Predicting Responses to Hunting Pressure for Tropical Forest Mammals Using Remote Sensing and Machine Learning

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Wednesday, June 18th | ML4EO 2025

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We are experiencing widespread loss of biodiversity

IUCN Red List

28% of assessed species threatened with extinction…

26% of mammals

12% of birds

IUCN Red List. “Summary Statistics.” Online.

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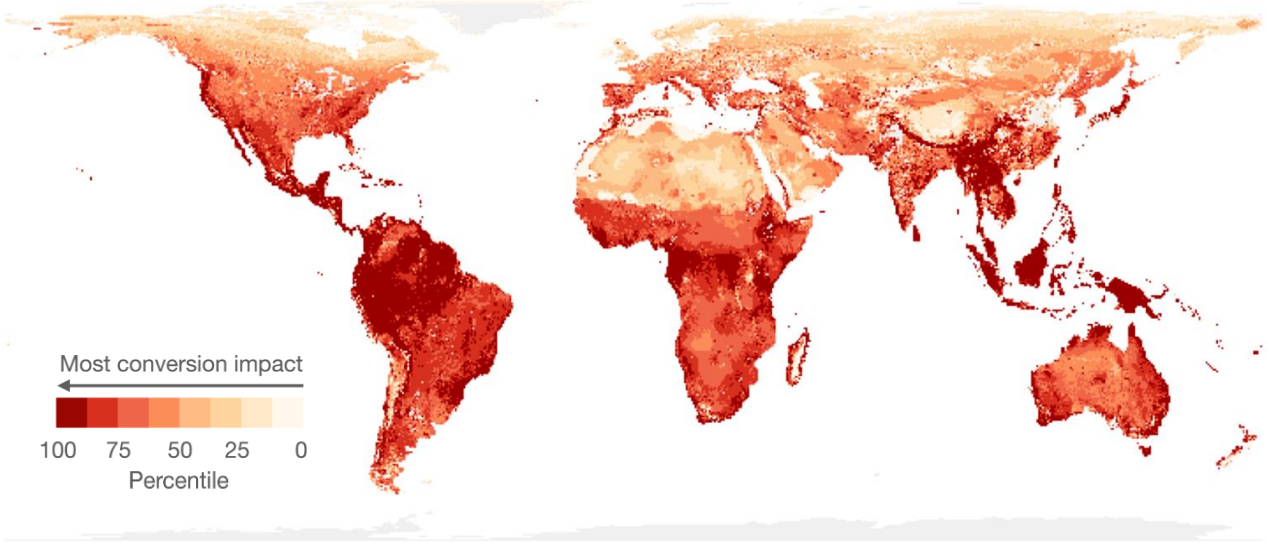
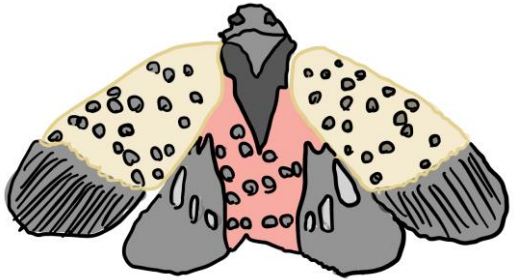
LIFE Metric

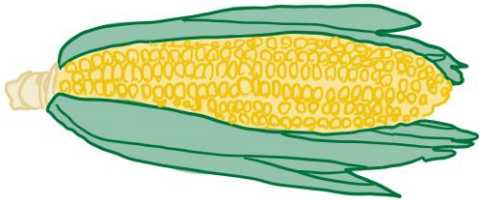


Eyres et al., 2025. *Phil Trans B* 380(1917): 20230327.

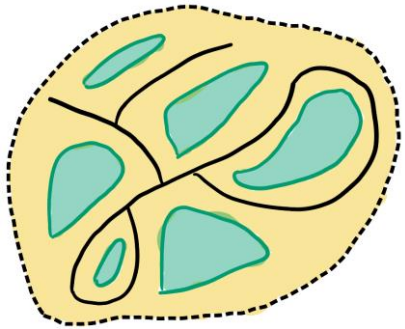
Species are subject to threats other than habitat loss



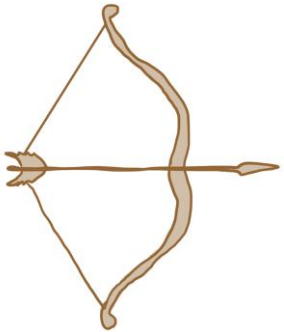
invasive species



agricultural practices

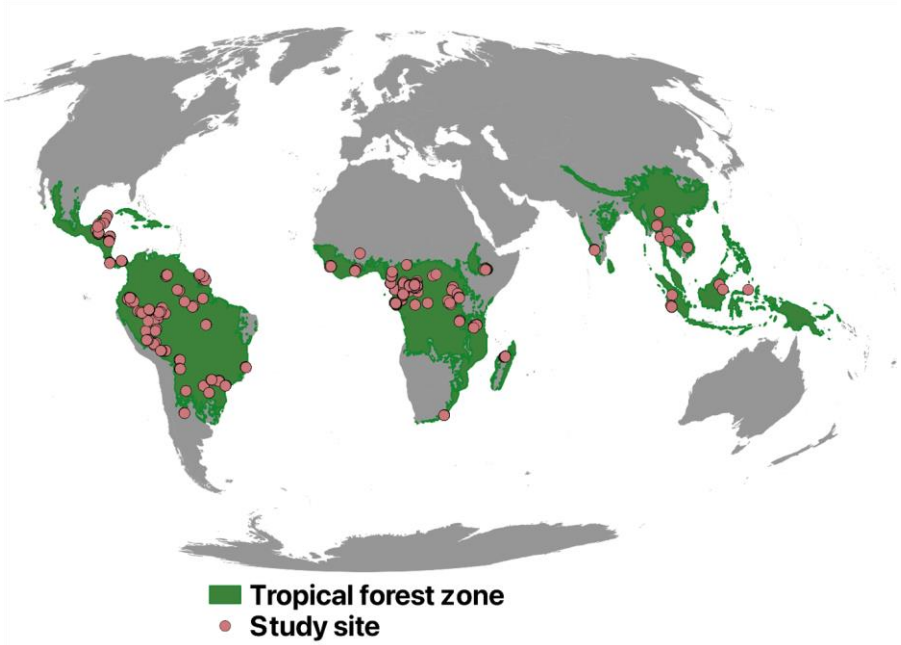


edge effects



hunting

Matched response ratios capture population differences attributable to hunting



Benítez-López et al., 2019. *PLoS Biology* 17.5: e3000247.

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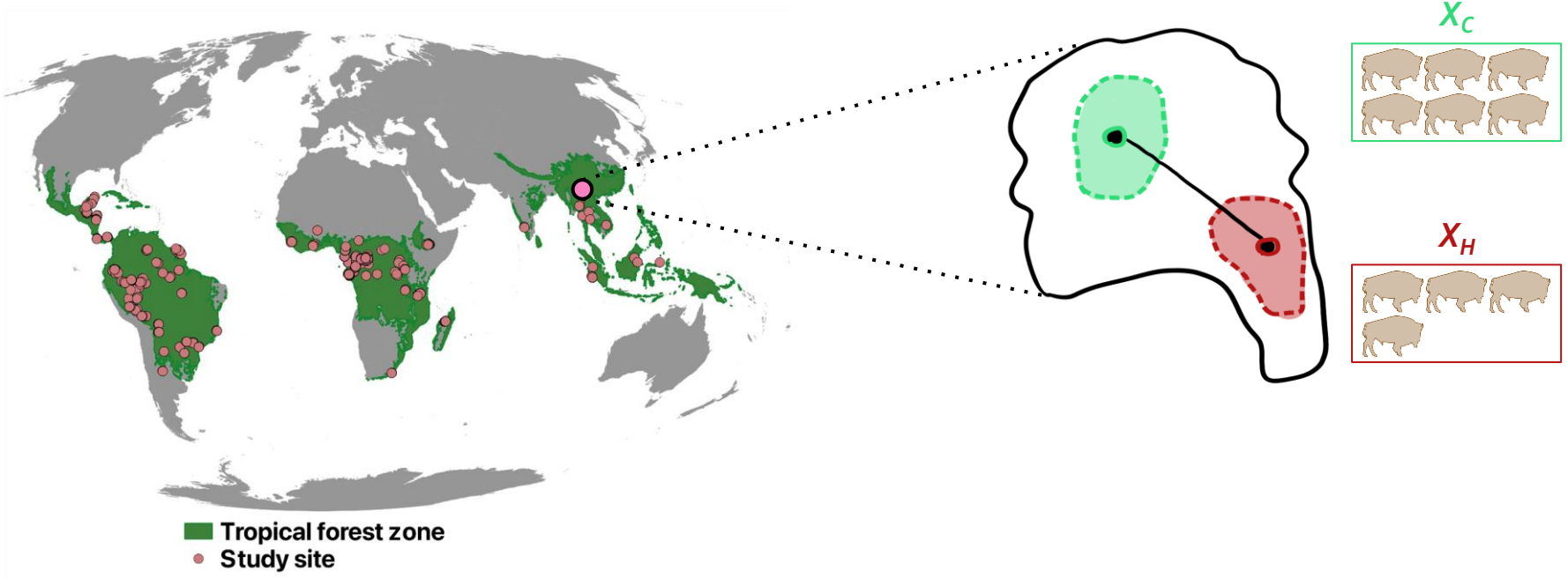

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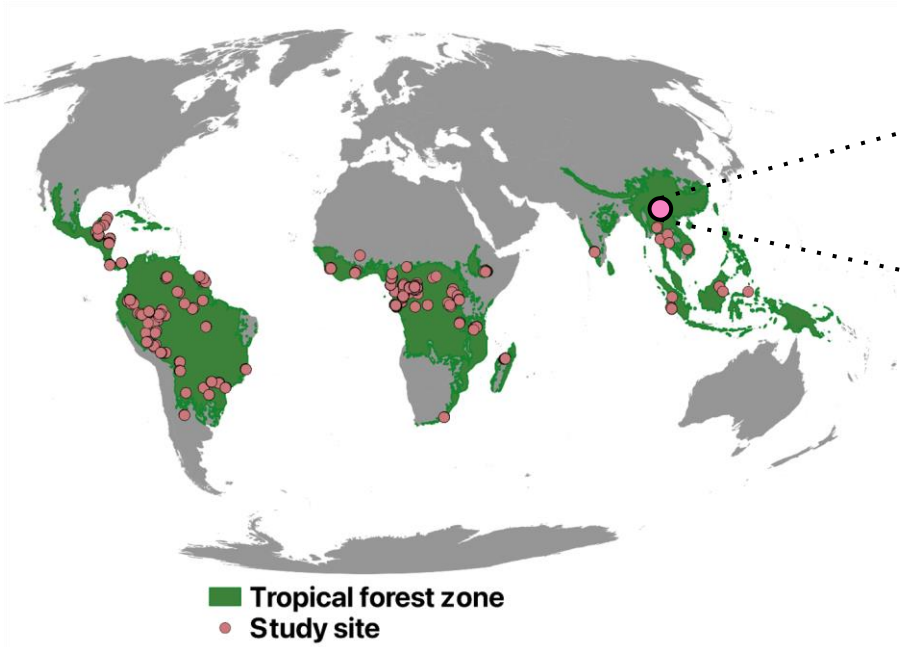
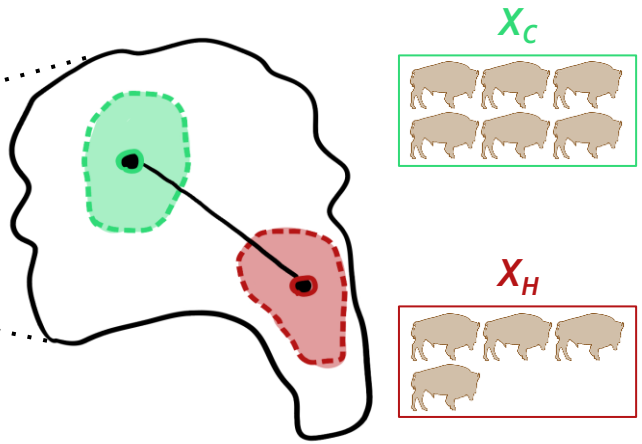
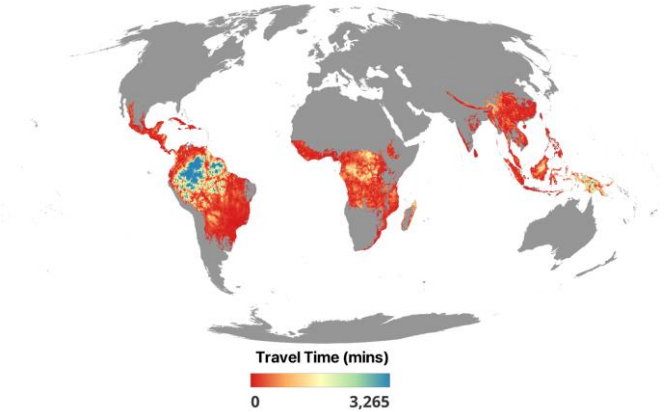




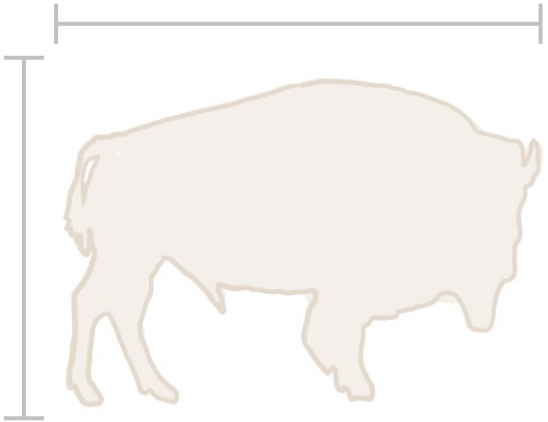
$$RR = \frac{X_H}{X_C} = \frac{\text{🐗🐗🐗🐗🐗}}{\text{🐗🐗🐗🐗🐗🐗🐗}} \approx 0.67$$

Benítez-López et al., 2019. *PLoS Biology* 17.5: e3000247.

Spatial products capture socioeconomic conditions and species traits inform population responses



spatial data



species traits

Benítez-López et al., 2019. *PLoS Biology* 17.5: e3000247.

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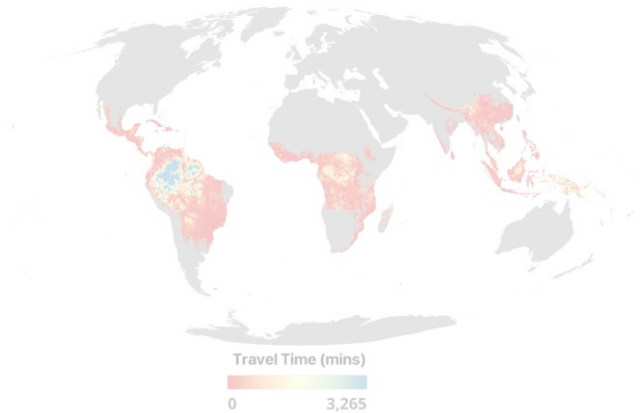

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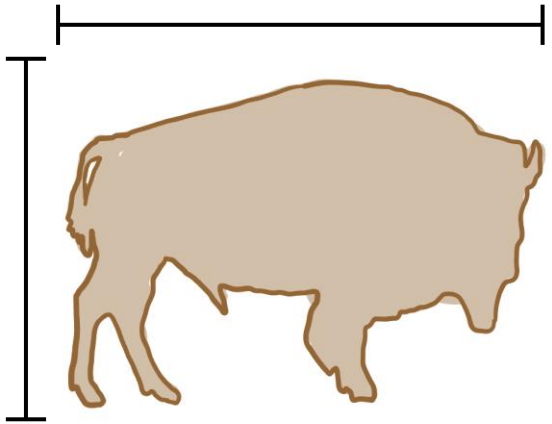

species traits

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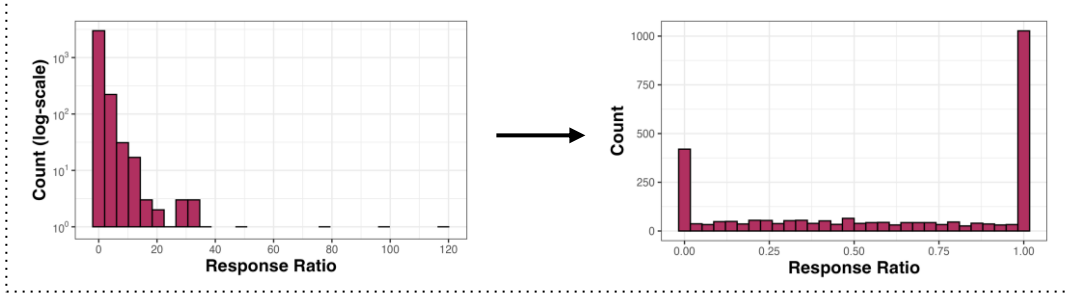
Two-stage hurdle modelling helps address the unusual distribution of response ratios

Two-stage hurdle modelling helps address the unusual distribution of response ratios

predictors



Two-stage hurdle modelling helps address the unusual distribution of response ratios

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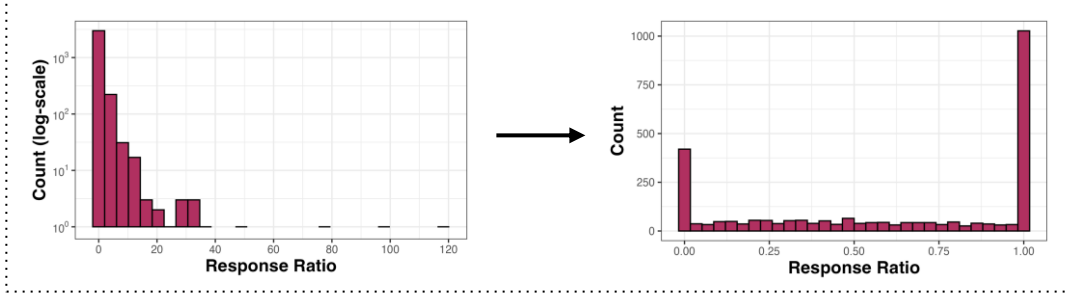

locally extirpated?

yes

response ratio = 0

Two-stage hurdle modelling helps address the unusual distribution of response ratios

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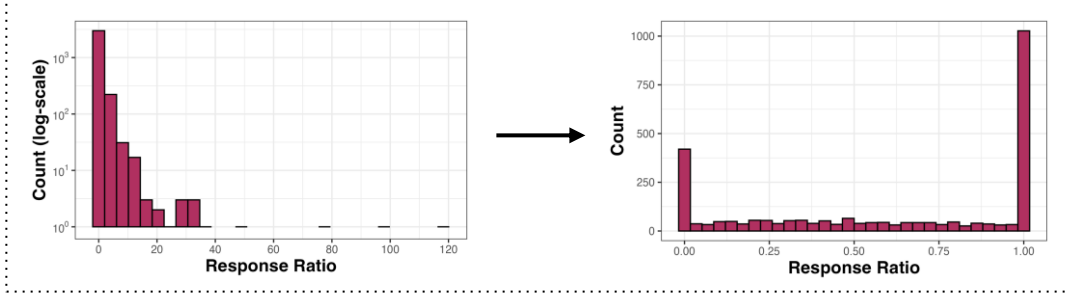


locally extirpated?

no

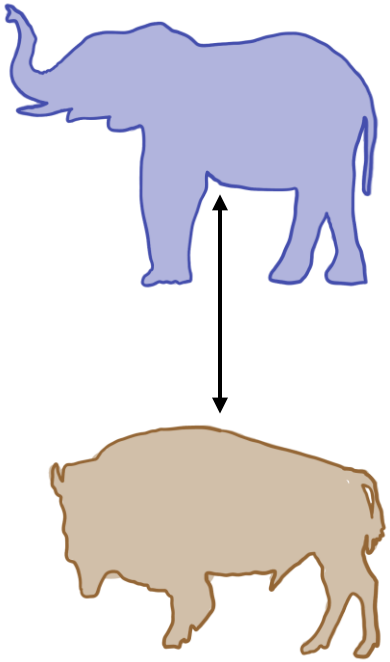
abundance response?

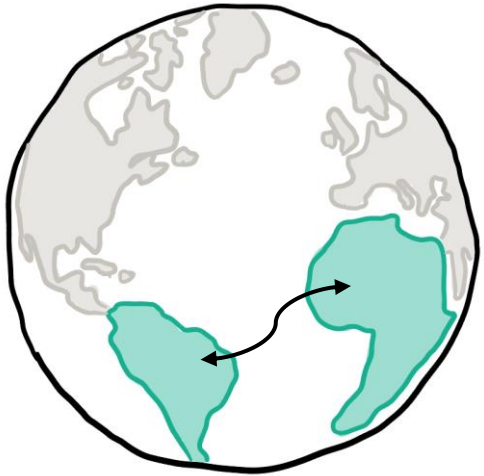
yes

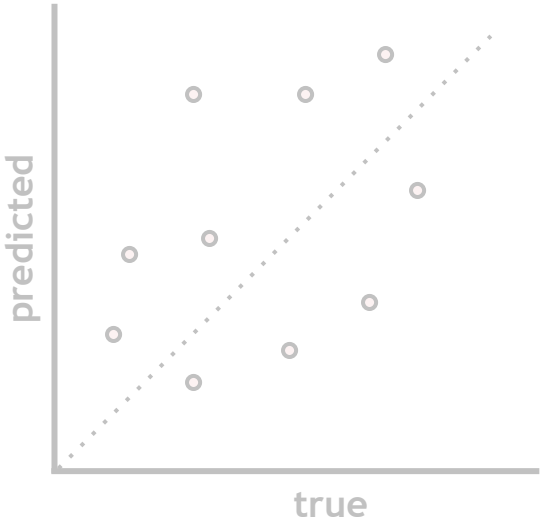
response ratio = 0

response ratio > 0

How do we most effectively evaluate these models?







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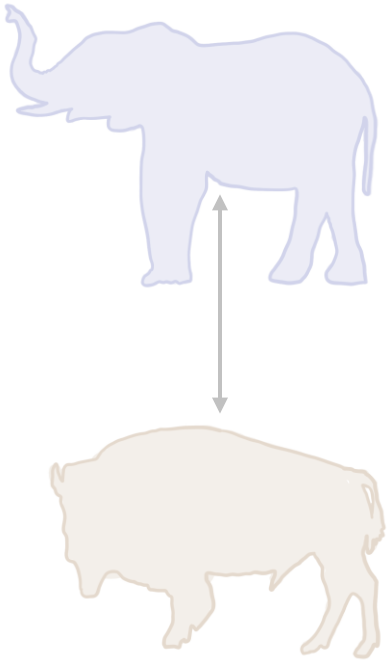

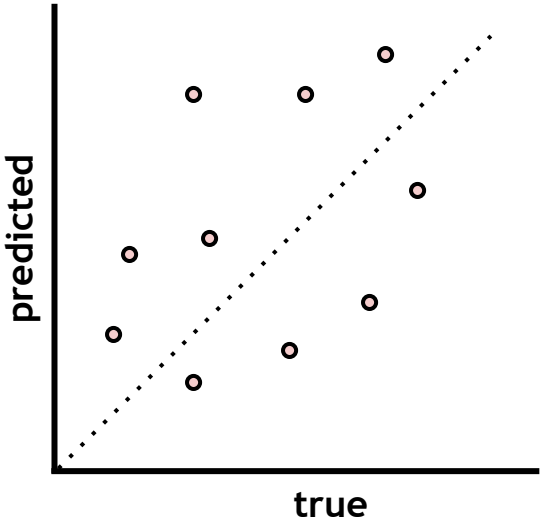

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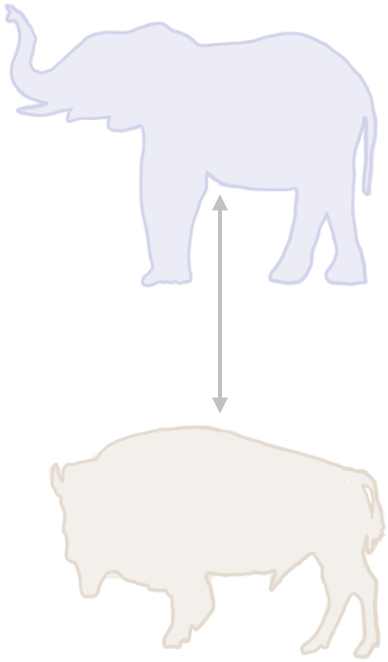

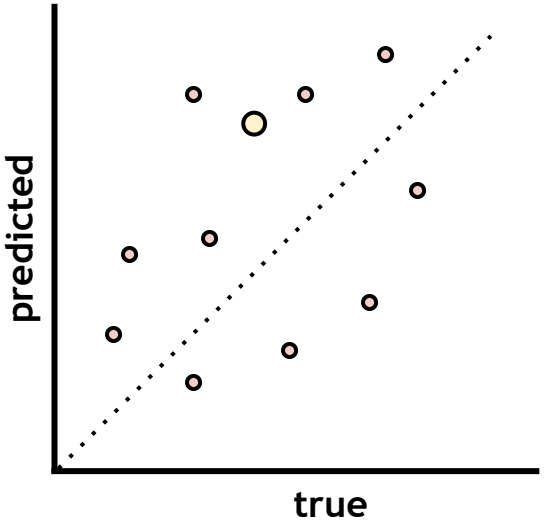

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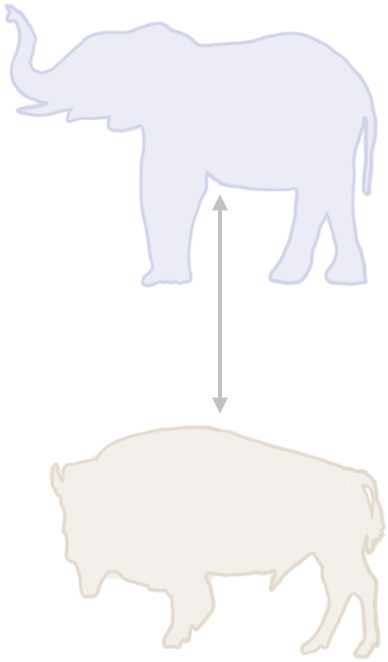

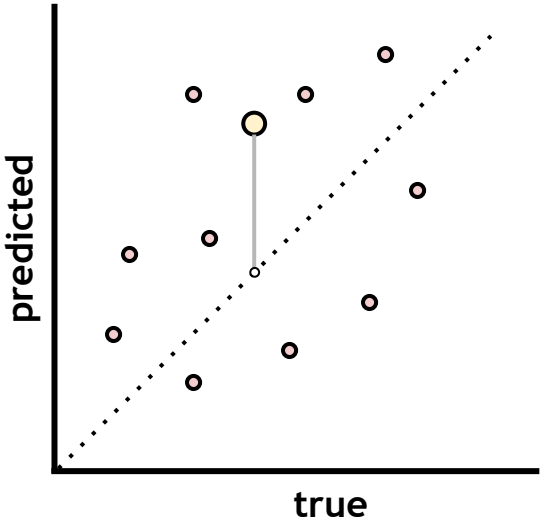

median/mean absolute
(percentage) error

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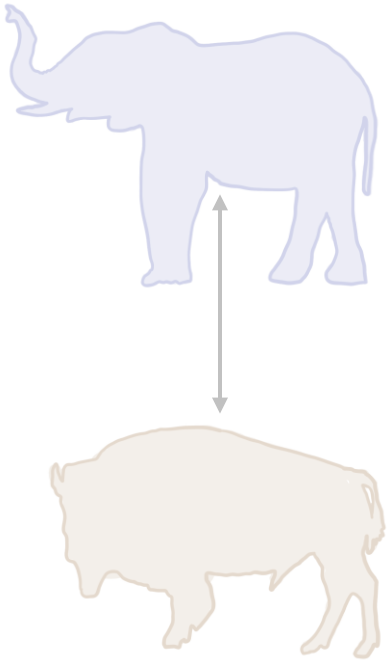
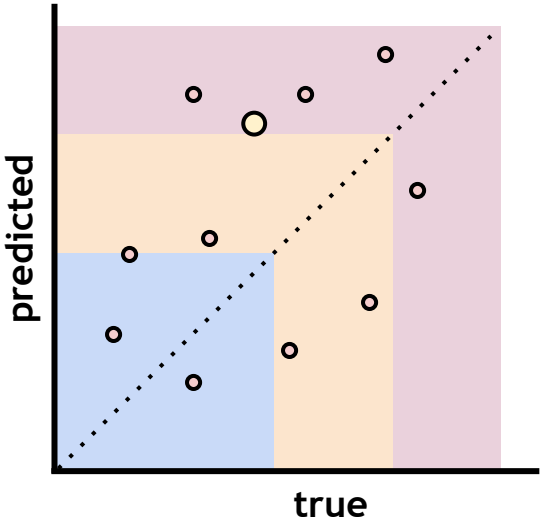
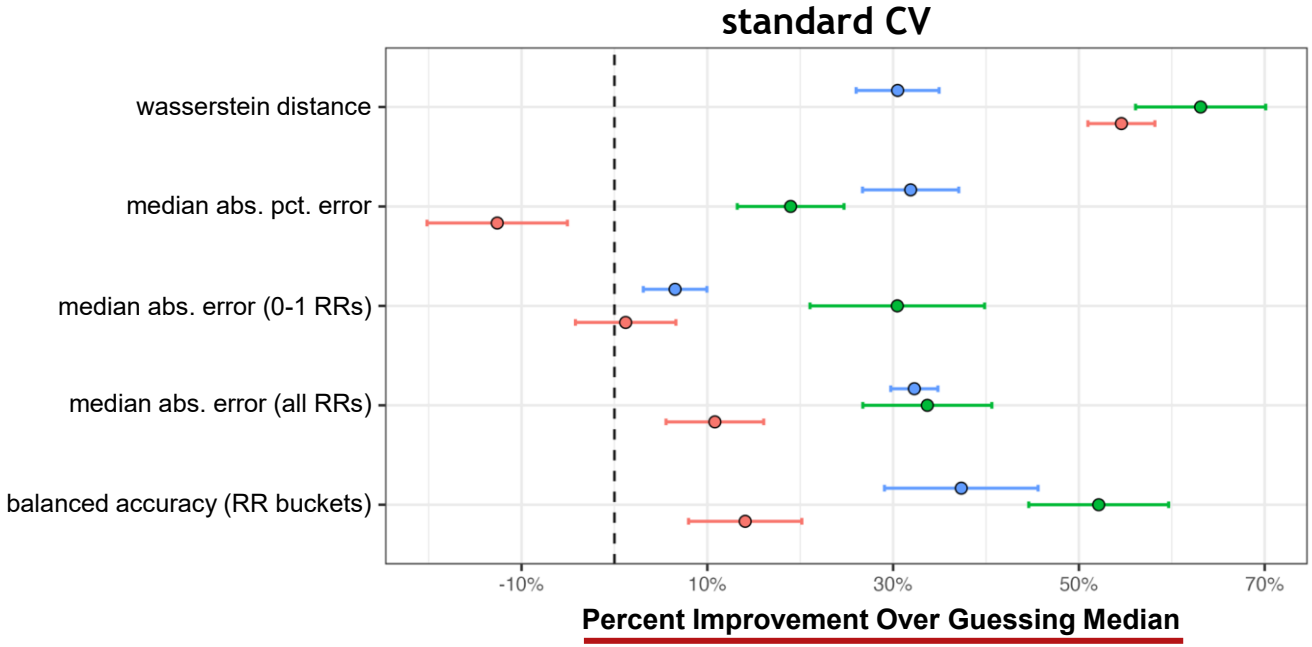


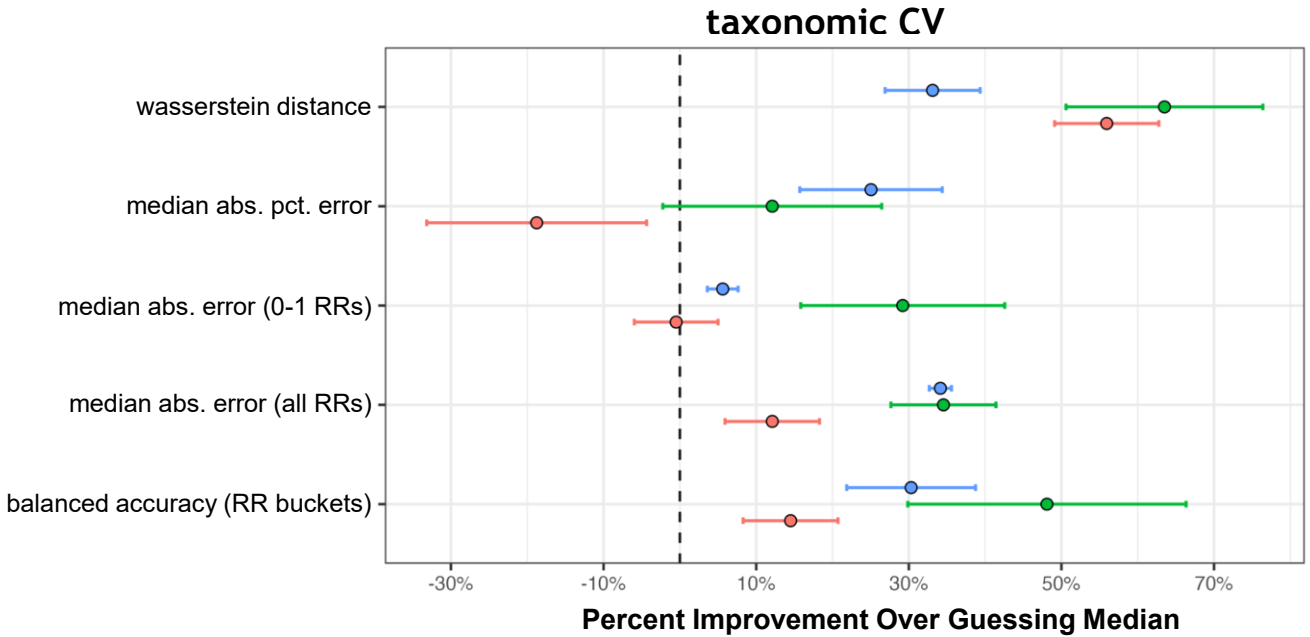


Wasserstein distributional distance and (balanced) accuracy on buckets

Machine learning can accurately predict hunting pressure for mammal species



Taxonomic generalisation is reasonable, but spatial generalisation is difficult



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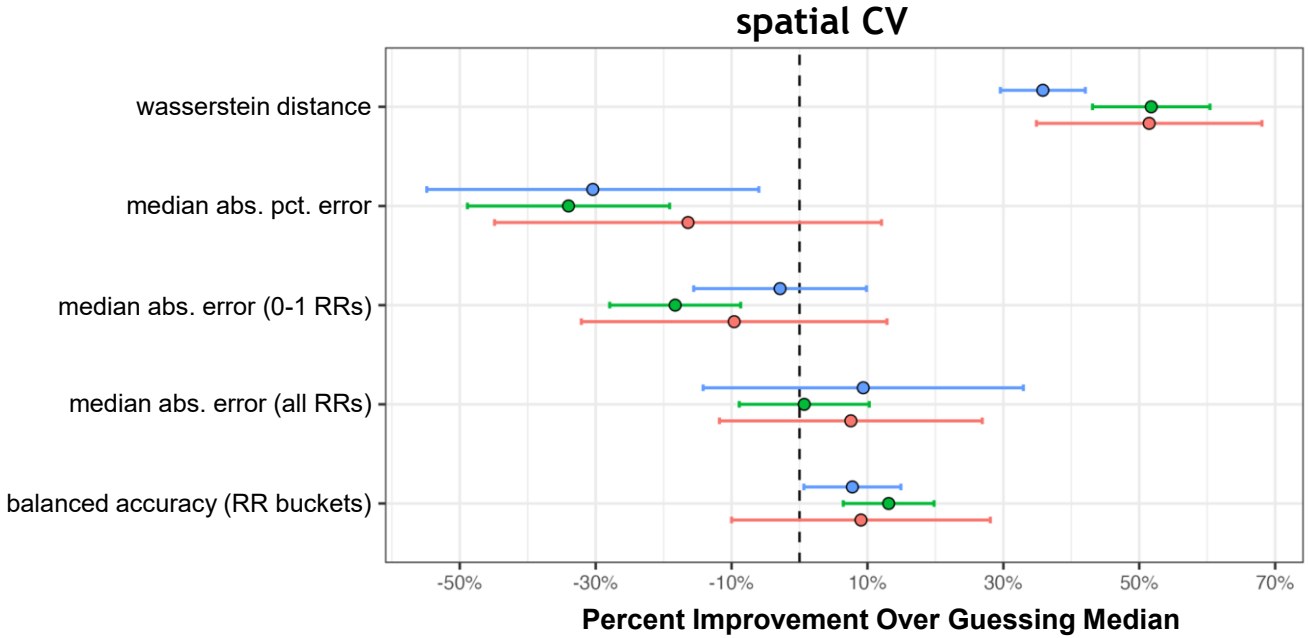
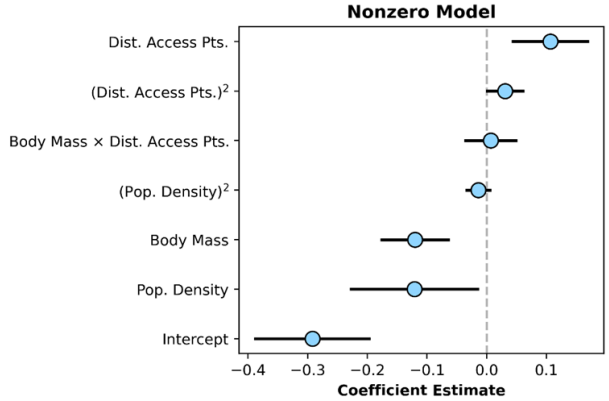
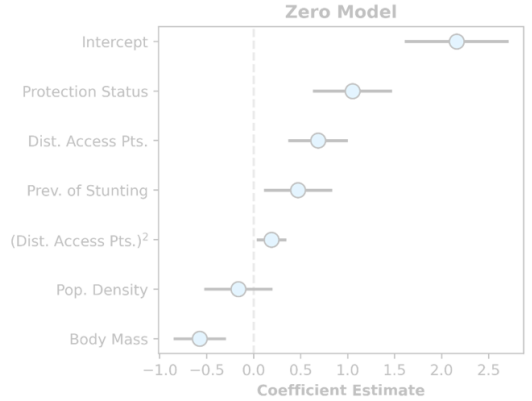


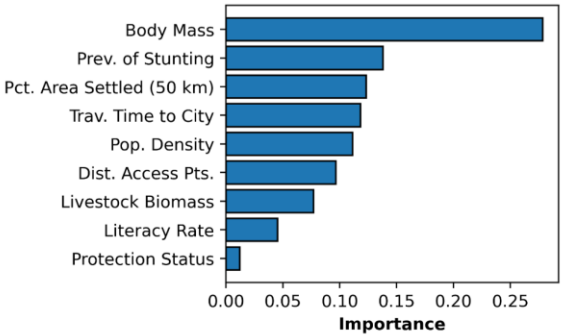
Inspecting fitted coefficients & feature importance scores hints at differences in learned patterns

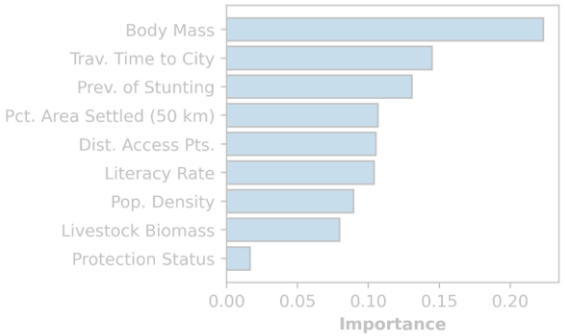
linear model





random forest





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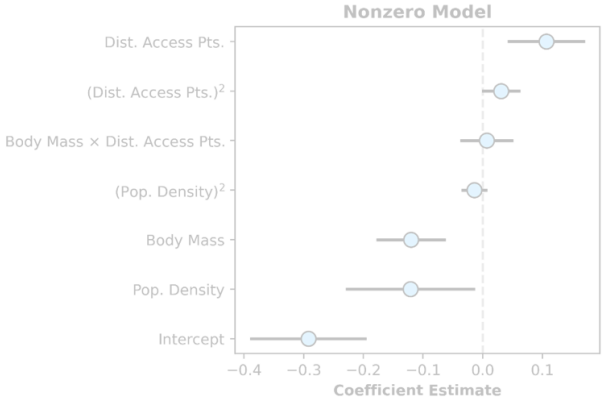

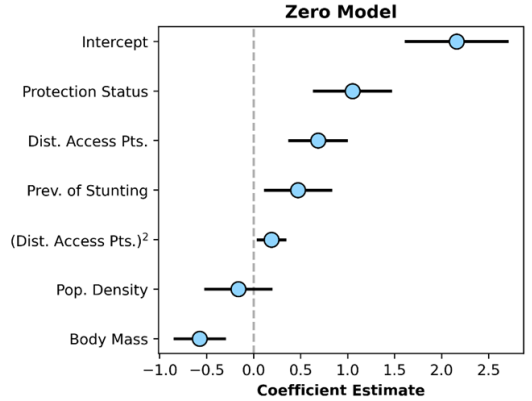

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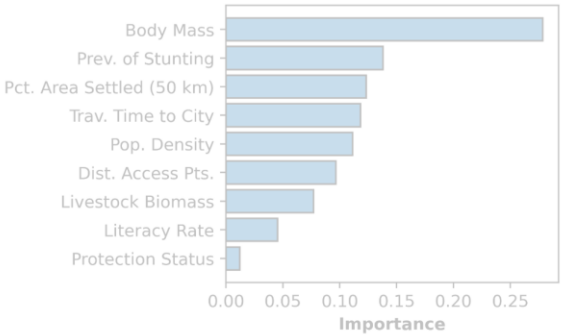
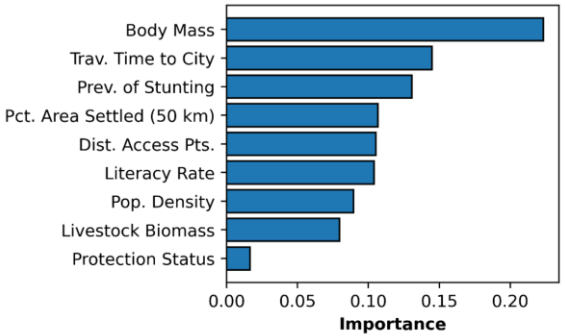
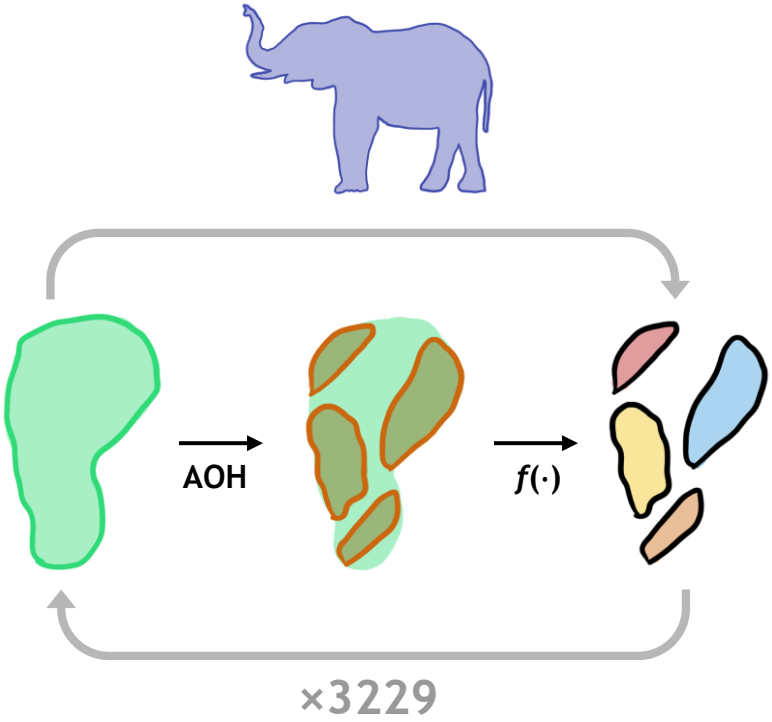




Current work: applying models to all tropical forest mammal species



Questions?

el590@cam.ac.uk