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Ignoring Climate Change May Falsify Conservation Efforts for the Threatened Reptiles of Bangladesh

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INTRODUCTION & AIM

Climate change poses a critical threat to global biodiversity (Parmesan & Yohe, 2003), with cold-blooded reptiles being particularly due to species-specific responses (Hof et al., 2011). Changes in temperature and precipitation patterns can affect them, by shifting their geographical distributions (Zacarias & Loyola, 2019), fragmenting habitats (Descamps et al., 2017), reducing their suitability (Dayananda et al., 2021), and if unaddressed the population declines are the ultimate consequences (Diele-Viegas et al., 2019). In Bangladesh, a country highly vulnerable to climate change, 38 reptilian species, including 17 critically endangered, 10 endangered, and 11 vulnerable species (IUCN Bangladesh, 2015), are at risk. Despite the alarming status of threatened reptiles, conservation efforts in Bangladesh lack climate change considerations. Current conservation initiatives, such as protected areas, may prove ineffective if they fail to account for climate change impacts (Groves et al., 2012). This research employs Species Distribution Models, particularly the Bioclim algorithm, to assess the impacts of climate change on the habitat suitability of the 38 threatened reptilian species. The study aims to provide valuable insights into how climate change affects each species, emphasizing the need to integrate climate considerations into conservation efforts to accurately address the challenges posed by climate change on reptiles' climatically suitable space in Bangladesh.

METHOD

Species Distribution Models / Ecological Niche Models – Bioclim Model

Due to a lack of sufficient occurrence data, Hawksbill Sea Turtle (*Eretmochelys imbricata*) was excluded from further analysis

R

All these operations were performed on the R (4.3.1) platform

Packages:
- Dismo
- maptool
- rgdal
- sp
- sf

100 occurrence points (IUCN Bangladesh, 2015) were randomly selected for each of the threatened reptiles using the *'bas. polygon()'* function

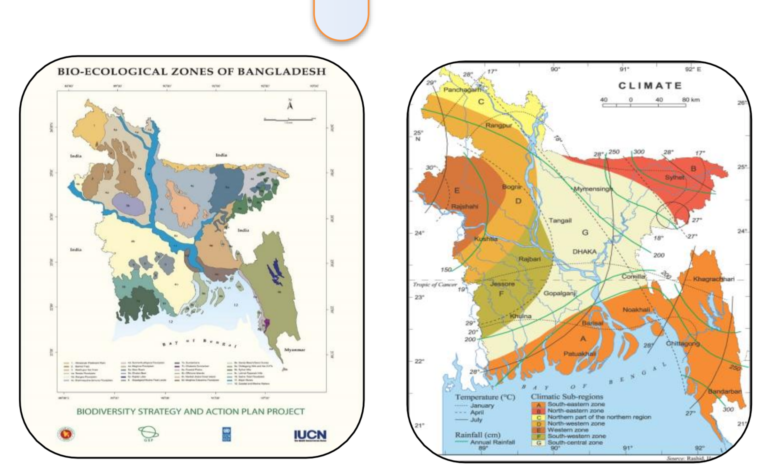
These points were utilized to extract values from 12 bioclimatic and 7 environmental variables (raster files)

'Bioclim()' function was employed from the 'Dismo' package to train the present models

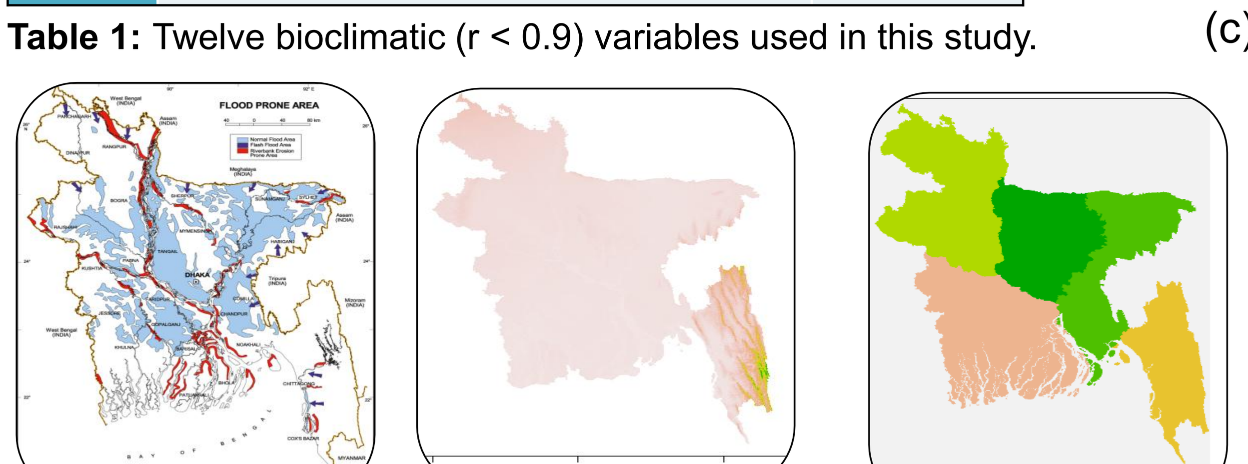
'Predict()' function was then employed to generate potential suitable climate spaces for each reptile species

Variable	Name	Category
Bio01	Annual mean temperature (°C)	Temperature
Bio02	Mean diurnal range (mean of monthly (max temp. - min temp.))	
Bio03	Isothermality (Bio02/Bio07) ×100	
Bio04	Temperature seasonality (Standard deviation×100)	
Bio05	Max. temperature of warmest Month (°C)	
Bio06	Min. temperature of coldest Month (°C)	
Bio07	Temperature annual range (Bio05-Bio06) (°C)	
Bio12	Annual precipitation (mm)	Precipitation
Bio14	Precipitation of driest month (mm)	
Bio15	Precipitation seasonality (coefficient of variation)	
Bio17	Precipitation of driest quarter (mm)	
Bio18	Precipitation of warmest quarter (mm)	

Table 1: Twelve bioclimatic (r < 0.9) variables used in this study.



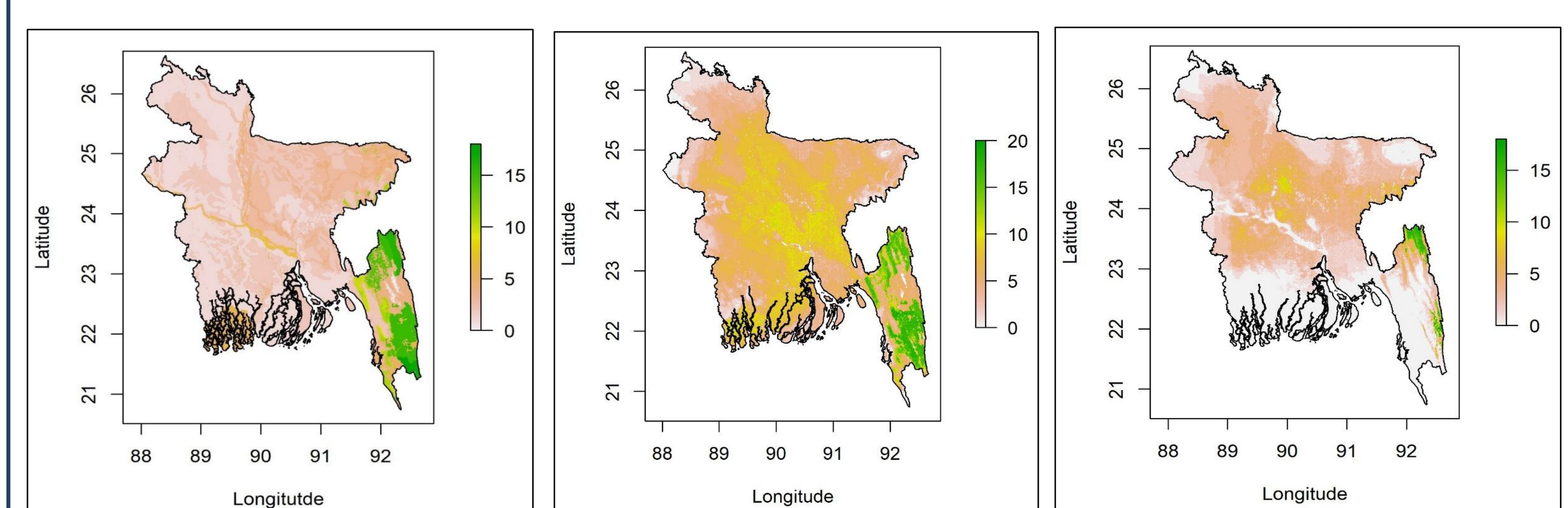
(a) (b) (c) (d)



(e) (f) (g)

Figure 1: Map of Bangladesh showing the complex distribution of seven important spatial variables for reptiles, **(a)** 12 bio-ecological subregions **(b)** 7 climatic sub-zones **(c)** 5 forest types **(d)** Land use and landcover **(e)** Flood zones **(f)** Elevation **(g)** River zones.

RESULTS & DISCUSSION



(a) (b) (c)

Figure 2: Species richness map of **(a)** observed data, **(b)** current suitable climate space for 37 threatened reptiles, and **(c)** future suitable climate space for 37 threatened reptiles.

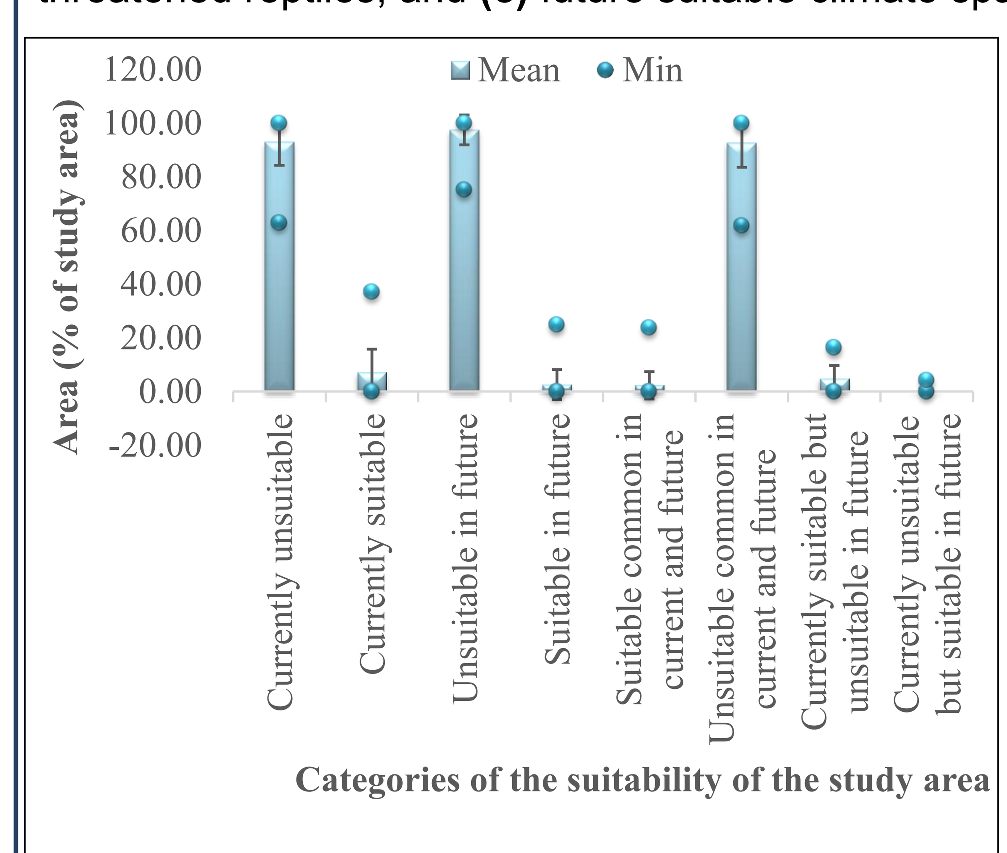


Figure 3: Categories of the suitability of the study area (%) according to various climatic conditions.

Responsible variable	Number of threatened reptiles (%)	
	In PCA1	In PCA2
Elevation	83.79	18.92
Bio-ecological subregions	16.21	67.57
River zones		5.41
Climatic subzones		2.7
Forest types		2.7
Precipitation of the driest month (mm)		2.7

Table 2: Responsible variables for limiting the distribution of 37 threatened reptiles.

Table 3: Number of threatened reptiles in various percentages of the study area.

Area (% of my study area)	Number of threatened reptiles							
	Currently unsuitable	Currently suitable	Unsuitable in future	Suitable in future	Suitable common in current and future	Unsuitable common in current and future	Currently suitable but unsuitable in the future	Currently unsuitable but suitable in the future
0-10	0.00	26.00	0.00	33.00	33.00	0.00	29.00	37.00
11-20	0.00	7.00	0.00	3.00	3.00	0.00	8.00	0.00
21-30	0.00	3.00	0.00	1.00	1.00	0.00	0.00	0.00
31-40	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
41-50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51-60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
61-70	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
71-80	3.00	0.00	1.00	0.00	0.00	3.00	0.00	0.00
81-90	7.00	0.00	3.00	0.00	0.00	7.00	0.00	0.00
91-100	26.00	0.00	33.00	0.00	0.00	26.00	0.00	0.00

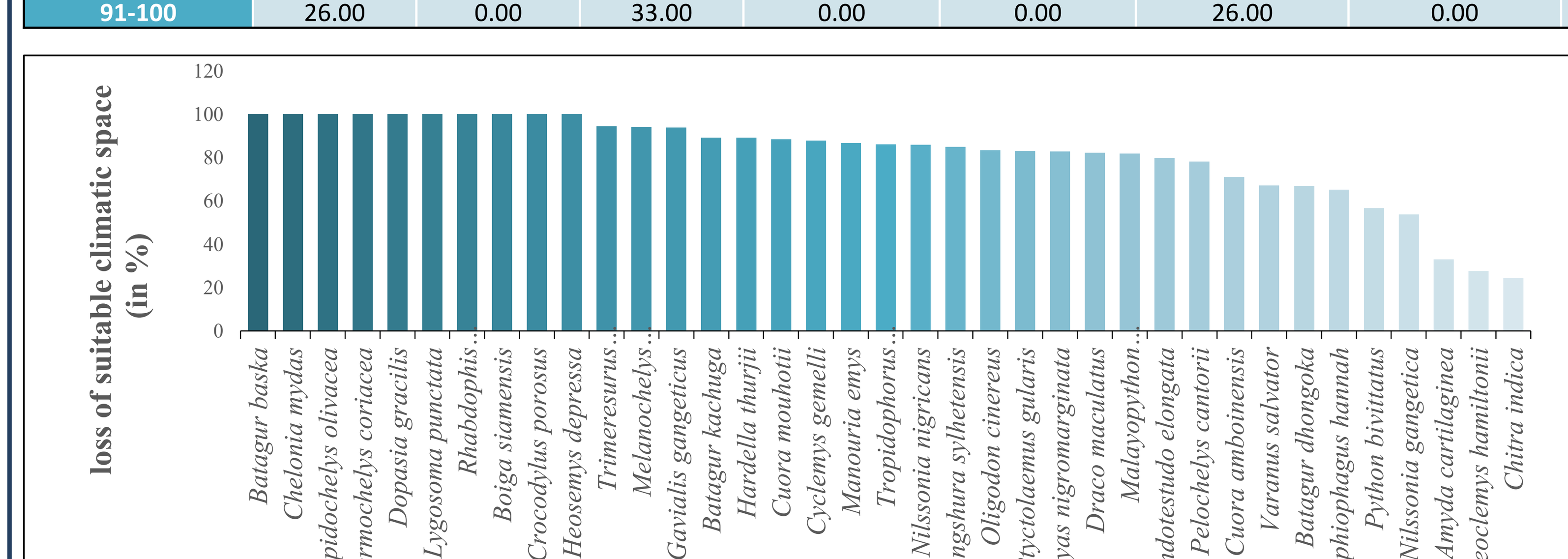


Figure 4: Loss of suitable climatic space (in %) of 37 threatened reptilian species (10 species-100% loss)

CONCLUSION

Climate change is rapidly fragmenting and shrinking the habitats of Bangladesh's threatened reptiles. By 2080, current conservation zones in the Southeast and Northeast may become climatically unsuitable, rendering existing protections obsolete. To prevent imminent extinction, we must integrate dynamic climate modeling into protected area management, otherwise, our current conservation efforts are building a future that these species cannot inhabit.

FUTURE WORK / REFERENCES

By modeling terrestrial and aquatic species separately, I am identifying niche-specific habitat gaps within current Protected Areas while integrating overlooked drivers- illegal trade, air quality, and wetland loss to transition from narrow climate projections to a comprehensive survival strategy.