Modeling Invasive Species Dynamics and Distribution: A Case Study on Cane Toads in Australia

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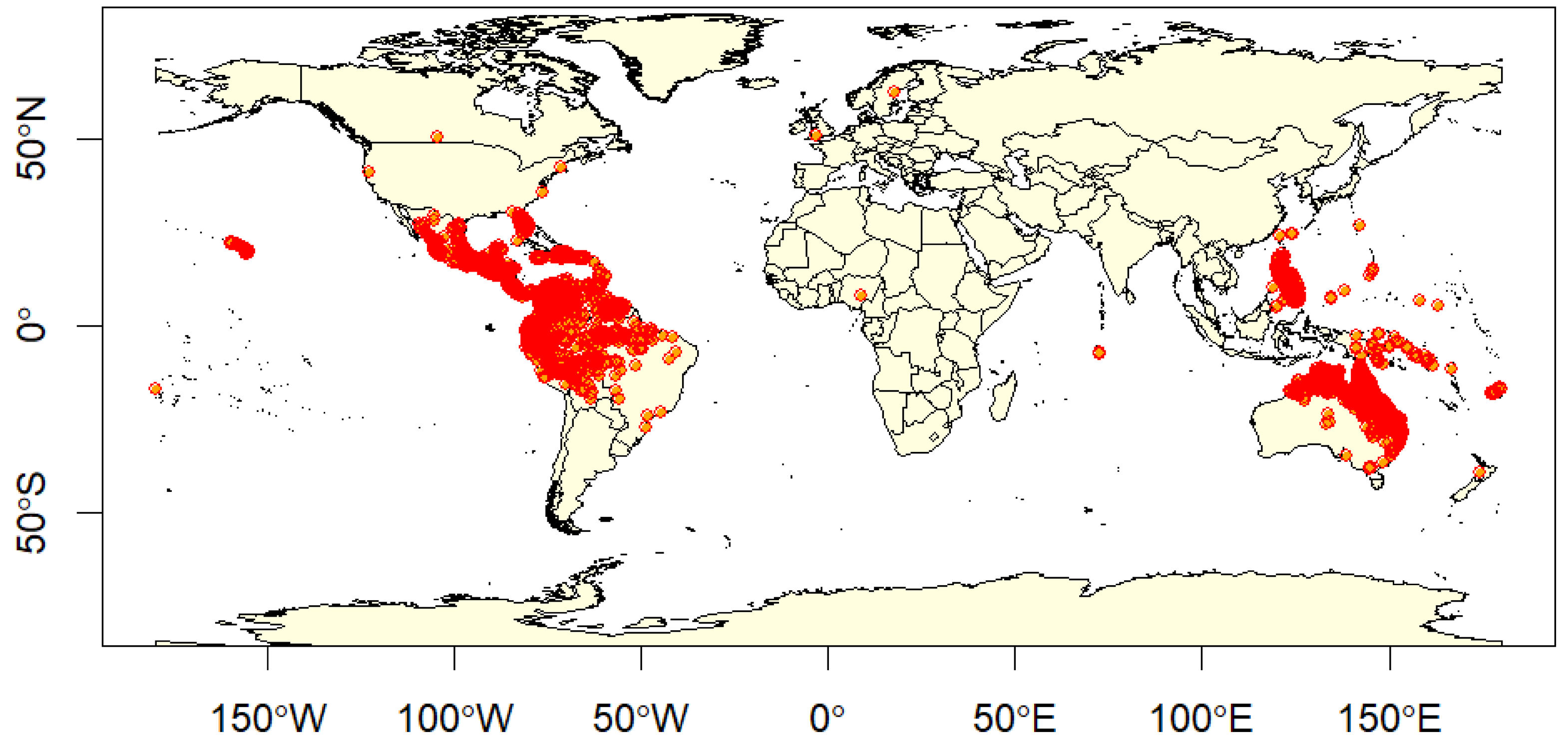
BACKGROUND & RATIONALE

1. We speculate that machine learning models will introduce more details on species occurrence than profile methods.

1. Invasive species like the cane toad wreak havoc on Australia's biodiversity and cost its economy over $1 billion annually.

Data

1. The presence data on cane toads from the Global Biodiversity Information Facility (GBIF).
2. The 17-bioclimatic-variables-climate data was acquired from the WorldClim database.



METHOD

2. Modeling Approach:
- Applied profile modeling: BIOCLIM and Domain algorithms.
- Applied Regression (GLM with Logit), Machine Learning models Random Forest and SVM for predictive modeling.

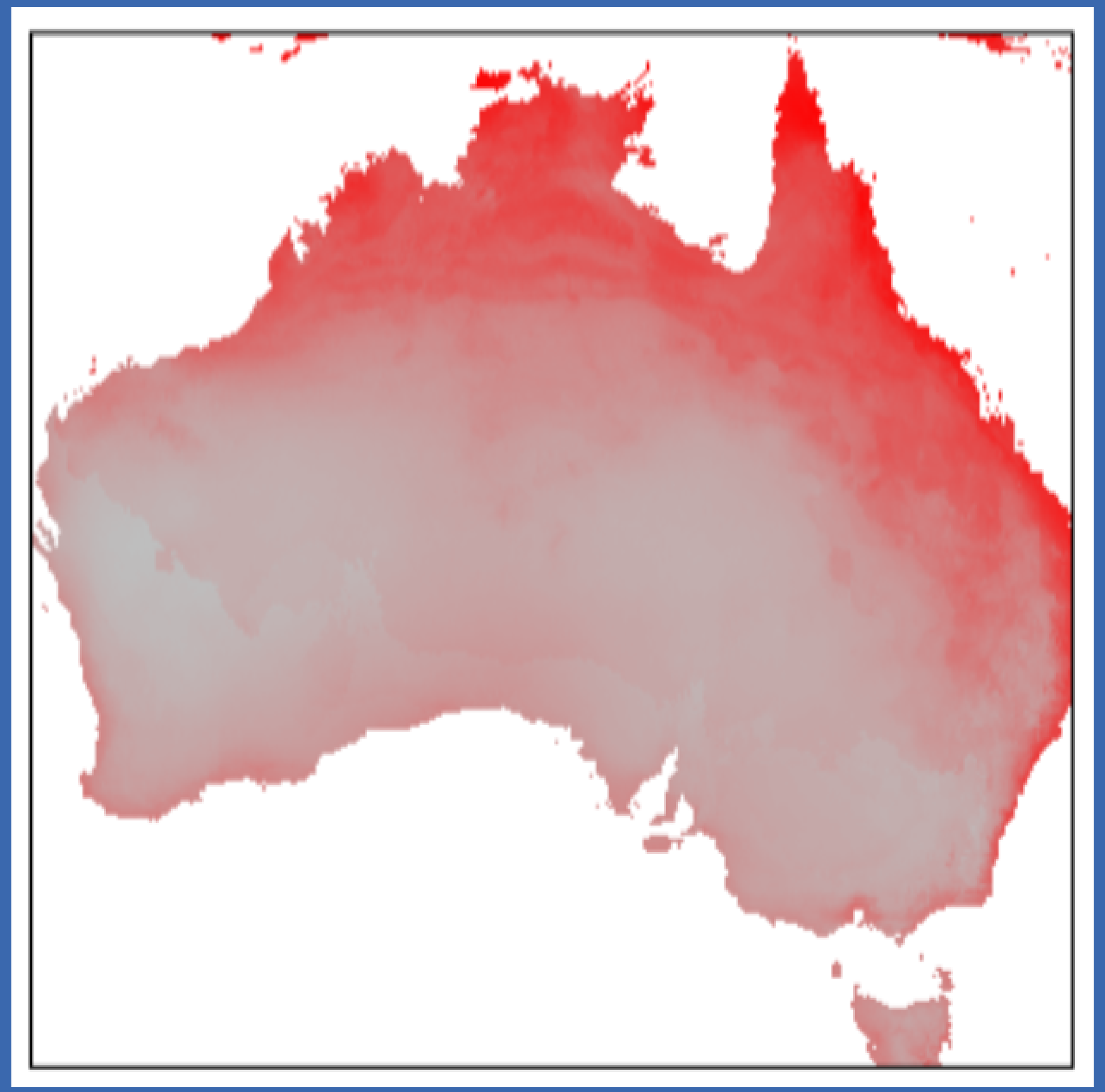
3. Model Validation:
- Evaluated models using AUC, correlation test and Maximum TPR_TNR for predictive accuracy.
- Conducted cross-validation to test model robustness.

4. Predictive Mapping:
- Produced predictive maps for cane toad distribution.
- Identified critical climatic factors influencing habitat suitability.

Machine Learning methods performing better than Profile and Regression methods.

Cane toads is predicted to spread through out Northern Australia.

Fig: Cane Toad (*Rhinella marina*) Vibing invading boy,
Source: https://wwf.org.au/blogs/10-facts-about-cane-toads/



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RESULT

The results indicate that the ensemble machine learning approach effectively predicts the cane toad distribution, with the Random Forest and Support Vector Machine models demonstrating high accuracy. Climate variables, particularly temperature and precipitation, emerged as significant factors in predicting the presence of cane toads, aiding in the identification of potential high-risk areas for invasion

Model	n Presences	n Absences	AUC	Correlation	Max TPR+TNR
BIOCLIM	168	200	0.7202	0.3286	0.0279
Domain Algorithm	168	200	0.7712	0.3949	0.6174
GLM with Logistic Regression	168	200	0.8888	0.6250	0.2394
MaxEnt	168	200	0.73	0.4545	0.3559
Random Forest	168	200	0.9169	0.7300	0.4772
Support Vector Machine	168	200	0.9074	0.6927	0.3204

Fig: Model Evaluation for each algorithm

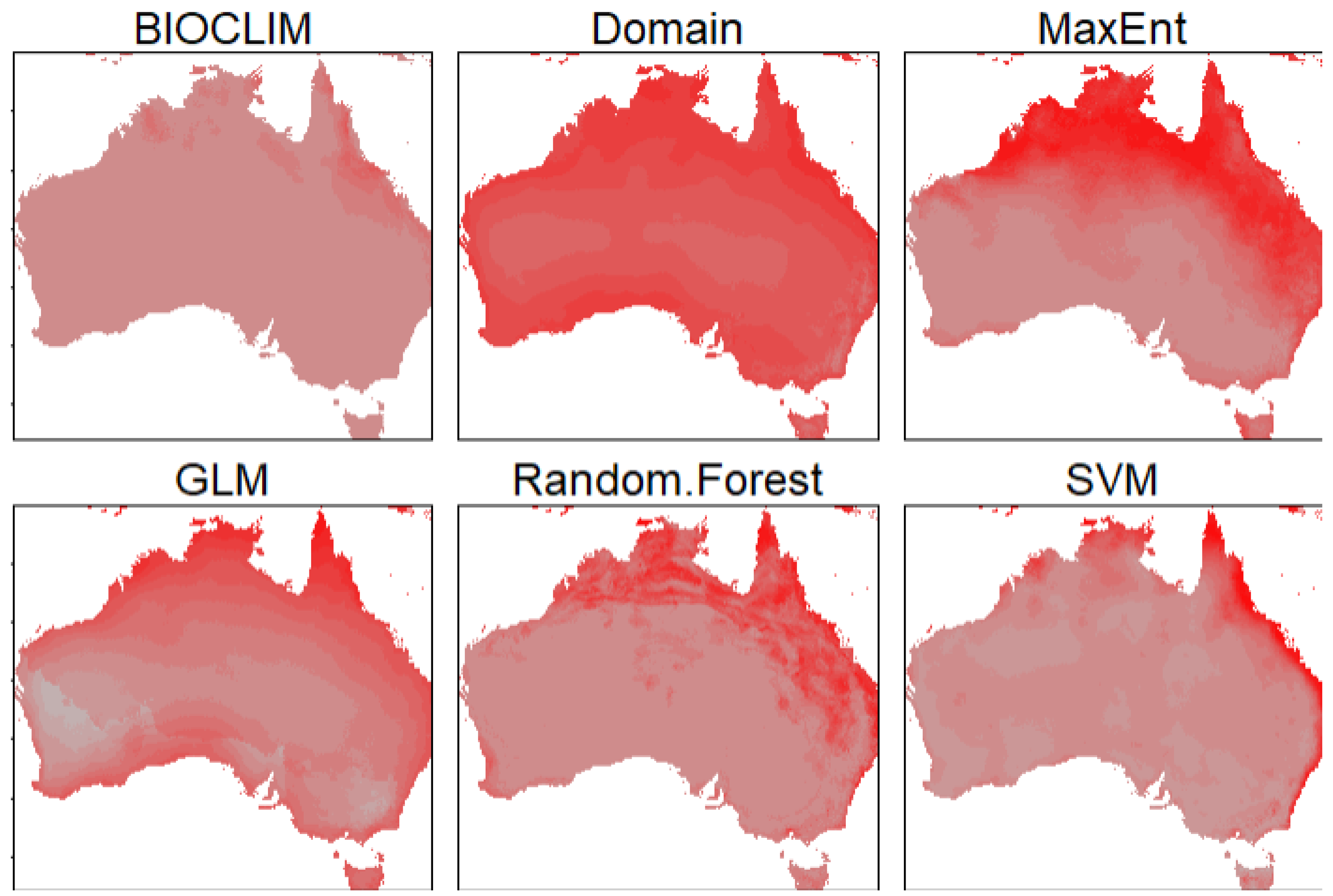

Fig: Model Prediction for each algorithm

CONCLUSION

We extend our heartfelt thanks to Dr. Sarah Supp from Denison University for her invaluable guidance and mentorship throughout this study. We also wish to acknowledge the Global Biodiversity Information Facility (GBIF) and WorldClim for providing the essential data that formed the foundation of our analysis. Our gratitude also goes to our peers for their constructive critiques and to our institutional sponsors for their support.

CITATION

We only add citations of the resources for this posters, Citation for the research itself is cited and mentioned in the research paper, accessed through the QR code in the left: All figures are from the author's own collection.

*Github Repo Citation: Le, H. X. (2024). Modeling the Dynamics of Invasive Species with Distribution Models to Inform Management Strategies: A Case Study on Cane Toads. *GitHub*. https://github.com/HoangLeXuan/modeling-invasive-species
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