Determinants Influencing the Sex Ratio of Turtle Offspring

https://github.com/christalzheng/HuangZheng

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Figure 1: A cute baby sea turtle

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Rationale and Research Questions

In the majority of species, sex is determined during fertilization; however, many reptiles including turtles, alligators, and crocodiles exhibit a unique characteristic where sex determination occurs after fertilization. This phenomenon is known as temperature-dependent sex determination (TSD). In TSD, the sex of offspring is influenced by the temperatures experienced during egg incubation in the nest.

Our project is motivated by a keen interest in understanding TSD, particularly in turtles. While TSD was first described in a lizard, the order Testudines has played an important role in advancing scientists' understanding of TSD. Studies on species within Testudines brought TSD to the attention of the broader research community, and the term "temperature-dependent sex determination" also first appeared in a study of a community of North American turtles in 1979 (Yntema, 1976; Bull and Vogt, 1979).

We aim to test TSD phenomenon by ourselves with focusing on the order Testudines. We will explore the following questions: 1. Does temperature affect the sex ratio of turtles? If so, how does temperature influence the sex ratio of turtles? 2. Is temperature the sole determinant of turtle sex, or are there other important factors?

Dataset Information

We use a dataset called Reptilian Offspring Sex and Incubation Environment (ROSIE). It is a dataset published in 2022 and contain over 7,000 individual measurements of offspring sex ratios in the order Testudines as well as SDM classifications for 149 species. This dataset obtain data by using Web of Science to search for research published since the discovery of TSD (1966) until 31 December 2020.

Variables we used and wrangled for this project is shown in Table 1. More information about ROSIE Dataset can be found at: https://github.com/calebkrueger/ROSIE/tree/main

Table: Dataset Information

Used Variables	Description
Species information	Order, Family, Genus, Species
Spatial information	Wild sampling location, or native range of species if captive or location not provided
Captivity	Eggs from captive or/and wild individuals
Time	Time of turtle nesting/egg collection
Temperature	Mean of actual/recorded incubator temperature in degrees Celsius
Humidity	Relative humidity of incubation chamber between 0 and 1
Sex ratio	Proportion of male and female

Exploratory Analysis

To have a better understanding of our data, we explore the distribution of different turtle species, variations in hatching temperatures across diverse turtle families, and distribution of data location.

Explore the species

Explore hatching temperature among families

Explore data position

The location of wild sampling points, or native range of species if captive, is plotted below as a map to show spatial distribution of data. The world continent data is downloaded from ArcGIS database.

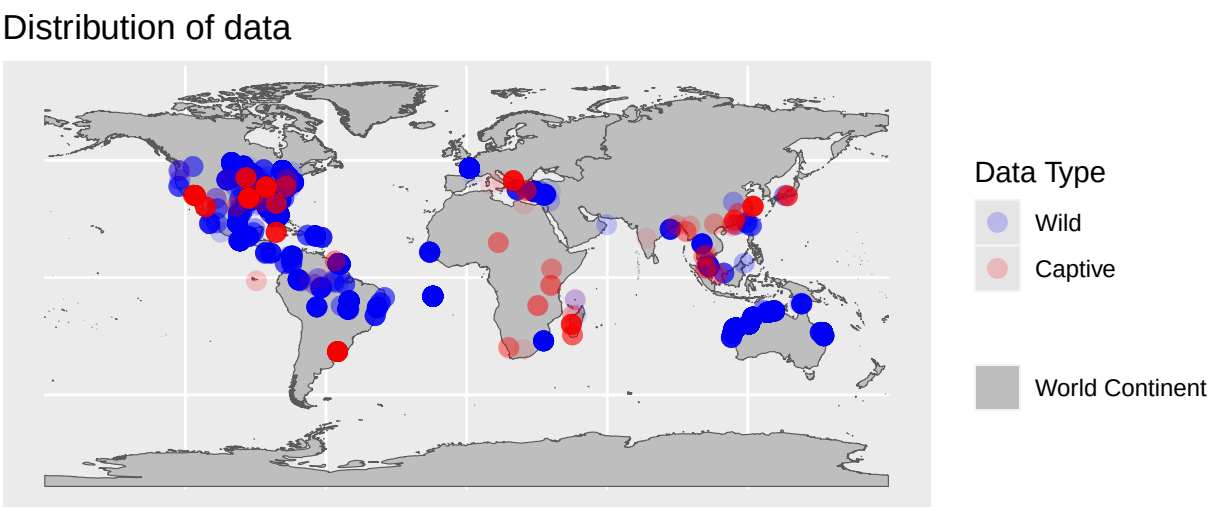

Figure 2: Map 1

Analysis

Question 1: <insert specific question here and add additional subsections for additional questions below, if needed>

Question 2:

Summary and Conclusions

"Researchers have also noted that the warmer the sand, the higher the ratio of female turtles. As the Earth experiences climate change, increased temperatures could result in skewed and even lethal incubation conditions, which would impact turtle species and other reptiles." https://oceanservice.noaa.gov/facts/temperature-dependent.html

References

Bull, J. J., & Vogt, R. C. (1979). Temperature-dependent sex determination in turtles. Science, 1186-1188.

Krueger, C. J., & Janzen, F. J. (2022). ROSIE, a database of reptilian offspring sex ratios and sex-determining mechanisms, beginning with Testudines. Scientific Data, 9(1), 22.

Yntema, C. L. (1976). Effects of incubation temperatures on sexual differentiation in the turtle, Chelydra serpentina. Journal of Morphology, 150(2), 453-461.

Photo credit: https://scitechdaily.com/why-does-temperature-determine-the-sex-of-turtles/ https://www.pinterest.jp/pin/61783826112891810/