Spatial patterns of intraspecific genetic diversity in herptiles: a machine learning approach to macrogenetics

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BIG PICTURE

Intraspecific genetic diversity (**ISD**) is key to species' evolutionary potential, resilience, and conservation. The **central-marginal hypothesis** predicts higher ISD near the **centre of a species' range**, where populations are presumed to be larger and more stable. Analogously, theory suggests that ISD also peaks near the **climatic centroid**, reflecting optimal environmental conditions and population performance. Yet, broad-scale assessments across taxa and regions are rare.

OBJECTIVES

1. Is ISD higher near the geographic or climatic centroids?
2. Can ecological, climatic, or historical traits predict ISD trends?

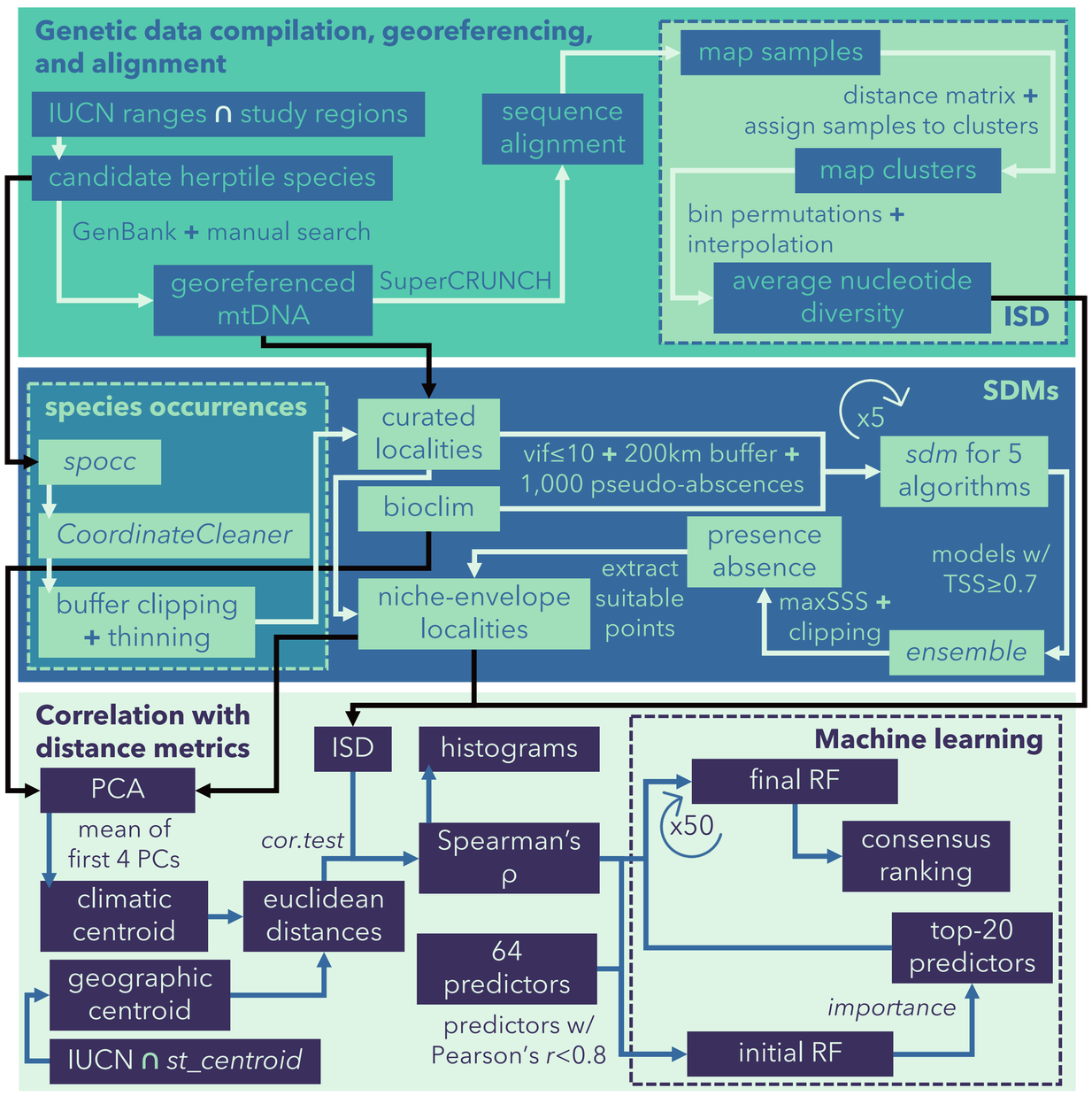
STUDY REGIONS

436 species: **248** non-avian reptiles & **188** amphibians
six global regions sampled across **five** continents
>39,000 mtDNA sequences georeferenced and filtered



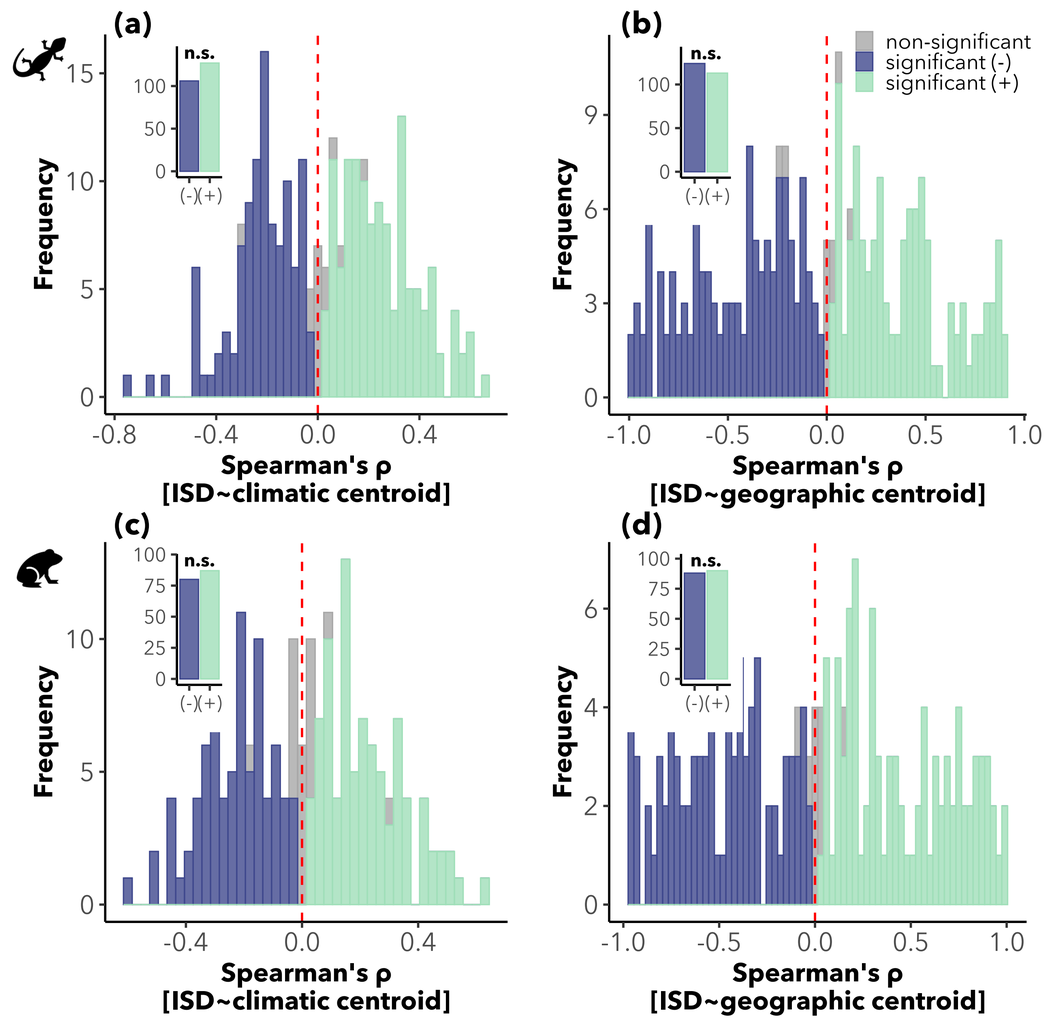
SCHEMATIC WORKFLOW

from data compilation to machine learning



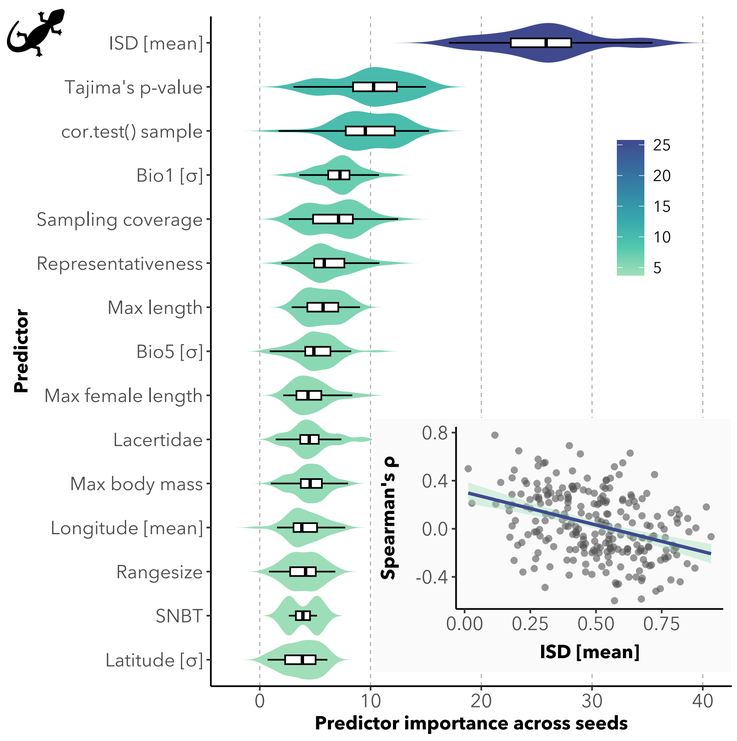
ISD VS. DISTANCE: HIGHLY IDIOSYNCRATIC

no significant bias toward geographic or climatic centres



SPEARMAN'S ρ VS. TRAITS: POOR FIT

RF models for the **ISD~climatic centroids** relationship in non-avian reptiles explained **~12%** of the variance
all other models (i.e. including amphibians and geographic centroids) performed even worse, with **R^2 values below 2%**



ONE VARIABLE TO RULE THEM ALL? BARELY...

weak negative trend: more diverse species (i.e. higher mean ISD) show steeper declines in ISD towards climatic margins

TAKE-HOME MESSAGE

- ISD does not follow a general rule across taxa
- genetic conservation requires species-specific data
- broad assumptions risk overlooking vulnerable populations

ACKNOWLEDGMENTS

This work was funded by Fundação para a Ciência e Tecnologia (FCT), I.P, via national funds, under the scope of project PLACES – "PLAnning for the Conservation of life on Earth in the light of evolution and Sustainability" (10.54499/2022.08134.PTDC) and UID/50027/2023-InBIO-Rede de Investigação em Biodiversidade e Biologia Evolutiva. SBC was supported by FCT through the individual scientific employment program contract (doi 10.54499/2022.04598.CEECIND/CP1730/CT0006).