Combining Observational Data and Language for Species Range Estimation

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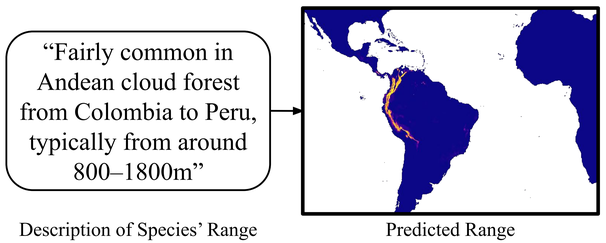
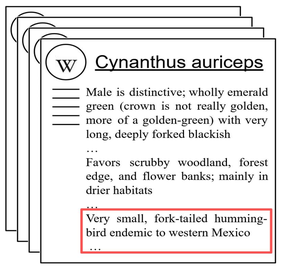


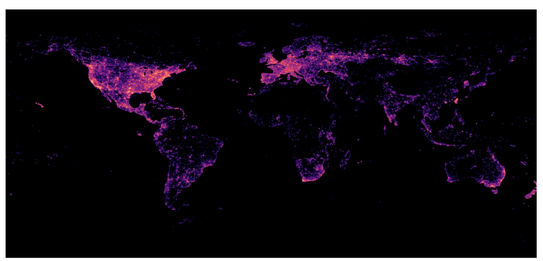
Motivation

(1) How can we generate species range maps (**SRMs**) when observation data is limited?
(2) What is the best way to utilize textual information about a species to generate better range maps?

Training Data

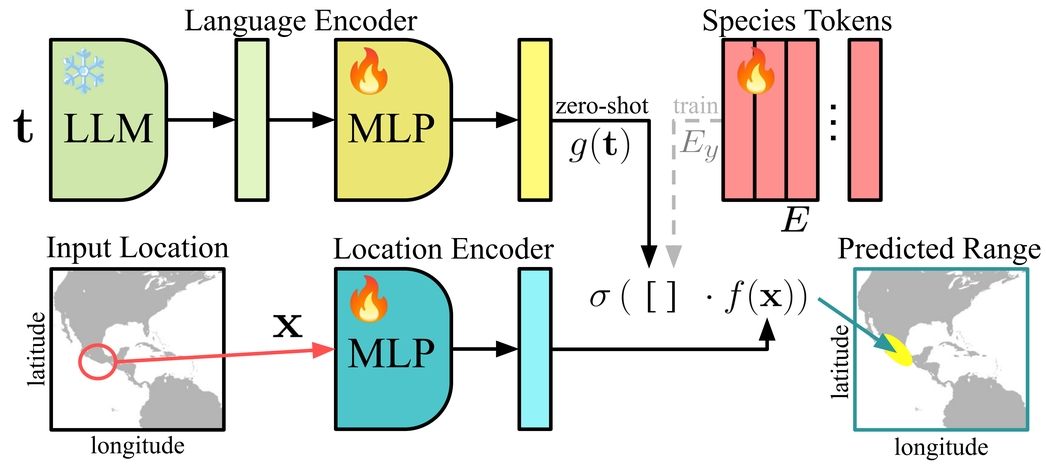
- **127.5K** sections from **37.9K** Wikipedia Articles
- **15.13M** observations of **44.2K** species from iNaturalist.





Loss function

$$\mathcal{L}'_{\text{AN-full}} = -\frac{1}{S}\sum_{j=1}^{M}[\mathbb{1}_{[z_j=1]}\lambda\log(\hat{y}_j) + \mathbb{1}_{[z_j\neq 1]}\frac{S-1}{M-1}\log(1-\hat{y}_j) + \frac{S}{M}\log(1-\hat{y}'_j)]$$



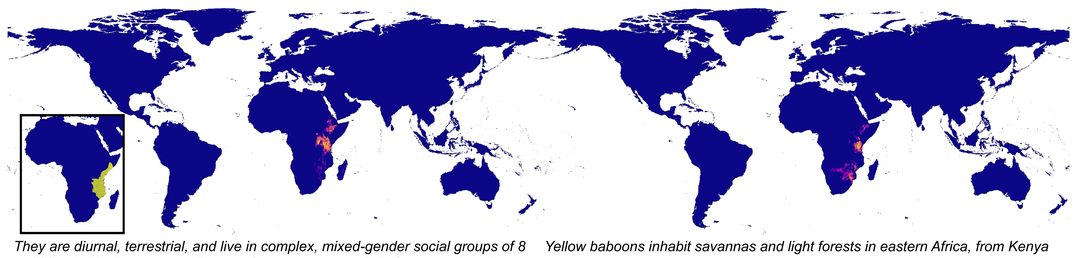
Zero-Shot Predictions

Habitat Text

The hyacinth macaw prefers semi-open, somewhat wooded habitats. It usually avoids dense, humid forest, and in regions dominated by such habitats, it is generally restricted to the edge or relatively open sections (e.g., along major rivers). In different areas of their range, these parrots are found in savannah grasslands, in dry thorn forests known as caatinga, and in palm stands or swamps, particularly the moriche palm (Mauritia flexuosa).

Range Text

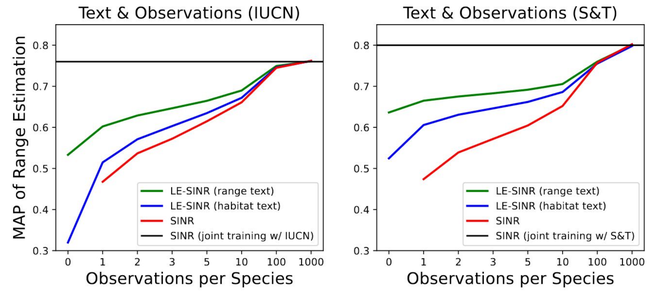
The hyacinth macaw occurs today in three main areas in South America: In the Pantanal region of Brazil, and adjacent eastern Bolivia andnortheastern Paraguay, in the cerrado regions of the eastern interior of Brazil (Maranhão, Piauí, Bahia, Tocantins, Goiás, Mato Grosso, Mato Grosso do Sul, and Minas Gerais), and in the relatively open areas associated with the Tocantins River, Xingu River, Tapajós River, and the Marajó island in the eastern Amazon Basin of Brazil.



They are diurnal, terrestrial, and live in complex, mixed-gender social groups of 8 to 200 individuals per troop. They prefer savannas and light forests with a climate that is suitable for their omnivorous diet.

Yellow baboons inhabit savannas and light forests in eastern Africa, from Kenya and Tanzania to Zimbabwe and Botswana.

Results



	Method	+Env	+Eval Sp.	IUCN	S&T
Oracle	SINR		✓	0.67	0.77
	LE-SINR (Species Token)		✓	0.69	0.78
	SINR	✓	✓	0.76	0.80
	LE-SINR (Species Token)	✓	✓	0.75	0.80
Baselines	Constant Prediction		✓	0.01	0.22
	Model Mean		✓	0.09	0.35
Zero-shot	LE-SINR (Habitat Text)			0.28	0.51
	LE-SINR (Range Text)			0.47	0.61
	LE-SINR (Habitat Text)	✓		0.32	0.52
	LE-SINR (Range Text)	✓		0.53	0.64

Non-Species Concepts