Accounting for land-use intensity & traits in species-area relationships

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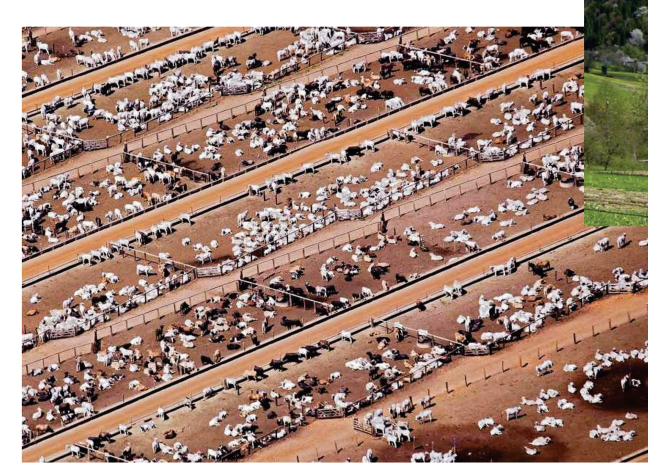
Background

- Land-use change is the single biggest cause of biodiversity loss.
- Assessing the relationship between land use & biodiversity is therefore crucial.
- Species-area relationships (SARs) provide an avenue to predict species richness (SR) & biodiversity loss.
- Classic SARs assume a hostile matrix - no species survive in an agricultural landscape.
- SARs now differentiate between agricultural and natural land but do not consider land-use intensity.

Intensive cotton production, Mato Grosso, Brazil, F. Gollnow

- Classifying an area as either agricultural or natural may be an over-simplification considering the large variety in intensity of land-use and impact on biodiversity.
- We developed a SAR regression model for mammal SR that accounts for biomes, land cover & land-use intensity (LUI).

Intensive monocultures, Valensole Plateau, France, J. Nilsen



Left: Intensive livestock, Brazil, P. Beltra.
Above: Low intensity farmland, Ukraine, T. Kuemmerle

Research hypotheses:

1. Land cover & LUI will perform as well as biomes in predicting SR.
2. SARs that incorporate LUI will differ.
3. SARs will be trait specific.

Predicting Species Richness

- Land cover & LUI in the form of % of Human Appropriation of Net Primary Productivity (HANPP %) performed as well as biomes in predicting SR (Table 1).
- Lower levels of HANPP were associated with higher SR (Fig. 1).
- Other LUI metrics varied considerably in their ability to predict SR.
- Results highlight the variability of relationships of LUI & biodiversity depending on the choice of LUI metric.
- Results suggest that global IUCN mammal range maps include a substantial land-use footprint.

Fig 1: Species-Area Relationship for high, med. & low levels of HANPP

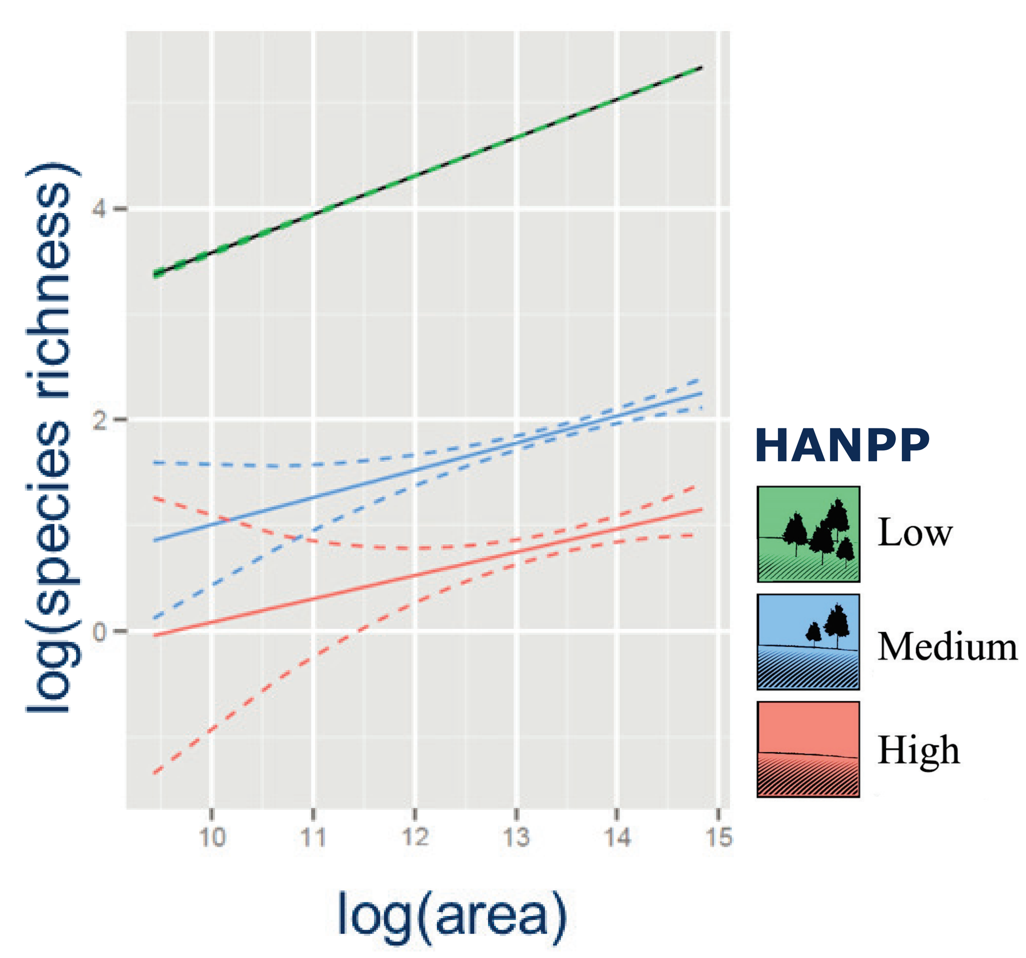


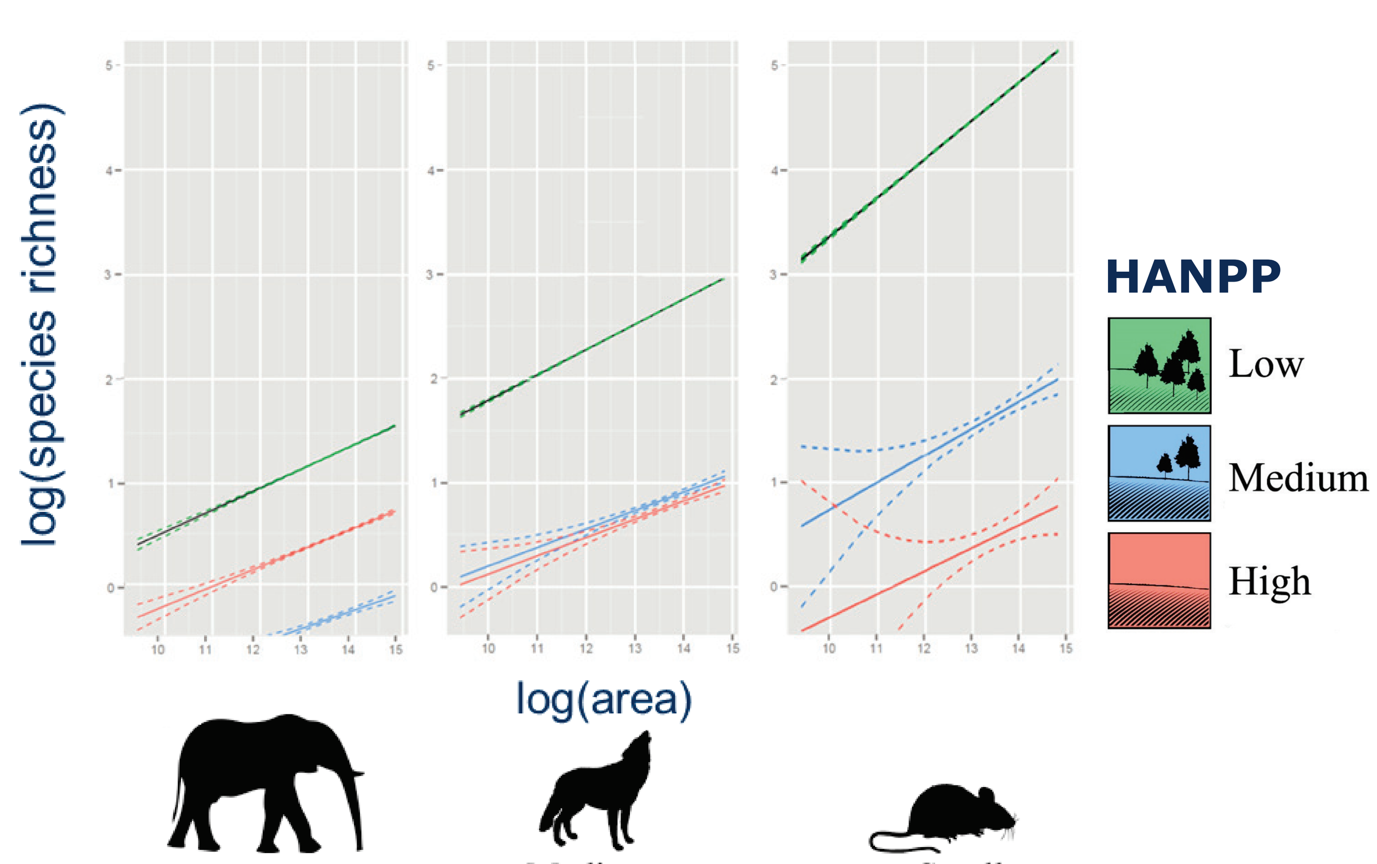
Table 1: 10 fold cross validation of models

	ΔAIC	R^2	RMSE
HANPP %	0	0.49	0.63
Land Cover	2.95	0.45	0.71
Biomes	11.82	0.48	0.67
Fertiliser Input	28.87	0.44	0.66
Cereal Yields	47.75	0.31	0.72
Livestock Density	49.93	0.38	0.68
Irrigation	55.81	0.26	0.74
Global *area only	80.31	0.16	0.78

Species Traits & LUI

- Splitting results by species traits helps us understand which species are potentially more at risk under different levels of LUI.
- We found that SARs were trait specific with diet specialists and small body mass exhibiting the steepest slopes and thus the most sensitivity to changes in area.
- In terms of interactions between species traits and LUI:
  - Large mammals had lower species richness in medium to high LUI
  - Medium sized mammals (10-100kg) had the same species richness under medium and high LUI
  - Small mammals (<10kg) had an inverse relationship with LUI (Fig. 2).

Fig 2: Species-Area Relationship split by body size for high, med. & low level HANPP



Conclusion

Our main finding, that LUI & land cover perform as well as biomes in predicting species richness, supports the argument that we have entered the anthropocene – a new era in which human factors are as important as climate & environment in shaping global patterns of SR.

References for LUI metrics

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