Area of Habitat models for the world's terrestrial birds and mammals

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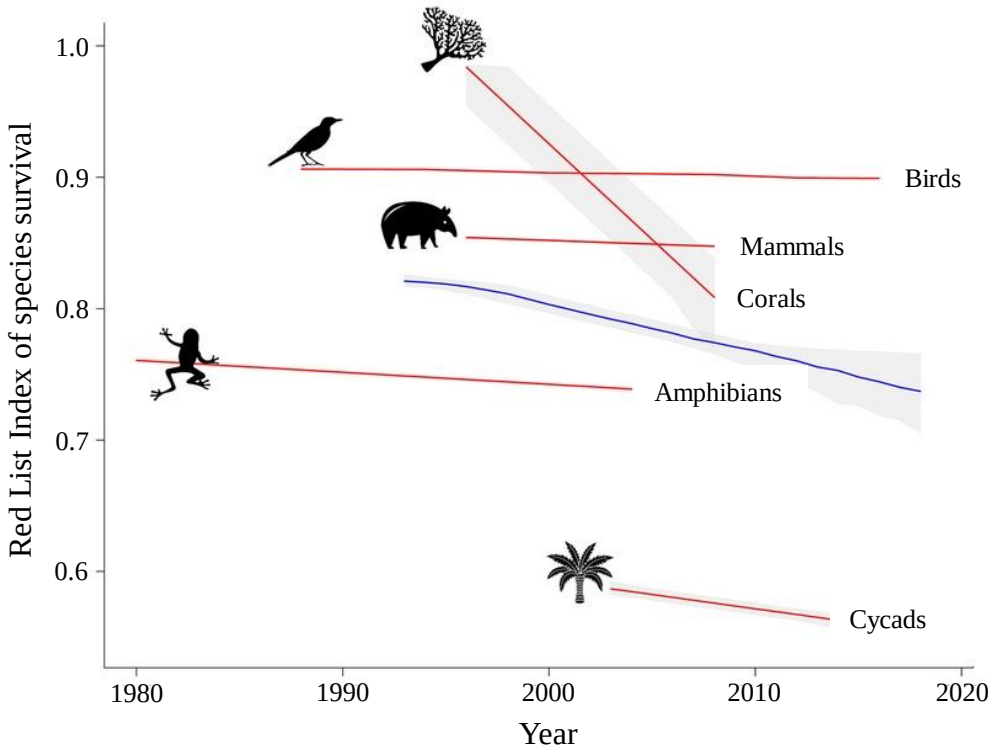
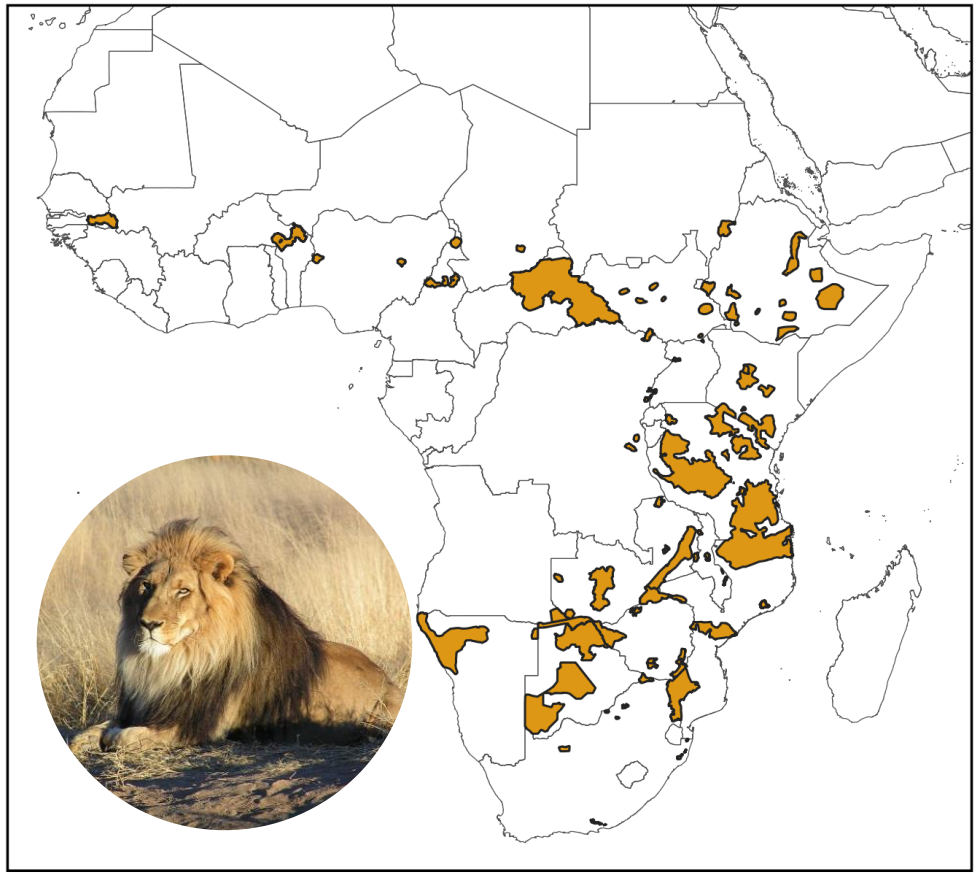
Biodiversity crisis

- Biodiversity loss crisis
- Habitat destruction is the major driver of biodiversity loss
- Area-based conservation prevents species extinction and protects habitats
- Knowing where specie are is crucial for conservation action

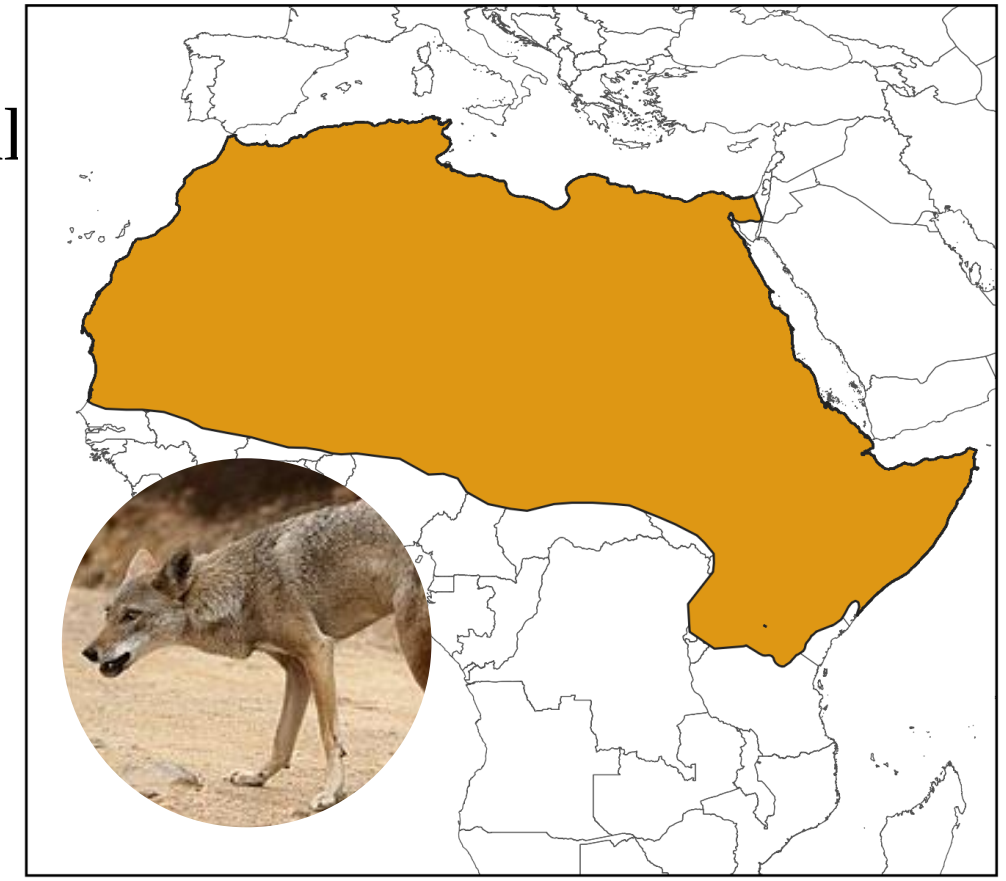


IUCN Red List geographical ranges

- Globally are the most comprehensive dataset available



Lion
(Panthera leo)

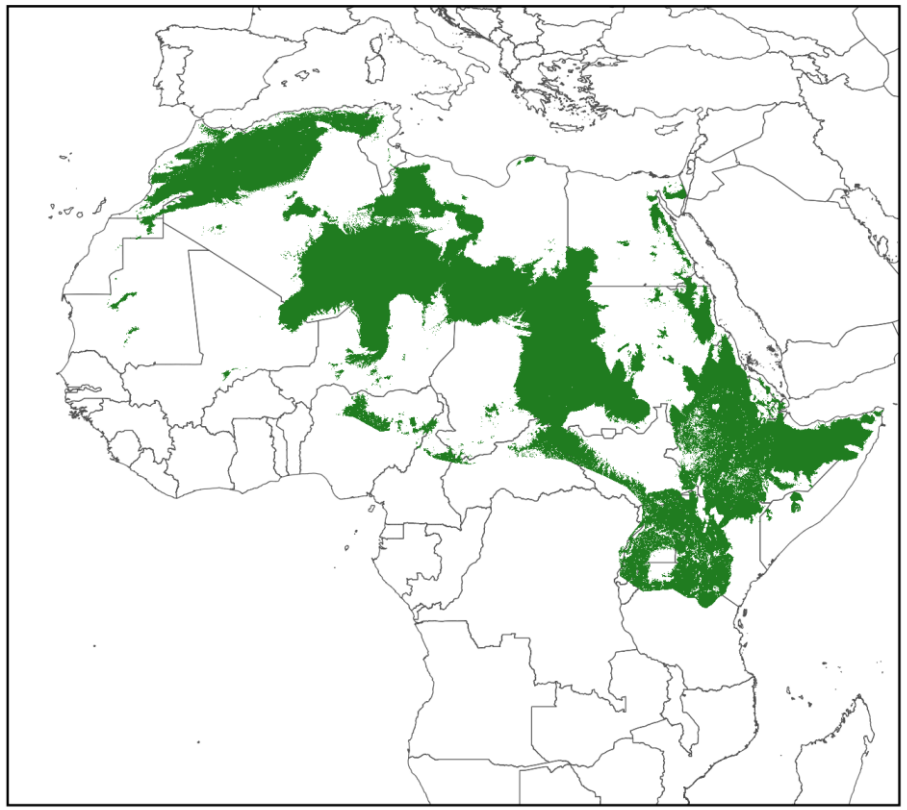


African Wolf
(Canis lupaster)

Area of habitat (AOH)

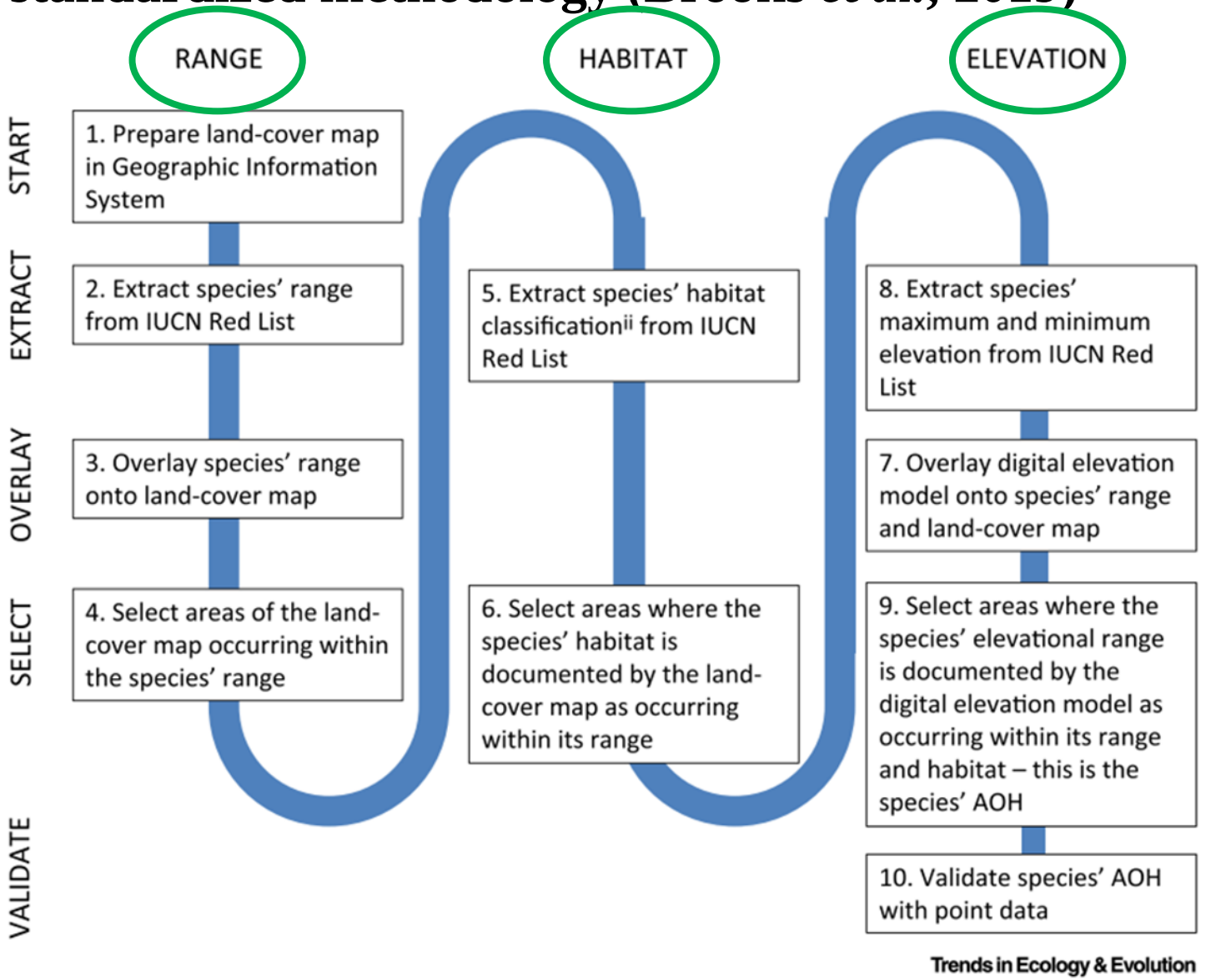
DEFINITION:

“habitat available to a species, that is, habitat within its range”



Workflow Area of Habitat

- **New and standardized methodology (Brooks *et al.*, 2019)**



Range maps & elevation limits

- Range maps and elevation limits are available on the IUCN website

- Manually enter elevation information for more than 600 species

Geographic Range

NATIVE

Extant (resident)

China (Chongqing, Guangxi, Guizhou); Viet Nam

NUMBER OF LOCATIONS

UPPER ELEVATION LIMIT

600 metres

LOWER ELEVATION LIMIT

100 metres

Habitat

HABITAT: IUCN Habitat Classification Scheme

- No GIS based

- Link between IUCN habitat and land cover map

- Previous crosswalks are expert-based and have not been validated

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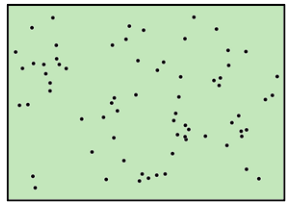
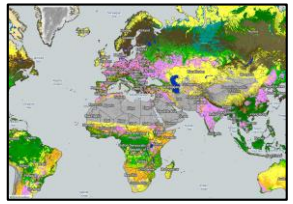
Translating habitat classes to land cover

METHODS



Occurrence points data

GBIF/eBird

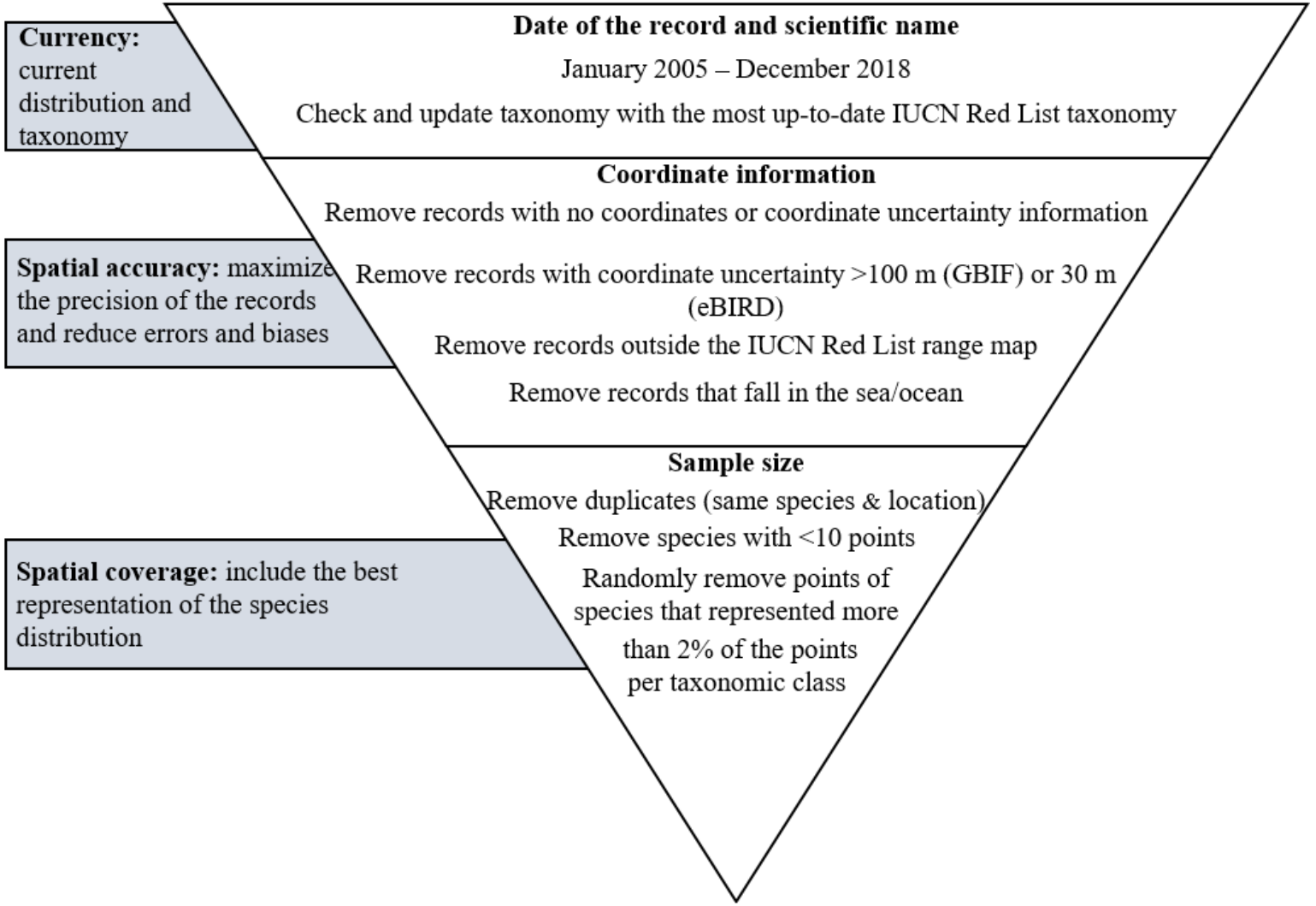


Land cover :

ESA-CCI 2015, 300m

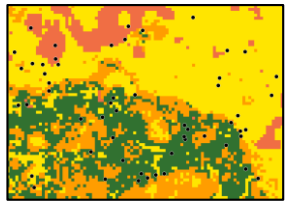
CGLS-LC100 2019, 100m

IUCN Red List Habitat Classification Scheme level 1 (artificial level 2)

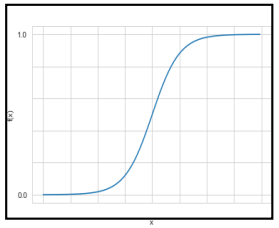


Translating habitat classes to land cover

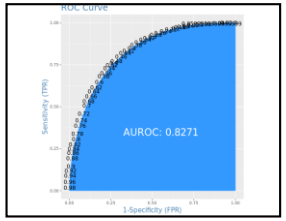
METHODS



Processing: Extracted the land-cover class at the coordinates of each point locality and associated to the habitat class/es



Modelling: **Land cover class = f (habitat class)** + Random effects (species + country)



Validating : training/ test data → Area Under the Curve (AUC)

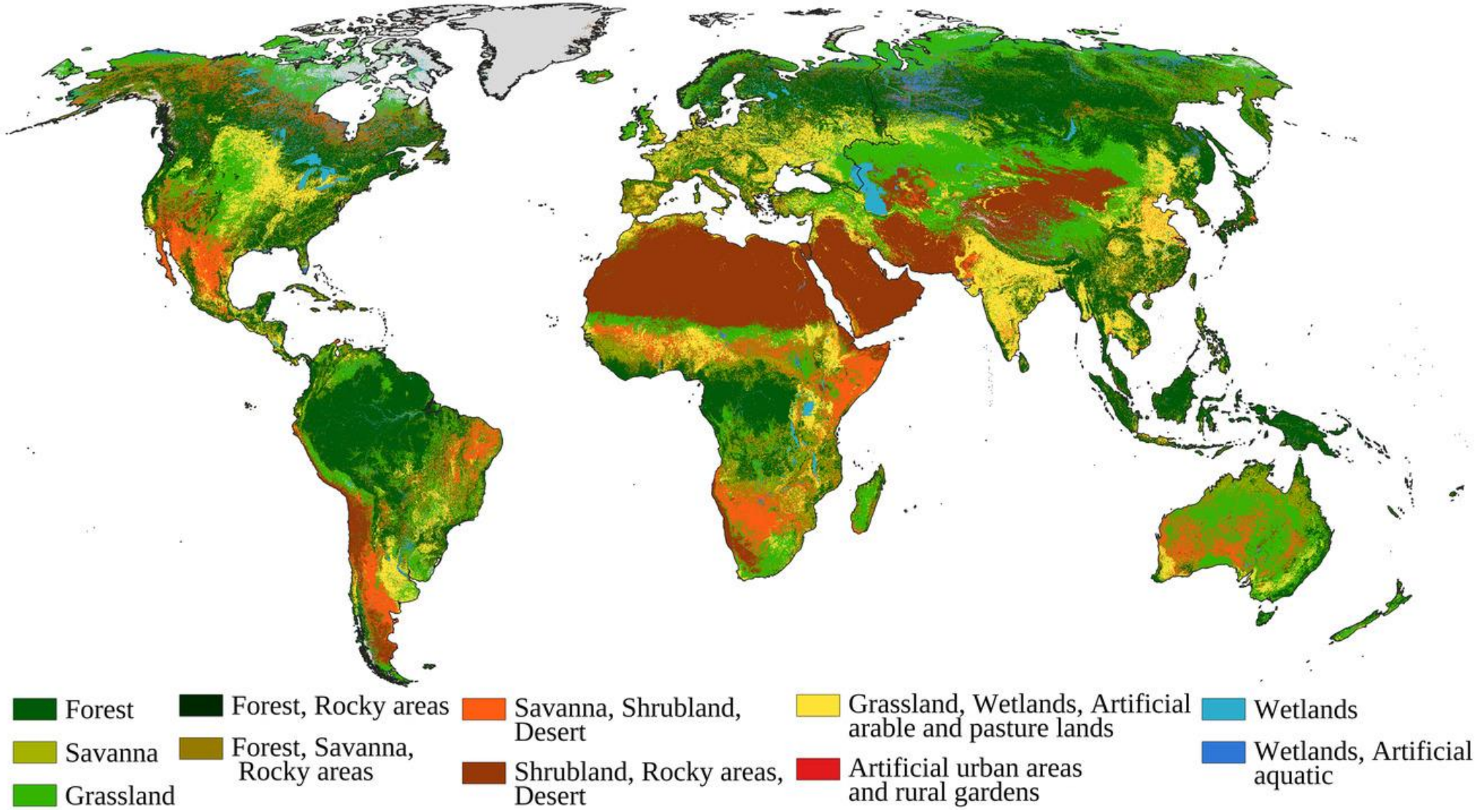
Comparing: Test against an expert based translation table

Translating habitat classes to land cover

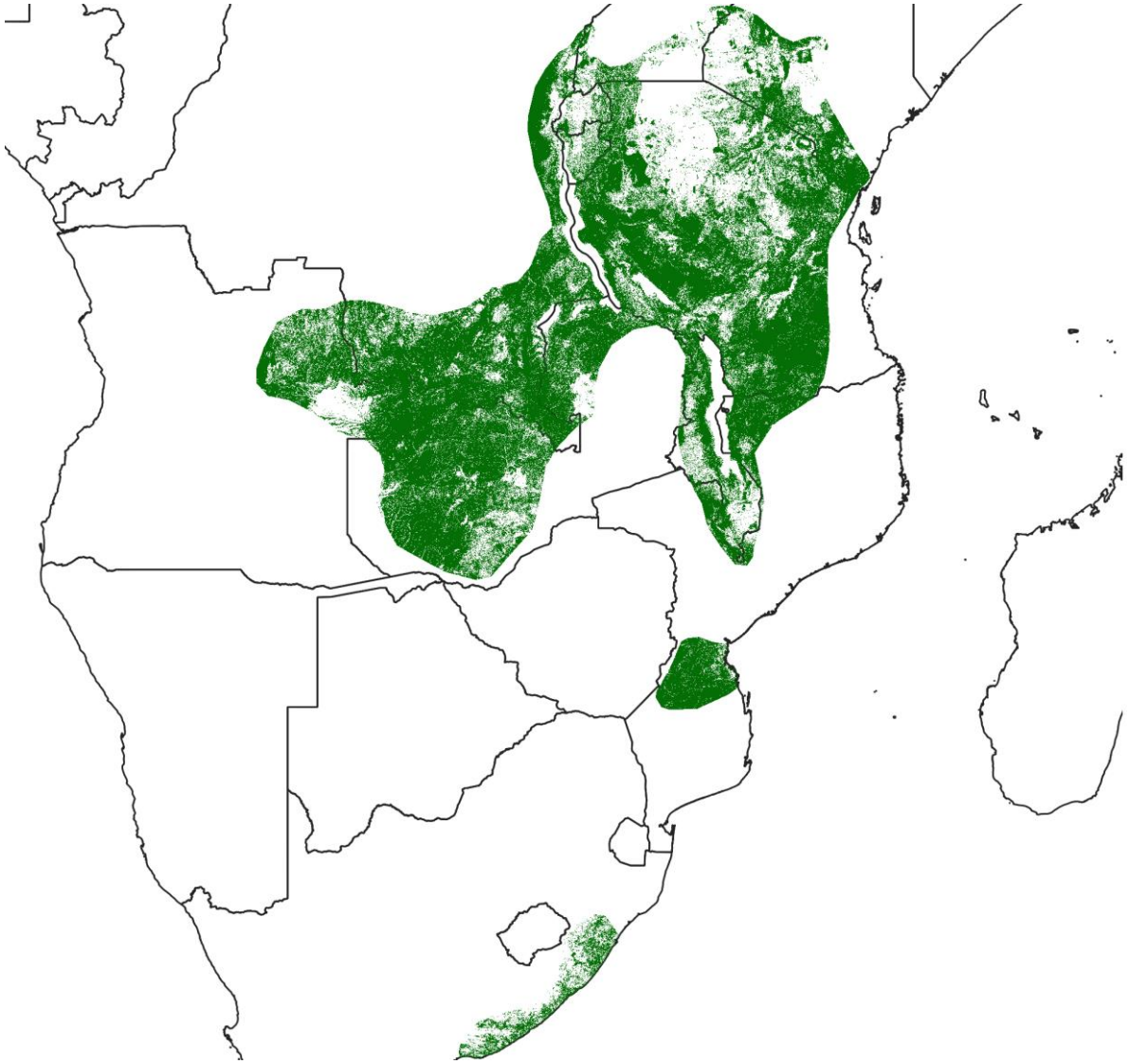
IUCN habitat class / Land-cover class	Number point	Forest	Savanna	Shrubland	Grassland	Wetlands	Rocky areas	Desert	Artificial arable and pasture lands	Artificial degraded forest and plantation	Artificial urban areas and rural gardens	Artificial aquatic	AUC
Shrubs	264166	0.309	1.870	2.683	1.188	-	1.383	4.225	-	0.711	-	-	0.882
Herbaceous vegetation	531007	0.372	1.180	1.622	2.369	1.204	1.506	1.517	1.296	0.880	1.262	-	0.793
Cultivated and managed vegetation agriculture	470123	0.588	1.570	1.395	1.748	1.875	0.687	-	1.743	-	1.330	1.523	0.807
Urban / built up	412978	-	-	1.362	-	1.351	-	-	1.488	1.293	3.183	1.696	0.763
Bare / sparse vegetation	30746	0.139	-	2.026	1.524	-	3.380	8.192	-	0.489	-	-	0.924
Permanent water bodies	112799	0.603	-	-	-	2.189	-	0.698	1.236	-	1.447	1.712	0.745
Herbaceous wetland	87084	0.732	1.240	-	1.248	3.185	0.631	0.367	1.215	1.220	1.396	2.360	0.827
Closed forest, evergreen needle leaf	415369	3.824	0.384	-	0.706	-	-	0.229	0.592	0.530	-	0.674	0.885
Closed forest, deciduous needle leaf	630019	13.720	0.455	0.382	0.475	-	0.483	0.052	0.735	1.516	0.748	-	0.940
Closed forest, deciduous broad leaf	311541	2.520	1.704	-	-	1.560	-	0.174	-	-	1.435	-	0.867
Closed forest, mixed	60555	5.461	0.548	0.671	-	1.523	-	-	-	-	-	-	0.906
Closed forest, unknown	128975	1.971	-	-	-	1.312	-	0.389	-	1.264	-	1.345	0.736
Open forest, evergreen needle leaf	108686	2.171	0.476	-	-	-	1.790	0.578	-	0.454	-	-	0.856
Open forest, evergreen broad leaf	49487	2.442	0.801	-	-	-	0.562	0.160	-	1.566	-	-	0.894
Open forest, deciduous broad leaf	103555	1.391	2.172	-	-	1.658	-	0.251	-	-	1.398	-	0.854
Open forest, mixed	2758	3.038	-	-	-	-	-	-	-	-	-	-	0.899
Open forest, unknown	773407	1.138	1.368	1.284	-	1.302	-	0.673	1.221	1.138	1.167	1.341	0.644

Low positive association (odds ratio = 1.138 - 1.351) **Medium positive association (odds ratio = 1.362 - 1.712)** **High positive association (odds ratio = 1.743 - 13.720)**
Negative association **Non significant association**

Translating habitat classes to land cover



Mapping Area of Habitat



Southern Tree Hyrax

Elevation : 0 – 4000 m

Habitat: Forest, Savanna, Rocky Areas

Mapping Area of Habitat

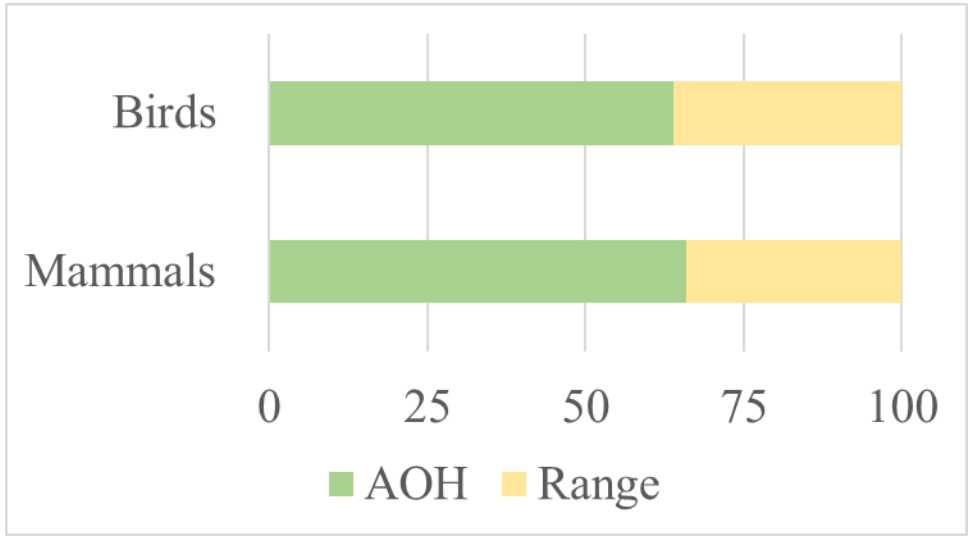
RESULTS

Birds = 10,651 sp
Mammals = 5,841 sp

Breeding
Non-breeding
Resident

Resolution 100 m

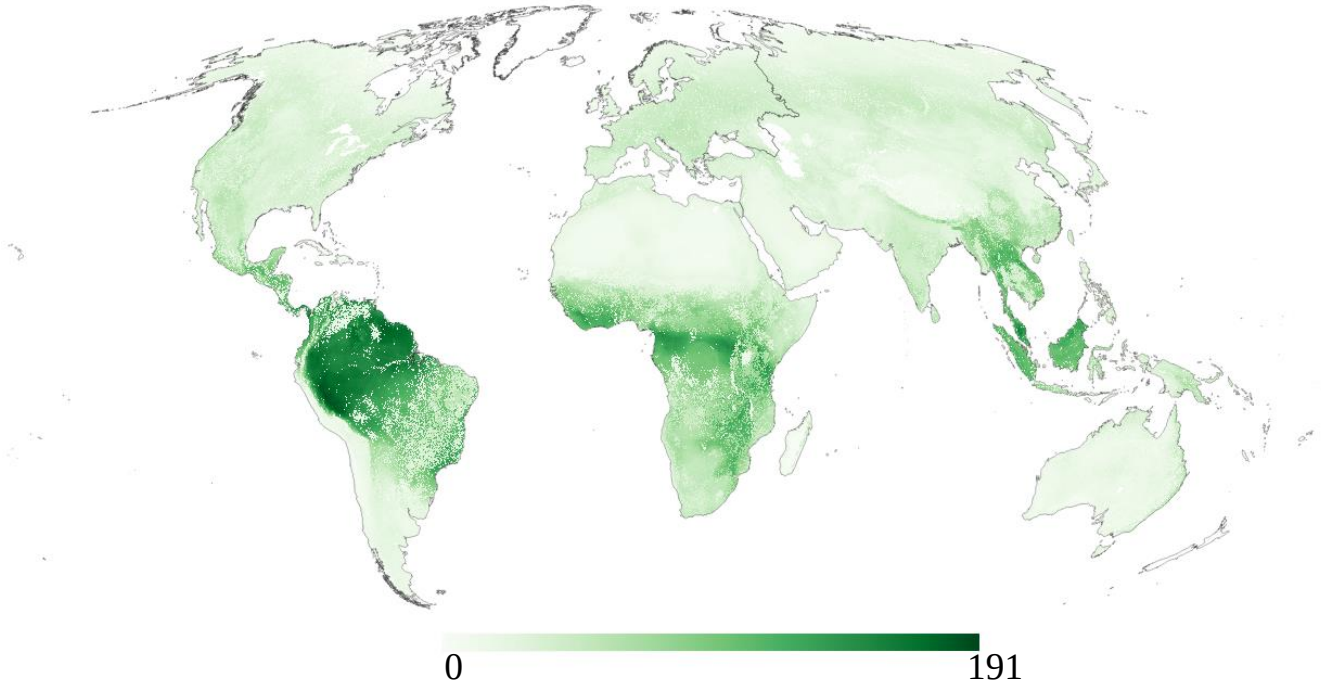
AOH vs IUCN geographical range



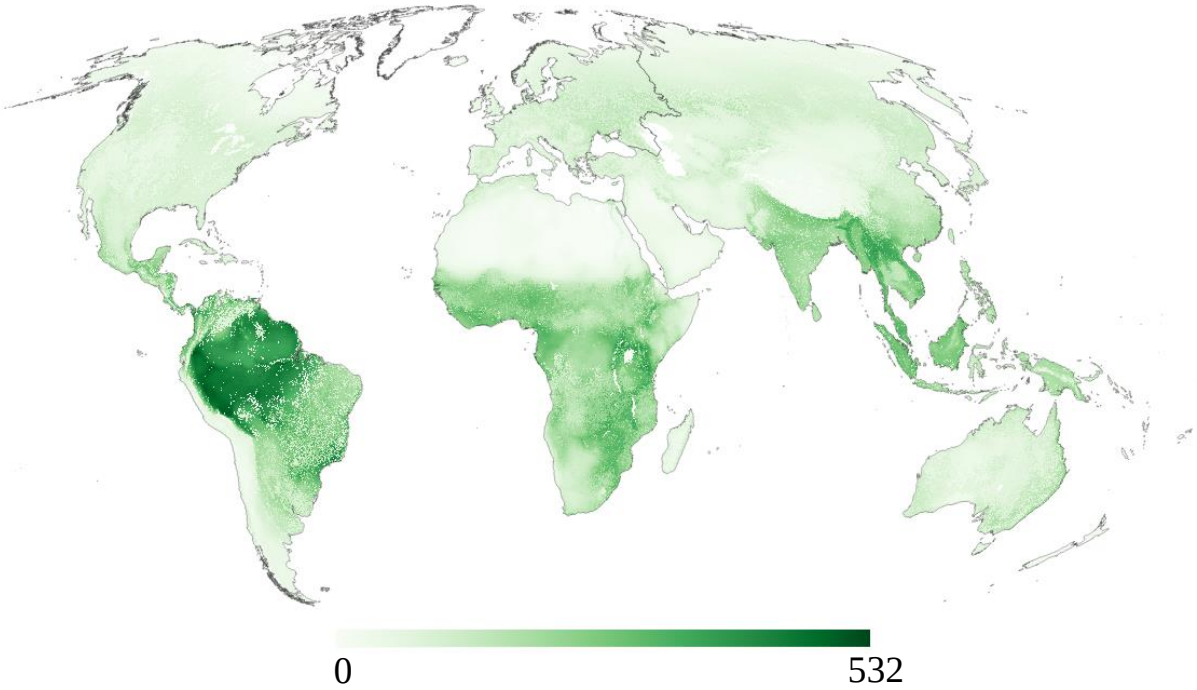
Mapping Area of Habitat

RESULTS

Mammal Richness Map



Bird Richness Map

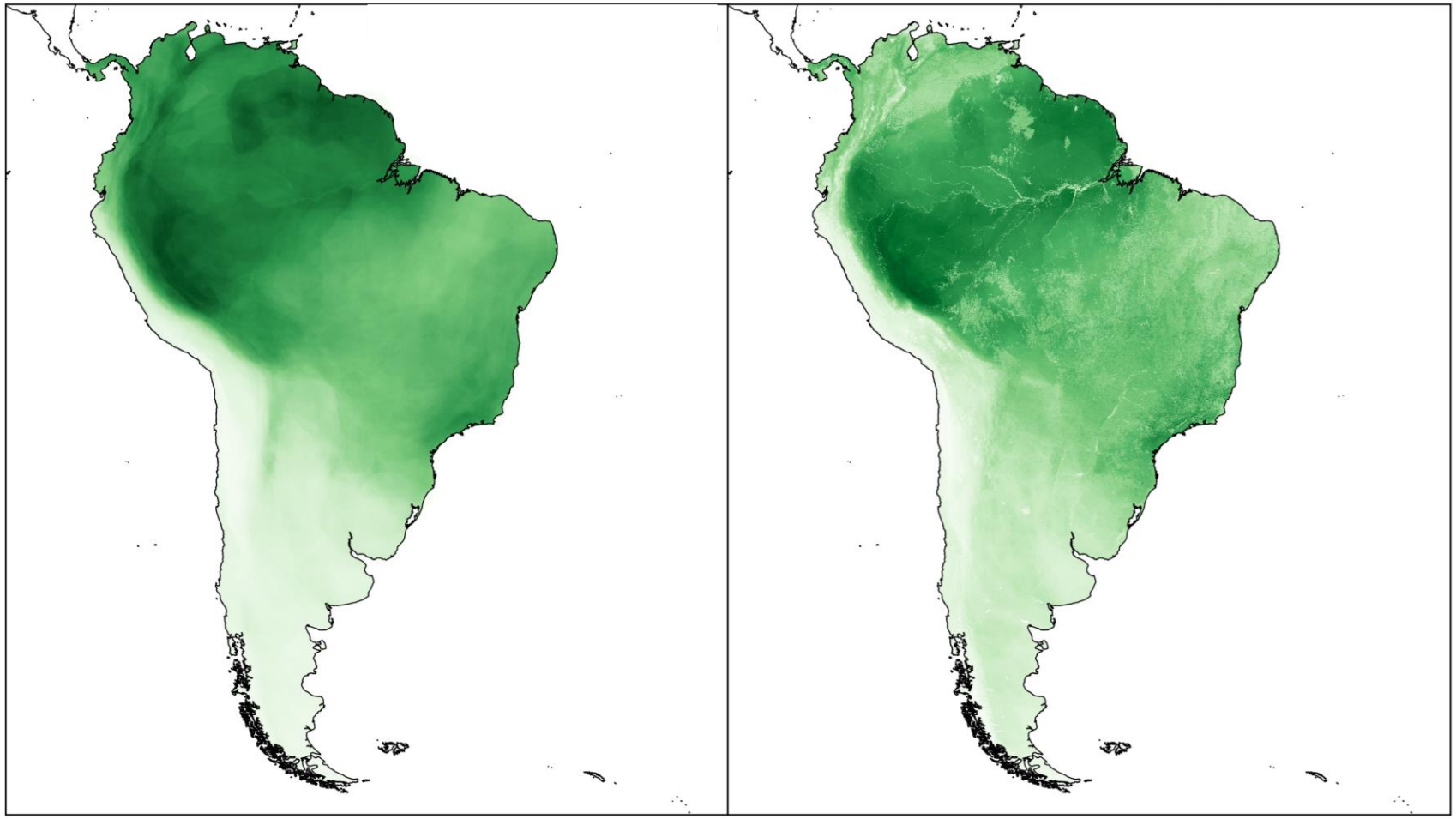


Mapping Area of Habitat

RESULTS **Terrestrial mammal richness of South America**

IUCN geographical range

Area of Habitat maps



Validation

MODELING BASED APPROACH

Dependent variable

$$\frac{\text{AOH Pixels}}{\text{Range Pixels}}$$

Independent variables

- Number of habitats
- Elevation range
- Mid point of elevation
- Realm
- Presence, origin and seasonality

Logistic regression model

↓

Tukey fences outlier test

↓

Outliers

OCCURRENCE DATA APPROCH

ebird data
GBIF data
KBA

→ Bird 4889 sp (45%)
Mammals 420 sp (8%)

Point locality

↓

Buffer around the point

↓

Overlay point with AOH

Validation

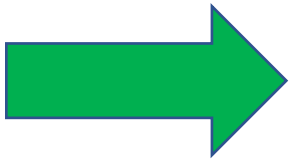
MODELING BASED APPROACH

Lower model prevalence

- Birds 178 sp (1.7 %)
- Mammals 64 sp (2.3 %)

Higher model prevalence

- Birds 118 sp (1.1 %)
- Mammals 21 (0.8 %)



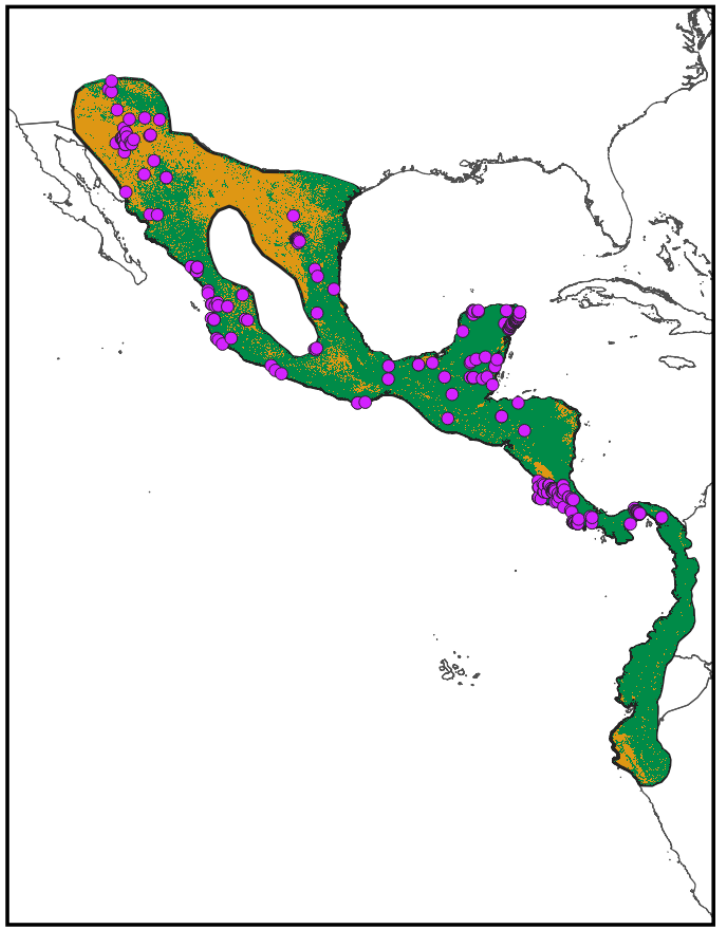
Incorrect elevation limits or habitat coding

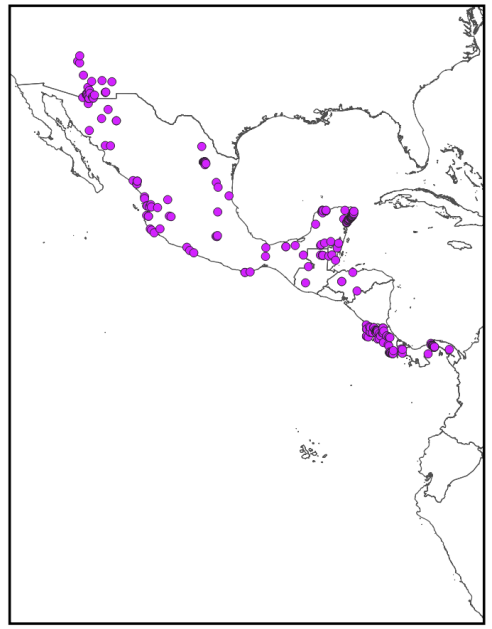
Validation

OCCURRENCE DATA APPROCH

White-nosed coati
(Nasua narica)

Range ma





GBIF point localities

Model prevalence (Area AOH / Area range)

Conclusions

→AOH area is 66% of the range area, enhancing the resolution of species distribution

→Reduce the commission errors without increasing the omission errors

→Follow a traceable methodology and allow quantifying the error, and ensure repeatability

Applications

→Assessing species' distributions

→Improving the accuracy of conservation planning

→ Monitoring habitat loss and fragmentation

→IUCN considers AOH an indispensable tool for Red List

→Assessment parameter in the identification of Key Biodiversity Areas (KBAs)

Acknowledgements



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Thanks for your attention

Full article!!!

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