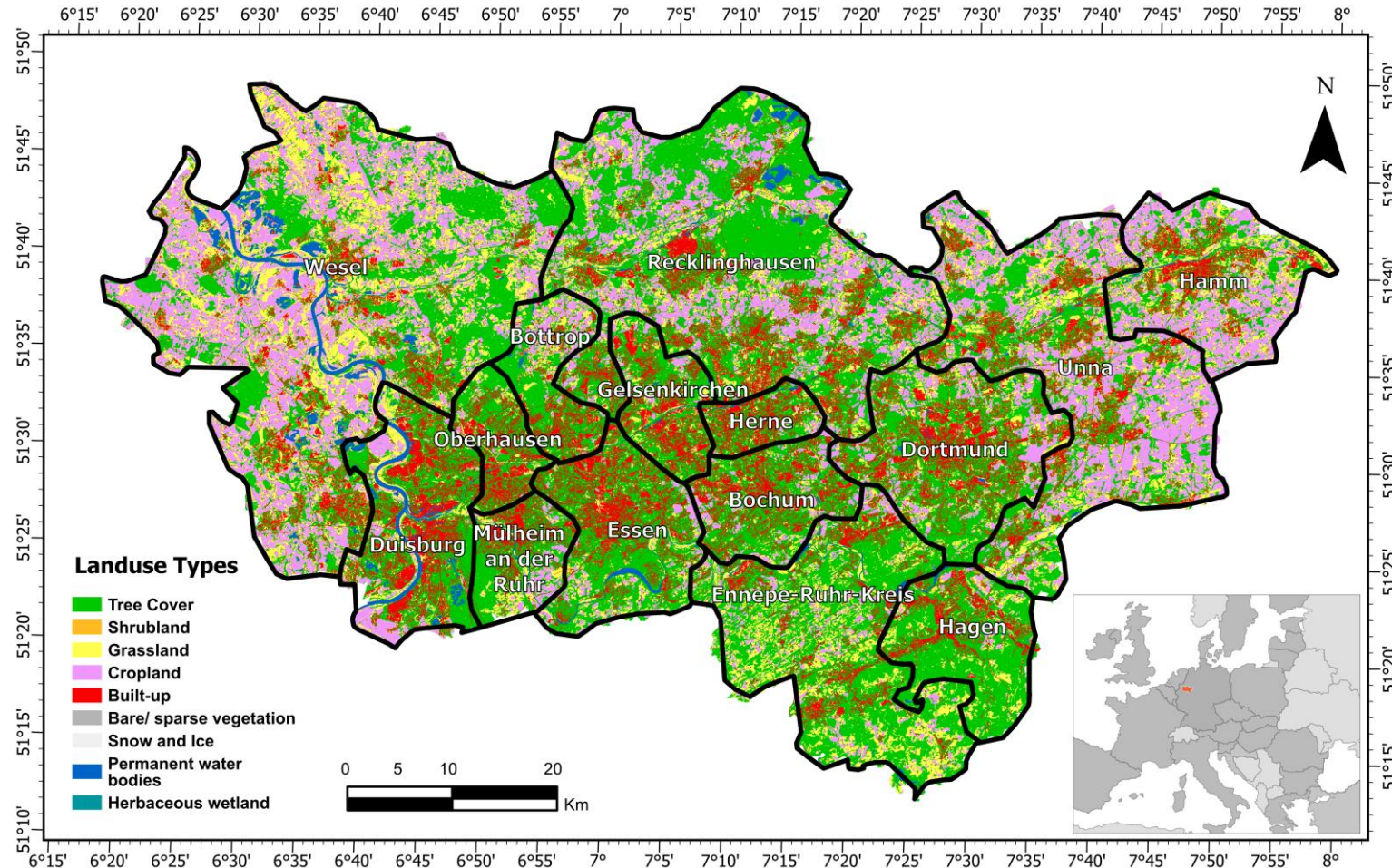
Sind Artverbreitungsmodelle (AVMs) in **urbanen** Gebieten auf **kleinem Raum** einsetzbar, wenn **Citizen Science**-Daten verwendet werden?



Welche **Einflussfaktoren** bestimmen das **Vorkommen** einzelner Arten?



Ist das aktuelle **Netzwerk** besonders **geschützter Bereiche deckungsgleich** mit Biodiversitäts-Hotspots? Wo gibt es **Lücken** zu schließen?



Eine hoch **diverse** und **dichte** Landschaftsstruktur

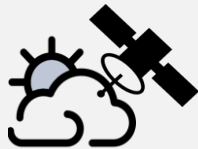
**Einzigartige** Zusammensetzung der Biodiversität durch die **Geschichte** des Ruhrgebiets

Fortschreitende Landnutzungsänderungen

**Abb. 2:** Charakterisierung der Landnutzung in der Metropole Ruhr  
WorldCover-Landnutzungsclassifikation in der Metropole Ruhr (Zanaga et al. 2022).



**Citizen Science-Daten von  
26 planungsrelevanten Arten**



Klima

Landnutzung

Höhe

Versiegelung

### Vorbereitung

Qualität Datenauswahl Interpolation

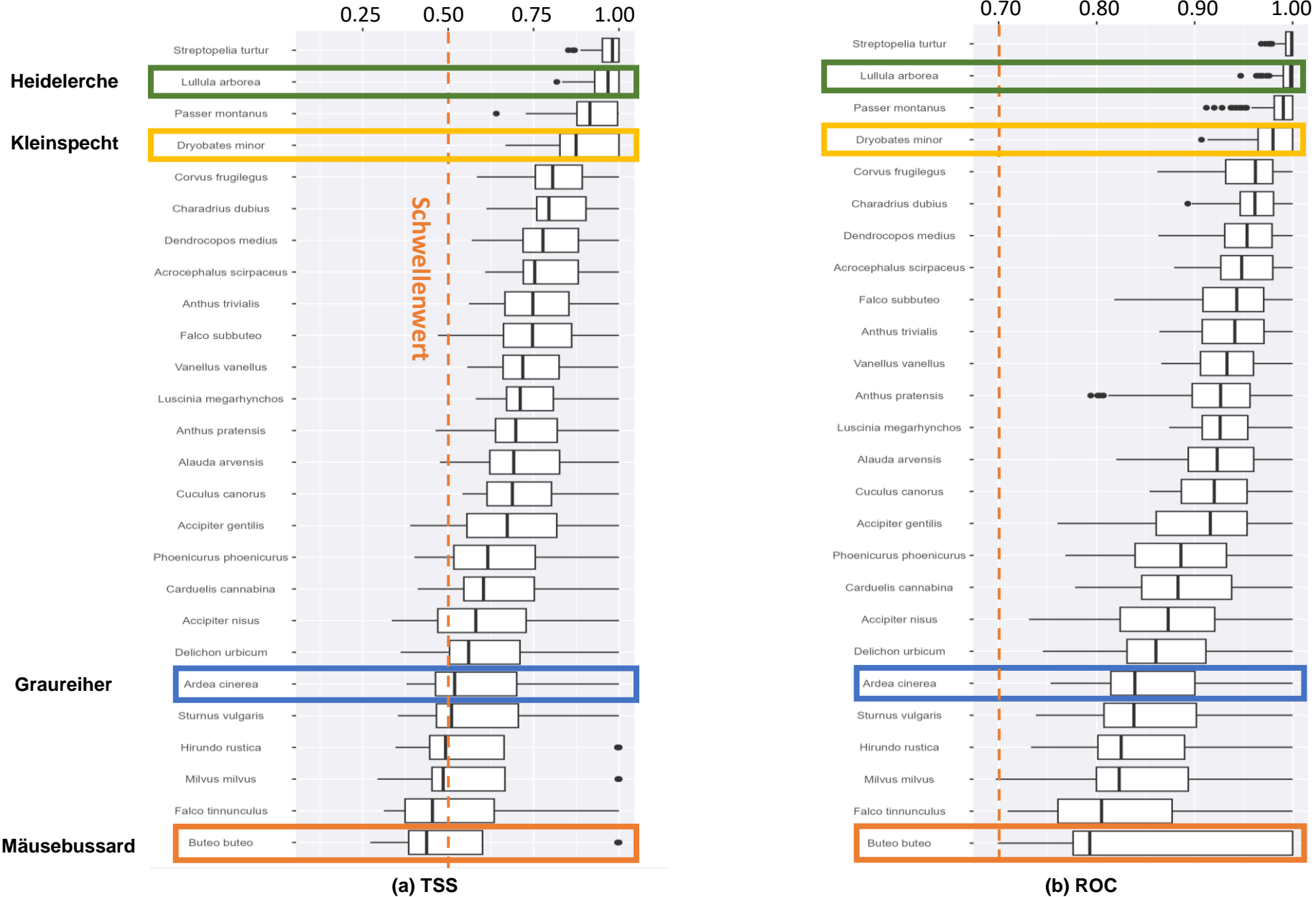
### Modell-Konstruktion

Modellauswahl Validation Selektion

### Modell-Ensembles & Binäre Transformation

### Ergebnisse:

- Modellqualität
- Einflussfaktoren
- Biodiversitäts-Hotspots
- Lücken im Biotopverbund



**Abb. 4:** Modellqualität (a) ROC und (b) TSS individuell pro Art für beide Metriken und über alle Durchläufe

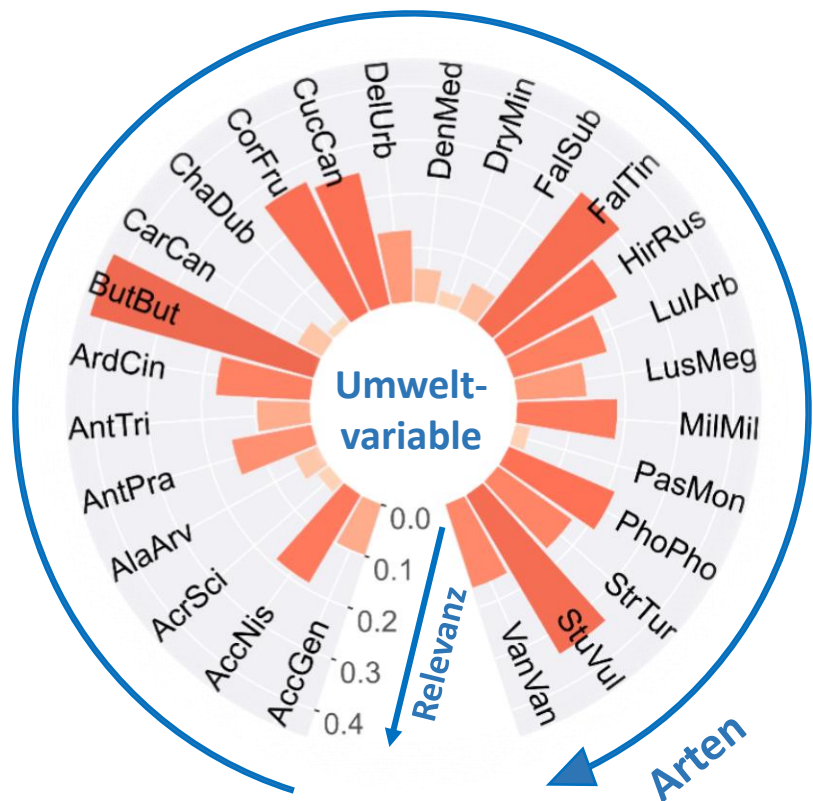
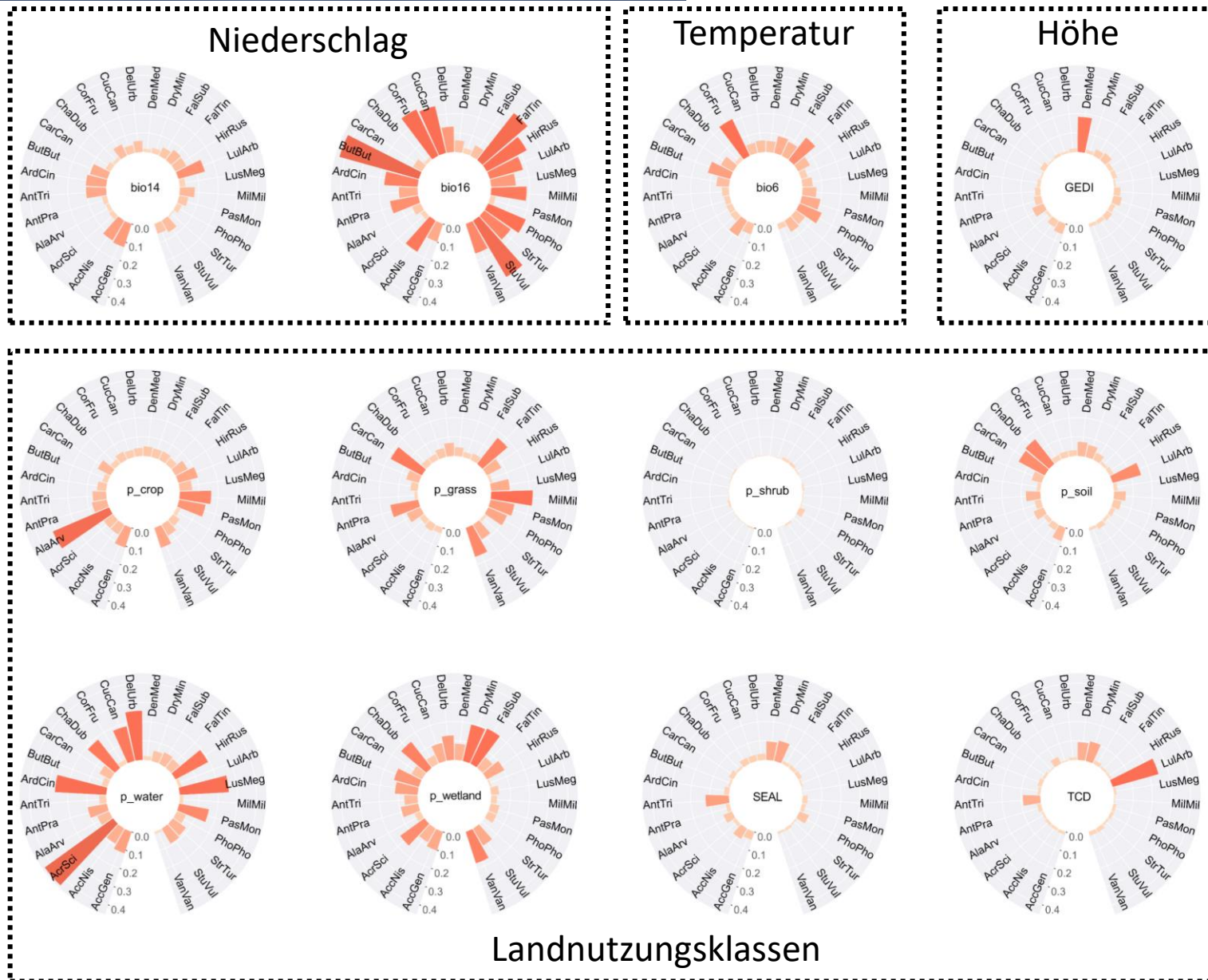
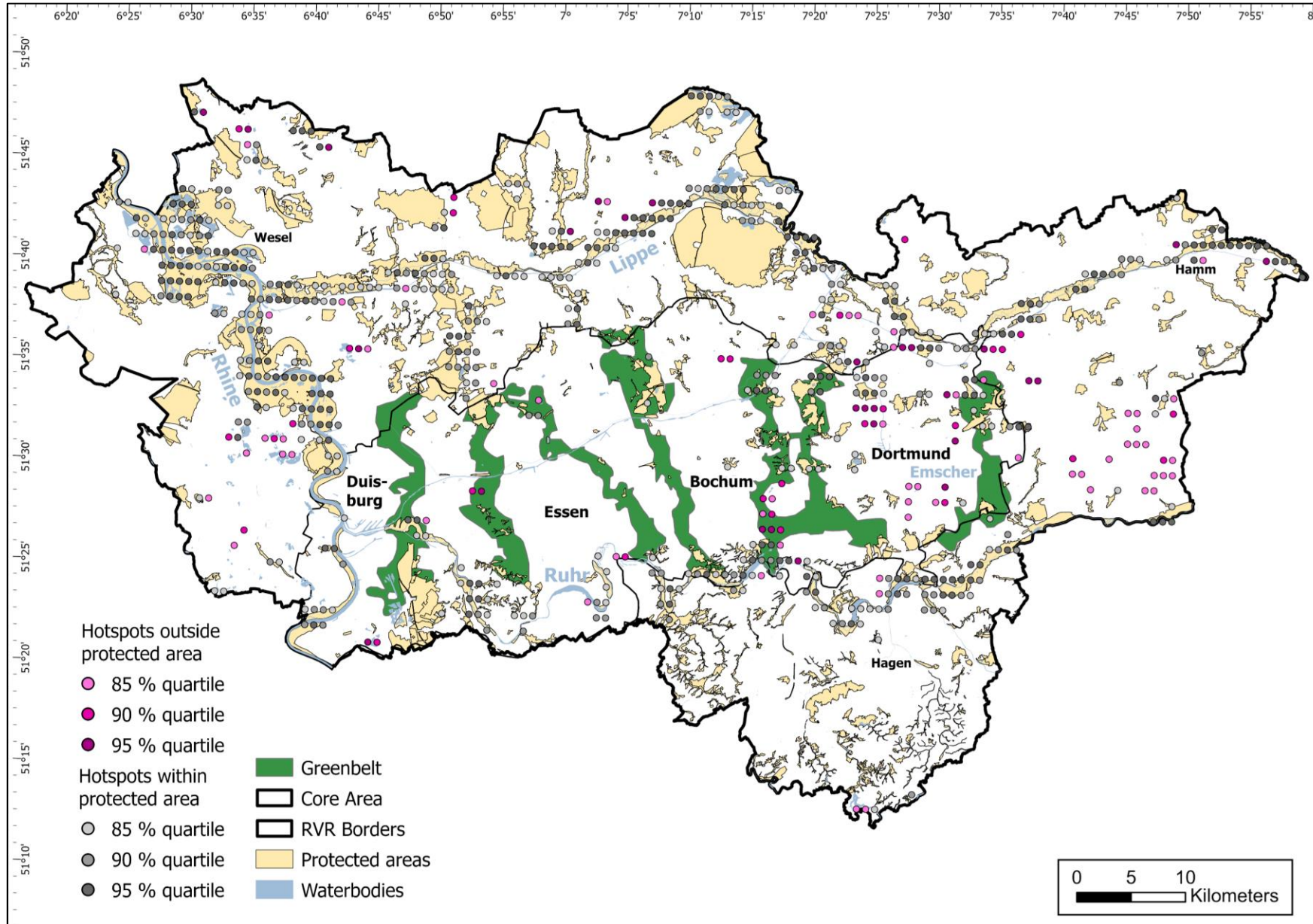


Abb. 5: Relevanz verwendeter Variablen

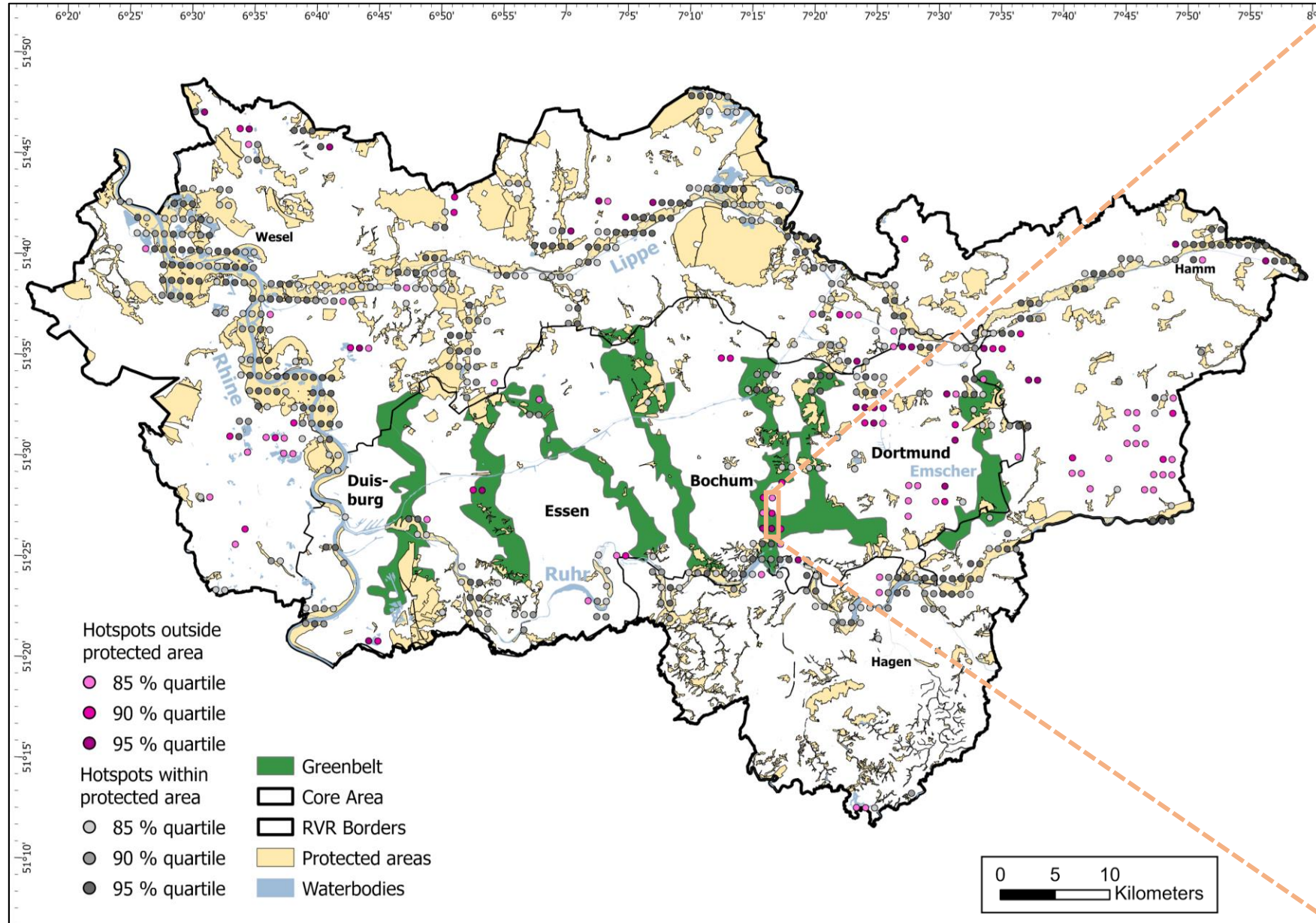


Landnutzungsklassen



- 250 km<sup>2</sup> (Q95) lassen eine sehr hohe Biodiversität erwarten
- 696 km<sup>2</sup> (Q85) lassen eine hohe Biodiversität erwarten
- 116 km<sup>2</sup> der Hotspots besitzen aktuell keinen Schutzstatus

# Areale hoher Biodiversität



2024

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## EVALUATING URBAN BIODIVERSITY: EFFECTIVENESS OF CITIZEN SCIENCE DRIVEN SPECIES DISTRIBUTION MODELS IN URBAN ECOSYSTEMS

A case study in the Ruhr Metropolis, Germany

MALTE BÜHRIS, HARALD ZEPP and THOMAS SCHMITT

With 7 figures, 3 tables and appendix

Received 02 April 2024 · Accepted 16 September 2024

**Summary:** Citizen science (CS) and remote sensing (RS) approaches have become more reliable, thus providing higher resolution and generating a large amount of environmental data. When considering urban environments, where fragmented and highly diverse landscapes are predominant, the combination of citizen science data and remote sensing techniques with species distribution models (SDM) can play a vital role in comprehensively investigating and evaluating urban biodiversity. However, citizen science derived species distribution models for multiple avian species in dense and fragmented urban areas are rarely used. The study aims (I) to elaborate, whether CS driven SDMs can be effectively used in spatially complex urban environments; (II) to identify biodiversity hotspots and prioritize areas for nature conservation and (III) to examine, if existing protective areas correspond to species' hotspots. Therefore, Citizen science-based datasets of 26 breeding bird species over three years were obtained for this analysis in Germany's Ruhr Metropolis. Quality assurance, data thinning, and pseudo-absence simulations were performed. Spatial data from the ecosystem LiDAR project GEDI (Global Ecosystem Dynamics Investigation), climate data from the German Weather Service, and land use information from Copernicus were used as environmental predictors. Eleven different species distribution models (SDMs) were trained on species subselection by using Biomod2 for preliminary analysis. Overall model performance was evaluated via several metrics, including TSS (true skill statistics) and ROC (receiver operating characteristic). Finally, four species distribution models were used for ensemble modelling. Subsequently, a species richness analysis was performed with the aim of identifying spots with high avian biodiversity. Overall, the CS-derived SDMs performed well, with high predictive power for all of the investigated species. Within the Ruhr Metropolis, approximately 6% (250 km<sup>2</sup>) of the terrain was identified as being highly suitable for avian diversity, inhabiting at least 17 out of 26 species. Predominantly within the core urban areas, high species richness was predicted on preserved brownfields and revitalized mine sites, as well as in the remnants of formerly demarcated regional greenbelts. Additionally, regions outside of the core area, which are part of the overarching biotope network framework, proved to have high species richness capabilities for avian biodiversity. These findings aid in optimizing urban development concepts and (sub)urban green space management with respect to urban biodiversity conservation. Following the implications of the recently established Regional Biodiversity Strategy in the Ruhr Metropolis, this analysis demonstrates the importance of networked green spaces, their preservation and the need to close existing network gaps within the Ruhr Metropolis.

**Keywords:** Avian biodiversity, species distribution models, citizen science, urban ecology, Ruhr Area, animal geography

Alle Informationen zu  
Methode & Ergebnissen  
sowie zur Diskussion:





Kompetenzfeld  
Metropolenforschung

# Vielen Dank für Ihre Aufmerksamkeit!

GEFÖRDERT VOM



Bundesministerium  
für Bildung  
und Forschung

in Verbindung mit:  
**IMECOGIP** in FONA:  
Sustainable Development of Urban Regions  
Prof. Dr. Harald Zepp (Projektleitung)



Dank an den DDA e.V. für die  
Bereitstellung von Artfund-  
punkten

Ein großes Dankeschön an alle  
Melder von Beobachtungen.

For more information  
of the project:



Ruhr-University Bochum  
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Building IA, Room 6/117

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- Callaghan, C. T., G. Bino, R. E. Major, J. M. Martin, M. B. Lyons & R. T. Kingsford, 2019: Heterogeneous urban green areas are bird diversity hotspots: insights using continental-scale citizen science data. *Landscape Ecol* 34 (6), 1231-1246. <https://doi.org/10.1007/s10980-019-00851-6>.
- Stiels, D., H.-V. Bastian, A. Bastian, K. Schidelko & J. O. Engler, 2021: An iconic messenger of climate change? Predicting the range dynamics of the European Bee-eater (*Merops apiaster*). *J Ornithol* 162 (3), 631-644. <https://doi.org/10.1007/s10336-021-01867-z>.
- Isaksson, C., 2018: Impact of Urbanization on Birds. In: Tietze, D. T., Koerner & Tietze (Hrsg.): *Bird Species*, 235-257. Springer International Publishing, [Place of publication not identified], 1st ed. [https://doi.org/10.1007/978-3-319-91689-7\\_13](https://doi.org/10.1007/978-3-319-91689-7_13).
- Thuiller, W., D. Georges, M. Gueguen, R. Engler, F. Breiner, B. Lafourcade & R. Patin, 2023: biomod2: Ensemble Platform for Species Distribution Modeling.
- MCDONALD, R. I., A. V. MANSUR, F. ASCENSÃO, M. COLBERT, K. CROSSMAN, T. ELMQVIST, A. GONZALEZ, B. GÜNERALP, D. HAASE, M. HAMANN, O. HILLEL, K. HUANG, B. KAHNT, D. MADDOX, A. PACHECO, H. M. PEREIRA, K. C. SETO, R. SIMKIN, B. WALSH, A. S. WERNER & C. ZITER, 2020: Research gaps in knowledge of the impact of urban growth on biodiversity. *Nat Sustain* 3 (1), 16-24.
- KNAPP, S., M. F. J. ARONSON, E. CARPENTER, A. HERRERA-MONTES, K. JUNG, D. J. KOTZE, F. A. LA SORTE, C. A. LEPCZYK, I. MACGREGOR-FORS, J. S. MACIVOR, M. MORETTI, C. H. NILON, M. R. PIANA, C. C. REGA-BRODSKY, A. SALISBURY, C. G. THRELFALL, C. TRISOS, N. S. G. WILLIAMS & A. K. HAHS, 2021: A Rese-arch Agenda for Urban Biodiversity in the Global Extinction Crisis. *BioScience* 71 (3), 268-279. <https://doi.org/10.1093/biosci/biaa141>.
- SPOTSWOOD, E. N., E. E. BELLER, R. GROSSINGER, J. L. GRENIER, N. E. HELLER & M. F. J. ARONSON, 2021: The Biological Deserts Fallacy: Cities in Their Landscapes Contribute More than We Think to Re-gional Biodiversity. *BioScience* 71 (2), 148-160. <https://doi.org/10.1093/biosci/biaa155>.
- ELITH, J. & J. R. LEATHWICK, 2009: Species Distribution Models: Ecological Explanation and Prediction Across Space and Time. *Annu. Rev. Ecol. Evol. Syst.* 40 (1), 677-697. <https://doi.org/10.1146/annurev.ecolsys.110308.120159>.
- GUISAN, A. & W. THUILLER, 2005: Predicting species distribution: offering more than simple habitat models. *Ecology letters* 8 (9), 993-1009. <https://doi.org/10.1111/j.1461-0248.2005.00792.x>.
- RANDIN, C. F., M. B. ASHCROFT, J. BOLLIGER, J. CAVENDER-BARES, N. C. COOPS, S. DULLINGER, T. DIRN-BÖCK, S. ECKERT, E. ELLIS, N. FERNÁNDEZ, G. GIULIANI, A. GUISAN, W. JETZ, S. JOOST, D. KARGER, J. LEM-BRECHTS, J. LENOIR, M. LUOTO, X. MORIN, B. PRICE, D. ROCCHINI, M. SCHAEPMAN, B. SCHMID, P. VERBURG, A. WILSON, P. WOODCOCK, N. YOCCOZ & D. PAYNE, 2020: Monitoring biodiversity in the Anthro-pocene using remote sensing in species distribution models. *Remote Sensing of Environment* 239, 111626. <https://doi.org/10.1016/j.rse.2019.111626>.
- WANG, F., X. YUAN, Y. SUN & Y. LIU, 2024: Species distribution modeling based on MaxEnt to inform biodiversity conservation in the Central Urban Area of Chongqing Municipality. *1470-160X* 158, 111491. <https://doi.org/10.1016/j.ecolind.2023.111491>.
- KEIL, P. & D. HERING (Hrsg.), 2022: Regionale Biodiversitätsstrategie Ruhrgebiet. *Offensive Grüne Infrastruktur 2030*. Regionalverband Ruhr, Essen.
- KEIL, P., D. HERING, T. SCHMITT & H. ZEPP (Hrsg.), 2021: Positionen zu einer regionalen Biodiversitäts-Strategie Ruhrgebiet. Regionalverband Ruhr, Essen.