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THE MONTH WITH THE HIGHEST NUMBER OF RAINY DAYS, AVERAGE AND WARMEST TEMPERATURES, DAILY HOURS OF SUNSHINE, AND RAINFALL ACROSS THE DISTRIBUTION OF PILL MILLIPEDES *SPHAEROTHERIUM* BRANDT, 1833

Author's Name: M. I. Cooper

Affiliation: University of Stellenbosch, South Africa

E-Mail: cm.i@aol.com

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Abstract

The objectives of this study were to determine what happened when Sexual Size Dimorphism (SSD) and body size changed with eco-geographical factors. The month with the highest number of rainy days, average and warmest temperature, daily hours of sunshine, and rainfall was correlated in the forest millipede genus Sphaerotherium. *There were correlations between month with the highest number of rainy days and rainfall (r=0.89, Z score=2.82, n=7, p<0.01), warmest temperature and highest number of rainy days (r=0.59, Z score=1.35, n=7, p=0.09), warmest temperature and rainfall (r=0.72, Z score=1.81, n=7, p=0.04), and coolest temperature and highest number of rainy days (r=0.65, Z score=1.54, n=7, p=0.06). There was a correlation between average temperature and daily hours of sunshine (r=-0.72, Z score=-1.83, n=7, p=0.03), average temperature and rainfall (r=0.73, Z score=1.85, n=7, p=0.03) and daily hours of sunshine and rainfall (r=-0.76, Z score=-2.00, n=7, p=0.02) . There was a correlation between warmest temperature and lowest temperature (r=0.87, Z score=2.70, n=7, p<0.01), warmest temperature and hours of sunshine (r=-0.88, Z score=-2.78, n=7, p<0.01), warmest temperature and rainfall (r=0.71, Z score=1.79, n=7, p=0.04), lowest hours of sunshine and rainfall (r=0.89, Z score=2.82, n=7, p<0.01), lowest hours of sunshine and coolest average temperature (r=-0.72, Z score=-1.83, n=7, p=0.03) and month with the highest number of rainy days and precipitation during the wettest month (r=0.69, Z score=1.72, n=7, p=0.04). Eco-geographical variance in the polygynandrous reproductive systems occurs with larger females and higher SSD co-occurring with cooler and warmer average temperatures, a higher number of rainy days, and rainfall.*

Keywords: *Dimorphic, eco-geography, gradient, temperature, size, species*

INTRODUCTION

A forest genus of diplopods belonging to the Order Sphaerotheriida found along the eastern coast of southern Africa was the subject of this study. The millipede genus *Sphaerotherium* is found in the temperate South African subregion. It occurs in all the forests of the coastal belt from the Cape Peninsula to Beira in Mocambique. While the coastal forests of the South-West and Eastern Cape are mist belt temperate forests, those of the Transkei, Natal, Zululand, and Mocambique are somewhat different, being better described as East Coast Bush, they are developed almost entirely in a narrow strip of the litoral on a dune sand substratum, and are more tropical in aspect and composition than those to the west of them. There is a summer rainfall of 76.2-101.6 cm, a uniform temperature, and an absence of frost; the component trees of the coastal bush with their abundant creepers and lianes, while not usually reaching a height of more than 11 meters, provide a dense covering with abundant shade and humidity at ground level. As essentially shade-loving Diplopoda, the members of the genus

are especially well represented in these litoral forests of the eastern half of the subcontinent (Cooper, 2018).

The coolest and warmest average temperatures and lowest daily hours of sunshine and rainfall were correlated in the sphaerotheriid millipede genus *Sphaerotherium* Brandt, 1833 (Hamer, 1998). Like worm-like millipedes, these pill millipedes have female-biased SSD (Cooper, 2017, 2018). The null hypothesis is that there are no correlations between the coolest and warmest average temperature, lowest daily hours of sunshine, and rainfall.

MATERIALS AND METHODS

60 valid species were identified as belonging to the genus *Sphaerotherium* Brandt, 1833. Millipede-type localities were obtained from a checklist of southern African millipedes (Hamer, 1998). These were tabulated and known type localities also listed in Microsoft Word online (https://office.live.com/start/Word.aspx). GPS coordinates were obtained from internet sources for known type localities using google (https://www.google.co.za/maps/place). The lowest and highest average temperatures, lowest daily hours of sunshine, mean precipitation during the driest month, and rainfall were obtained from https://en.climate-data.org/search/?q= and internet sources for known type localities using google (https://www.google.co.za). The lowest and highest average temperatures, lowest daily hours of sunshine, and rainfall were checked for correlations using the Pearson Correlation Coefficient calculator (https://www.gigacalculator.com/calculators/correlation-coefficient-calculator.php).

RESULTS

There were correlations between a month with the highest number of rainy days and rainfall (Figure 1: r=0.88790522, Z score=2.82387837, n=7, p=0.00237238), warmest temperature, and highest number of rainy days (Figure 2: r=0.588410, Z score=1.35046136, n=7, p=0.08843408), warmest temperature and rainfall (Figure 3: r=0.71896159, Z score=1.81098431, n=7, p=0.03507158) and coolest temperature and highest number of rainy days (Figure 4: r=0.64553369, Z score=1.53520672, n=7, p=0.06236655) across the distribution of *Sphaerotherium*. There was a correlation between the lowest average temperature and lowest daily hours of sunshine (Figure 5: r=-0.72332391, Z score=-1.82916274, n=7, p=0.03368756), lowest average temperature and rainfall (Figure 6: r=0.72778103, Z score=1.84798645, n=7, p=0.03230209) and lowest daily hours of sunshine and rainfall (Figure 7: r=-0.76143647, Z score=-1.99924929, n=7, p=0.02279062) across the distribution of *Sphaerotherium*. There was a correlation between warmest temperature and lowest temperature (Figure 8: r=0.87397580, Z score=2.69934357, n=7, p=0.00347387), warmest temperature and hours of sunshine (Figure 9: r=-0.88353626, Z score=-2.78332633, n=7, p=0.00269029), warmest temperature and rainfall (Figure 10: r=0.71498960, Z score=1.79463664, n=7, p=0.03635575), lowest hours of sunshine and rainfall (Figure 11: r=0.88790522, Z score=2.82387837, n=7, p=0.00237238), lowest hours of sunshine and coolest average temperature (Figure 12: r=-0.72332391, Z score=-1.82916274, n=7, p=0.03368756), and month with the highest number of rainy days and precipitation during the wettest month (Figure 13: r=0.69497192, Z score=1.71501762, n=7, p=0.04317096).

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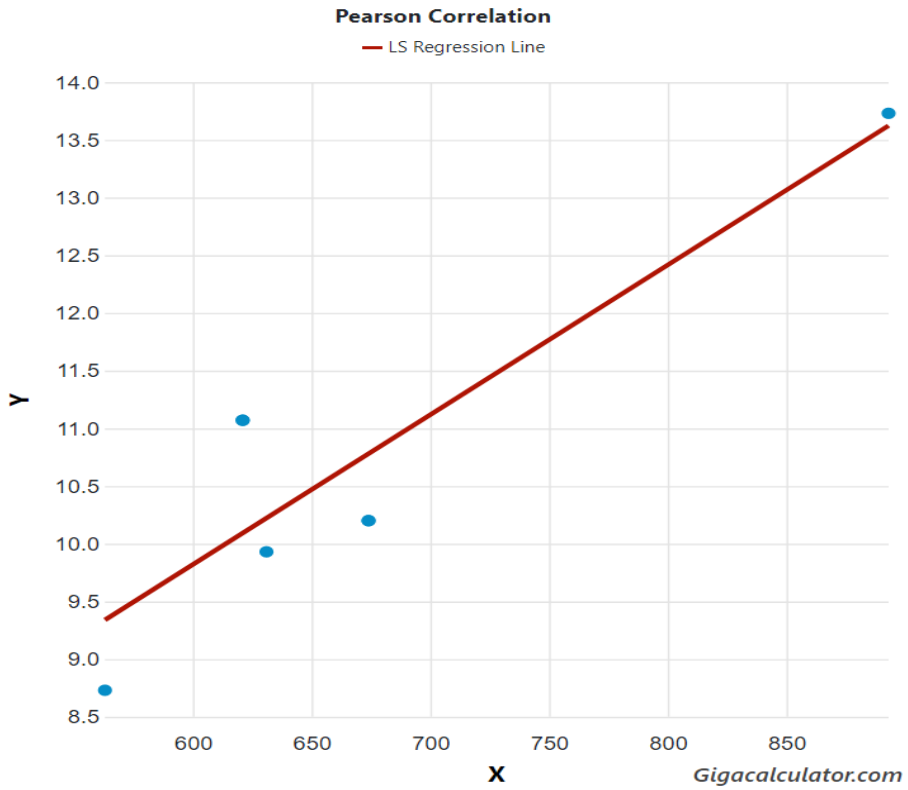

Figure 1. Correlation between the highest number of rainy days and rainfall (x) for *Sphaerotherium.*

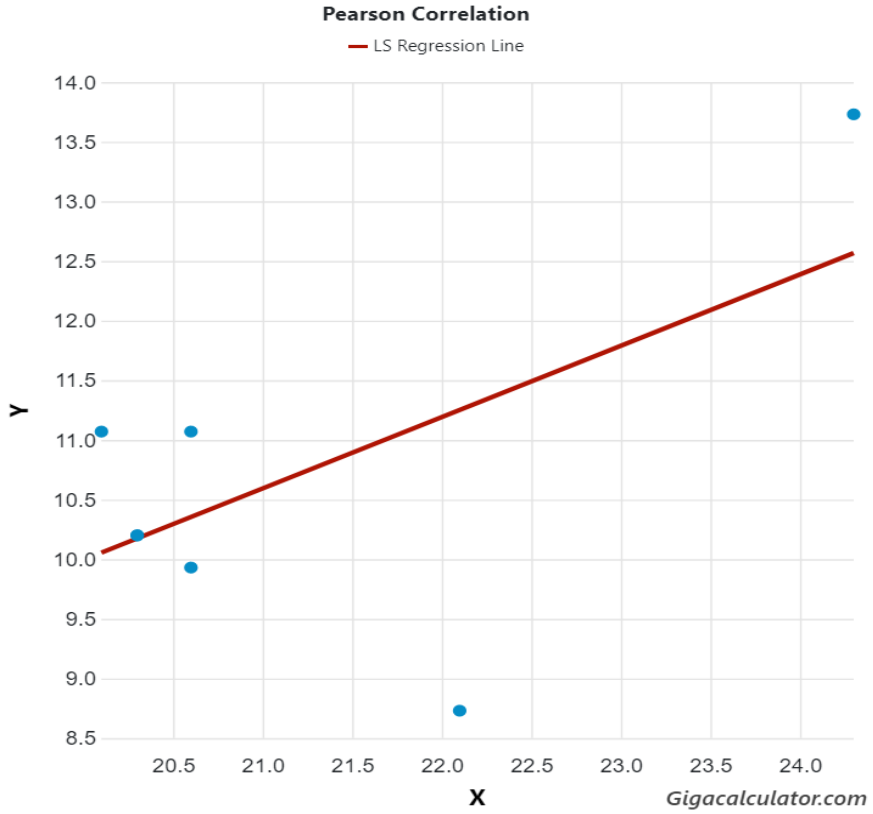

Figure 2. Correlation between warmest temperature (x) and highest number of rainy days (y) for *Sphaerotherium.*

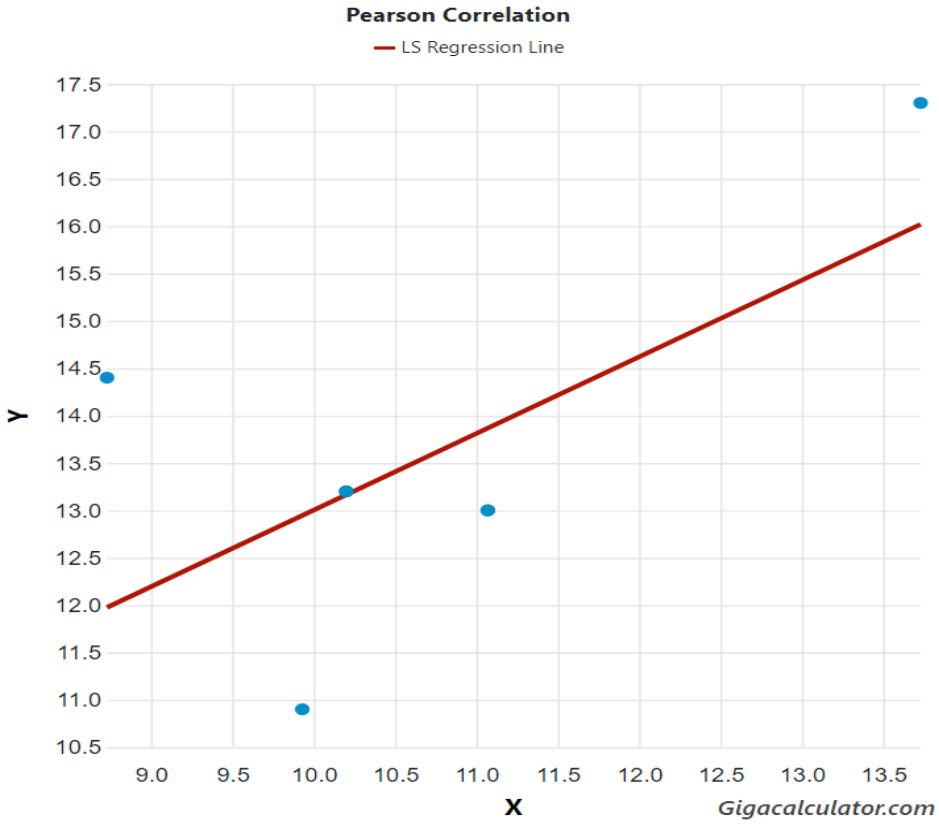

Figure 3. Correlation between coolest temperature (x) and the number of rainy days (y) for *Sphaerotherium.*

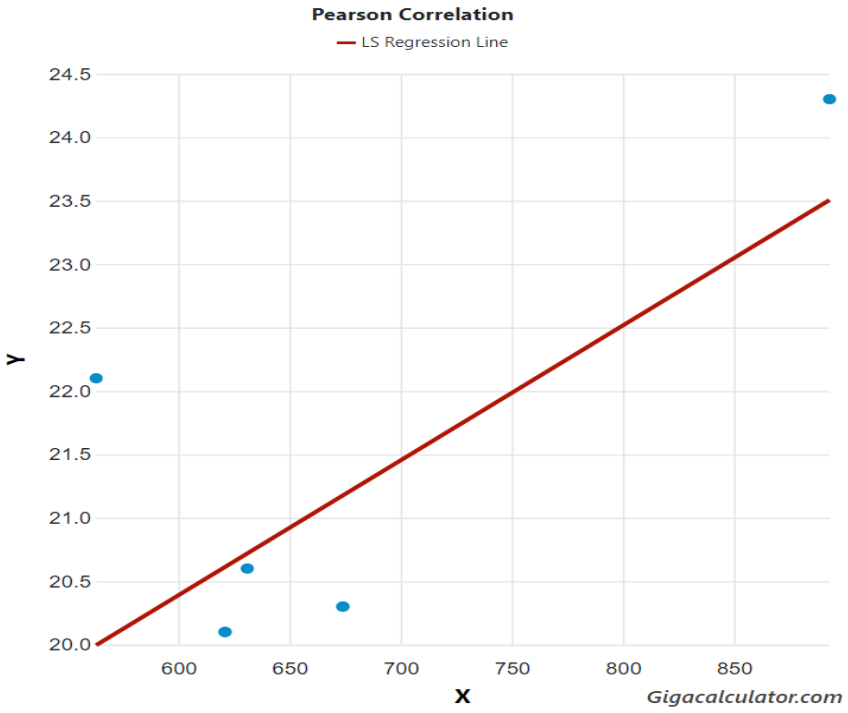

Figure 4. Correlation between warmest temperature (y) and rainfall (x) for *Sphaerotherium.*

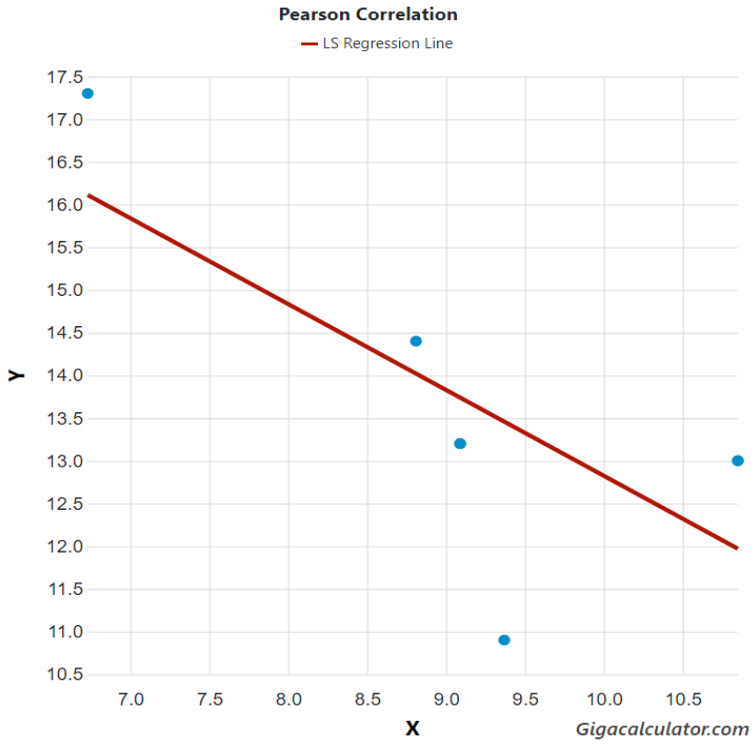

Figure 5. Correlation between lowest average temperature (y) and lowest daily hours of sunshine (x) for *Sphaerotherium.*

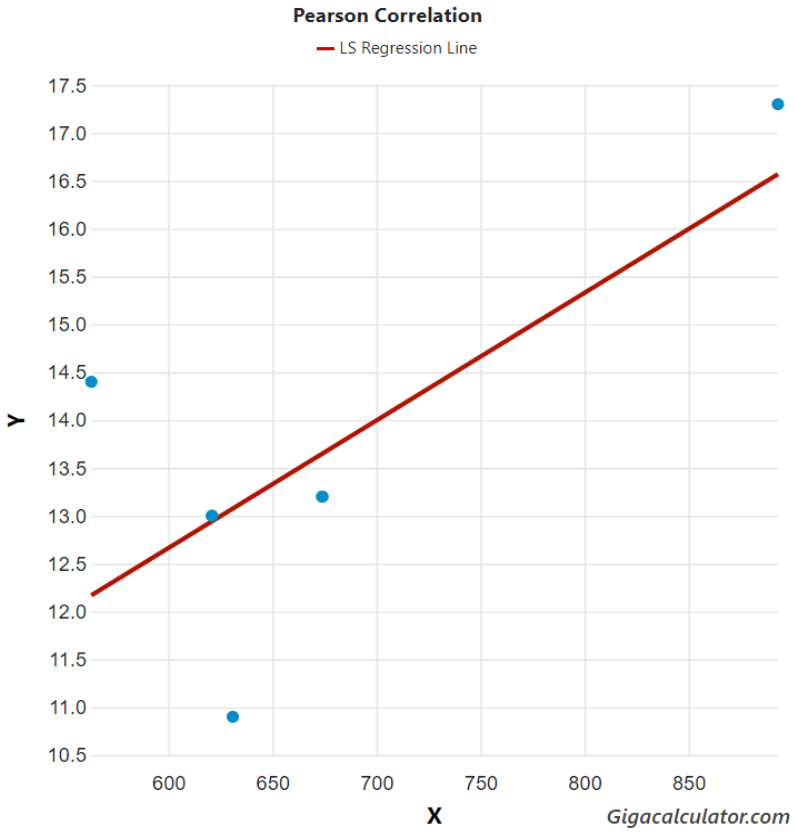

Figure 6. Correlation between lowest average temperature (y) and rainfall (x) for *Sphaerotherium.*

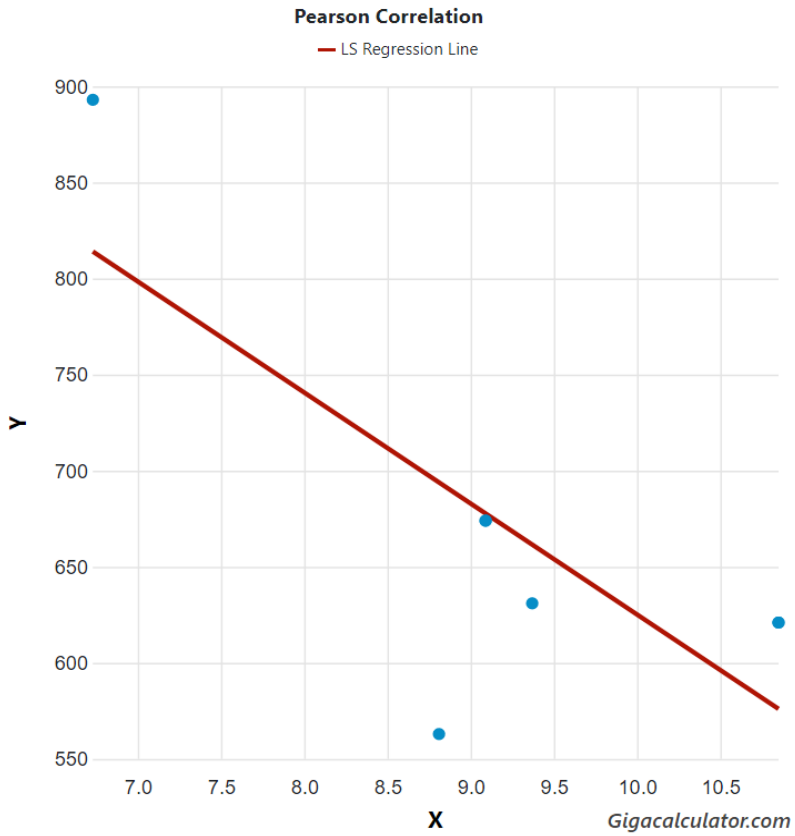

Figure 7. Correlation between lowest hours of sunshine (x) and rainfall (y) for *Sphaerotherium.*

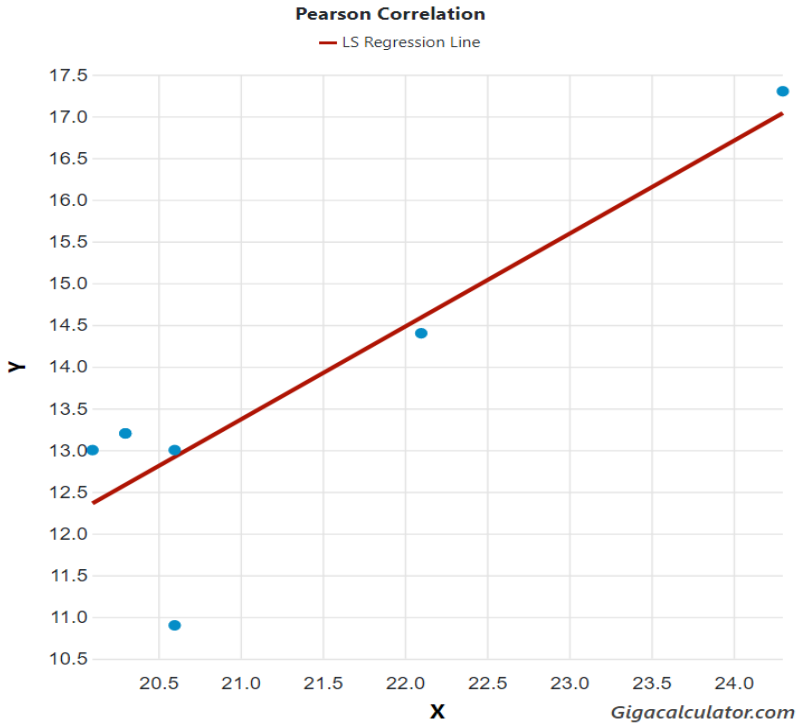

Figure 8. Correlation between warmest average temperature (x) and coolest average temperature (y) for *Sphaerotherium.*

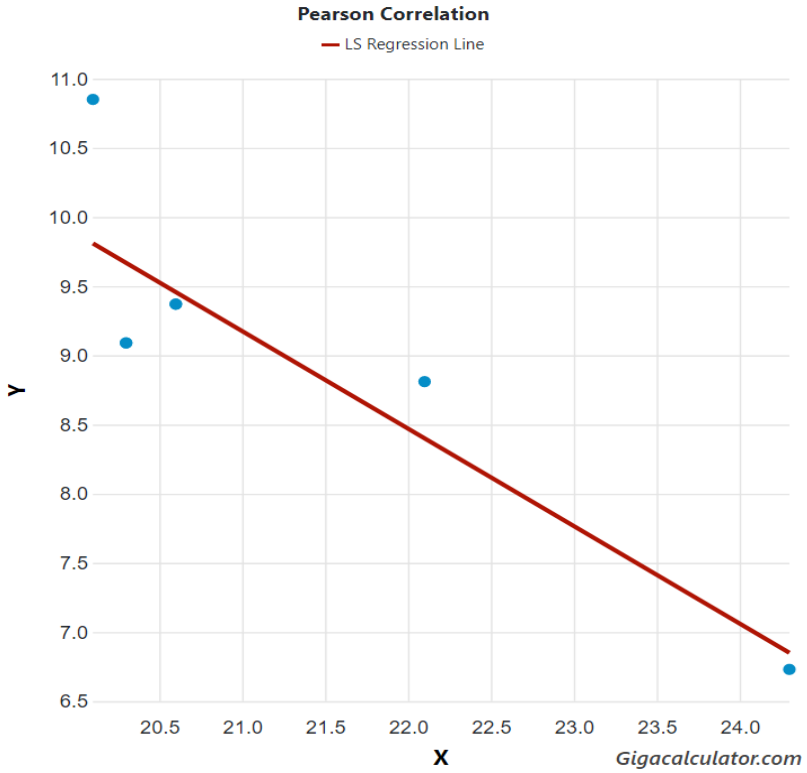

Figure 9. Correlation between warmest temperature (x) and hours of sunshine (y) for *Sphaerotherium.*

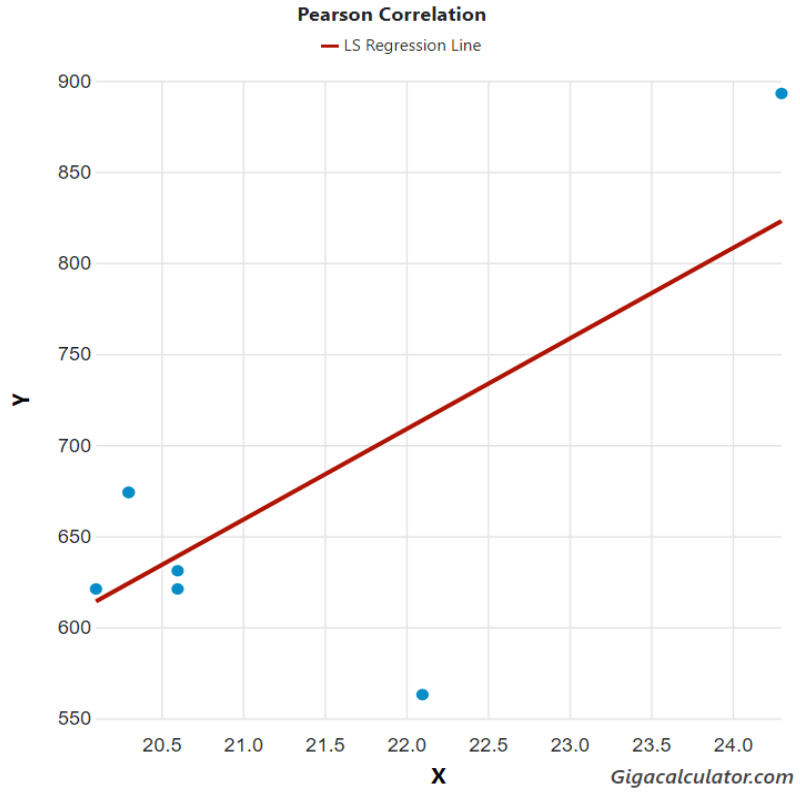

Figure 10. Correlation between warmest temperature (x) and rainfall (y) for *Sphaerotherium.*

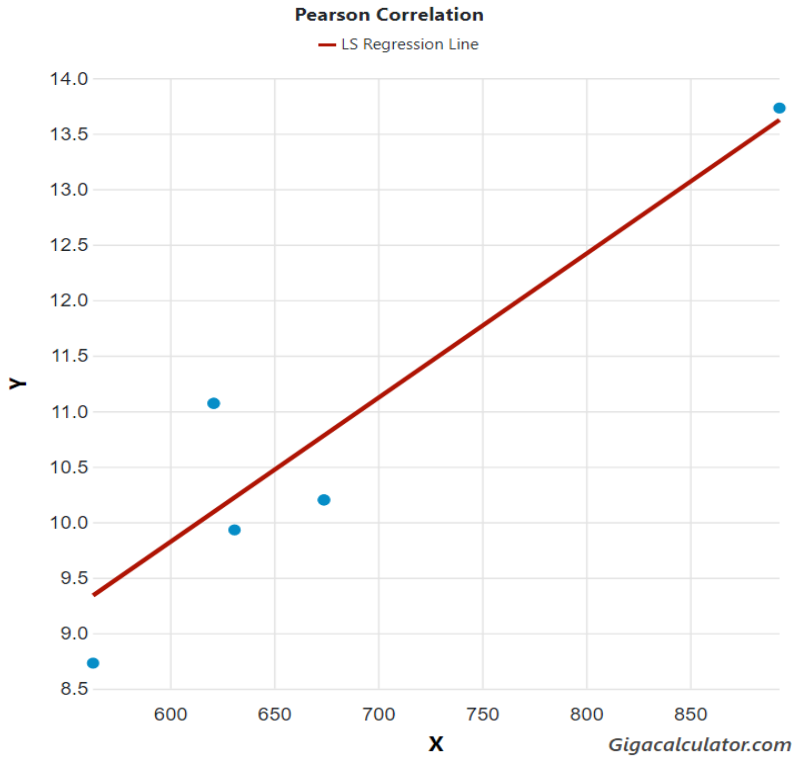

Figure 11. Correlation between lowest hours of sunshine and rainfall for *Sphaerotherium*.

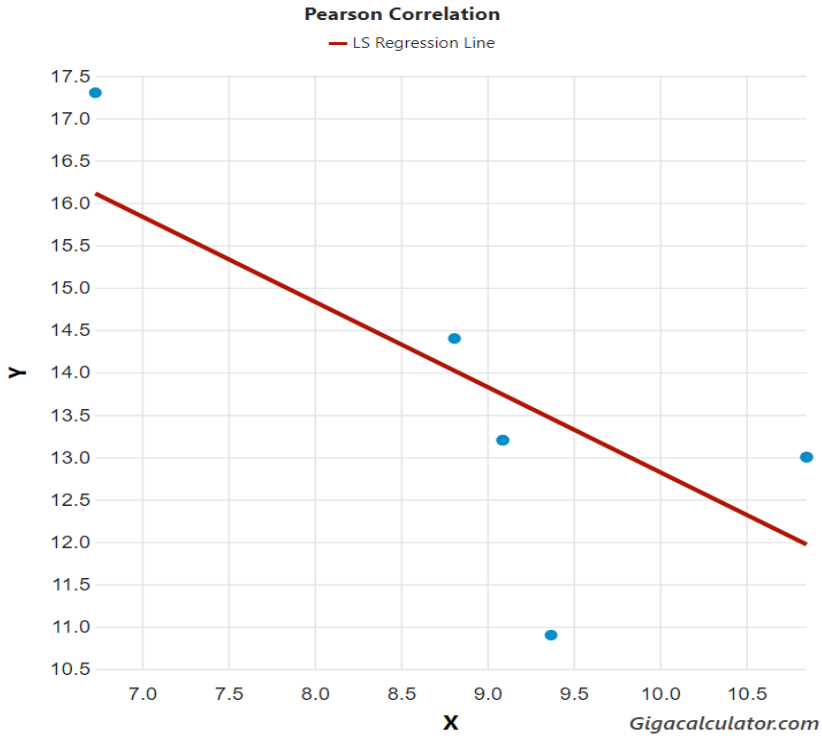

Figure 12. Correlation between lowest hours of sunshine and coolest average temperature for *Sphaerotherium.*

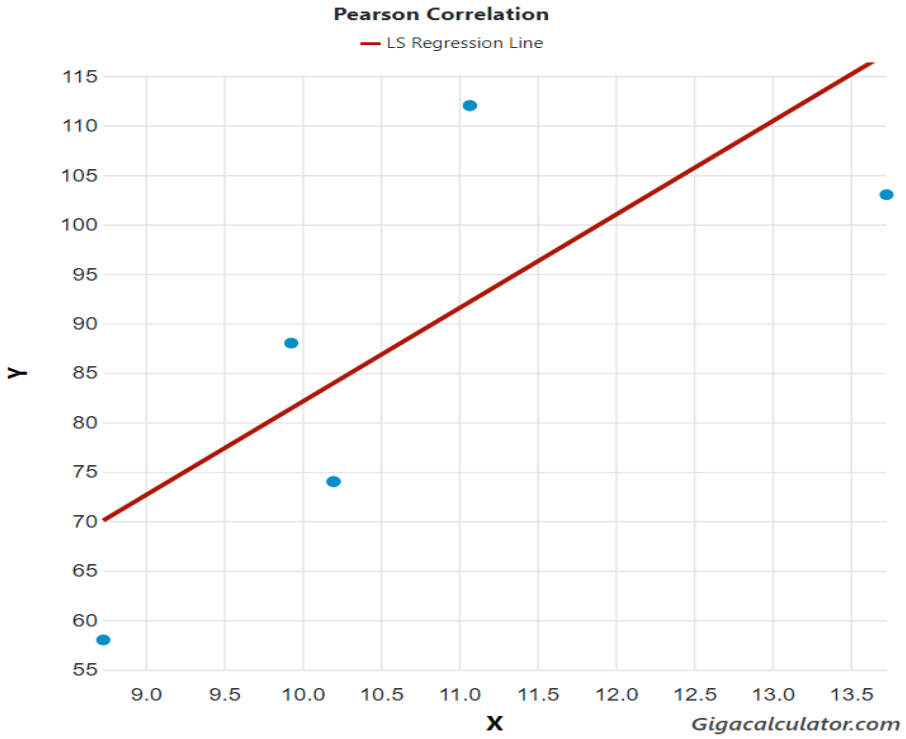

Figure 13. Correlation between a month with the highest number of rainy days and precipitation during the wettest month in *Sphaerotherium*.

DISCUSSION

Relationships between temperature, daily hours of sunshine, and rainfall were found in *Sphaerotherium*. Near Durban (latitude: 30.1 degrees East) there was the highest coolest average temperature (17.3 degrees Celsius), warmest average temperature (24.3 degrees Celsius), and the lowest daily hours of sunshine (6.73 hours), and the highest rainfall (893 mm). A relationship between precipitation during the wettest month and latitude was also found in *Sphaerotherium*. Near Durban (latitude: 30.1 degrees East) there was the highest amount of precipitation during the driest month (1373mm).

This study supports the coolest and warmest average temperature, rainfall, and hours of sunshine as covariables in *Sphaerotherium*. Higher cool and warm average temperatures, lower daily hours of sunshine, and higher rainfall may explain greater fecundity selection. Higher temperature, lower daily hours of sunshine, and higher rainfall may be an explanation for activity in species showing sexual size dimorphism, such as millipedes.

CONCLUSION

Eleven new relationships were found between latitude, lowest and highest average temperatures, lowest daily hours of sunshine, and rainfall in *Sphaerotherium*.

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