

## FEMALE SURFACE AREA-TO-VOLUME RATIO IS RELATED TO MINIMUM TEMPERATURE IN *CENTROBOLUS* COOK, 1897

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**Abstract-** Surface area-to-volume ratio was tested for a correlation with minimum temperature in forest red millipedes *Centrobolus*. Surface-area-to-volume ratio was not related to minimum temperature in males (Spearman's  $r=-0.27303561$ , Z score= $-1.18604347$ ,  $n=22$ ,  $p=0.11780263$ ) and was related in females (Spearman's  $r=-0.37298673$ , Z score= $-1.65915079$ ,  $n=22$ ,  $p=0.04854269$ ).

$0.37298673$ , Z score= $-1.65915079$ ,  $n=22$ ,  $p=0.04854269$ ).

**Keywords:** surface area, SSD, Red Millipedes

### I. INTRODUCTION

Red millipedes are found in the southern African subregion with northern limits on the east coast being about  $-17^\circ$  latitude S and southern limits being  $-35^\circ$  latitude S. They are well represented in the littoral forests of the eastern half of the subcontinent [1-326]. It consists of taxonomically important species with 12 species considered threatened and includes nine vulnerable and three endangered species [326]. It occurs in all the forests of the coastal belt from the Cape Peninsula to Beira in Mocambique [325]. These worm-like millipedes have female-biased sexual size dimorphism [57].

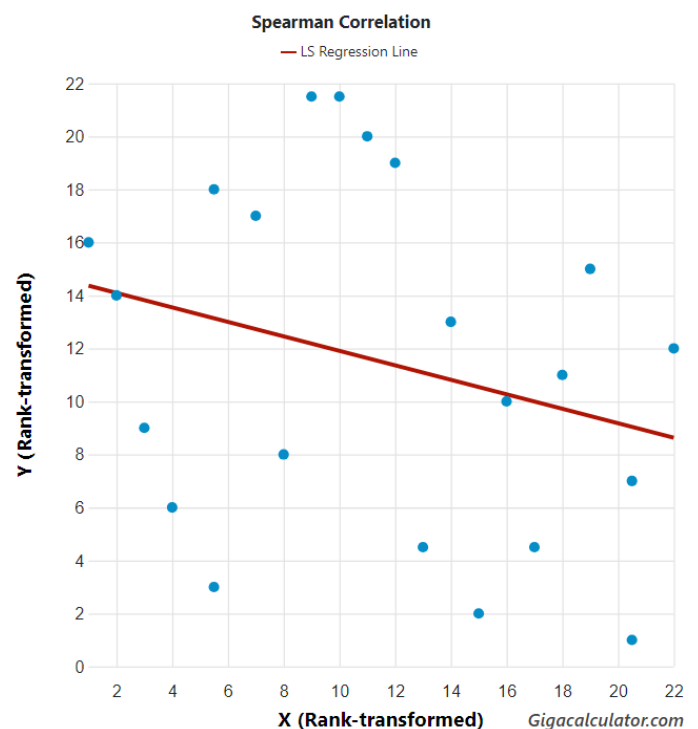
Here, surface-area-to-volume ratio was tested for a correlation with minimum temperature in *Centrobolus* Cook, 1897.

### II. MATERIALS AND METHODS

Surface-area-to-volume ratio for 22 species of southern African *Centrobolus* were obtained from published material [68]. These were correlated with minimum temperature and generated at <https://www.gigacalculator.com/calculators/correlation-coefficient-calculator.php>.

### III. RESULTS

Surface-area-to-volume ratio was not related to minimum temperature in males (Fig. 1: Spearman's  $r=-0.27303561$ , Z score= $-1.18604347$ ,  $n=22$ ,  $p=0.11780263$ ) and was related in females (Fig. 2: Spearman's  $r=-$



**Fig. 1** Surface-area-to-volume ratio marginally correlated with minimum temperature in male *Centrobolus* Cook, 1897.

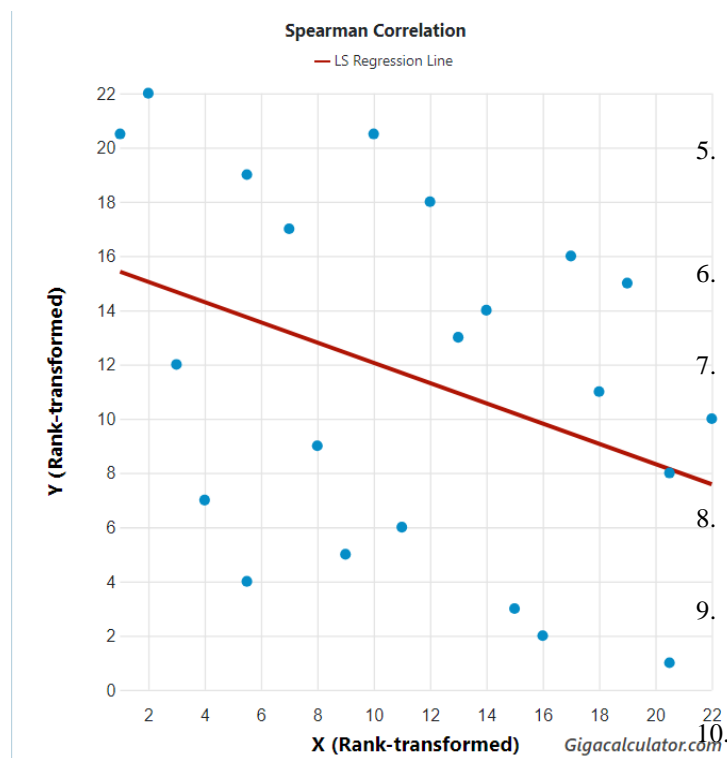


Fig. 2 Surface-area-to-volume ratio correlated to minimum temperature in female *Centrobolus* Cook, 1897.

#### IV. DISCUSSION

The significant differences between males and females in volumes are known in this genus [68]. There is a correlation between surface-area-to-volume ratios and minimum temperature in female *Centrobolus*. This is an addition to one of the many correlated with body size in millipedes.

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**APPENDIX 1.** Male surface-area-to-volume ratios preceded by minimum temperature (degrees Celsius) for 22 species of *Centrobolus* Cook, 1897.

14.5, 0.000510  
19.9, 0.000486  
14.8, 0.000365  
11.4, 0.000485  
11.5, 0.000245  
19.8, 0.000218  
21.6, 0.000294  
18.7, 0.000136  
20.5, 0.000393  
15.3, 0.000335  
17.7, 0.000156  
11.4, 0.616435  
15.7, 0.000510  
19.8, 0.418711  
19.7, 0.000220  
22.2, 0.000223  
16.6, 0.000169  
13.6, 0.000357  
15.0, 0.559114  
19.4, 0.000422  
9.5, 0.000349

19.0, 0.000136

**APPENDIX 2.** Female surface-area-to-volume ratios preceded by minimum temperature (degrees Celsius) for 22 species of *Centrobolus* Cook, 1897.

14.5, 0.000177  
19.9, 0.000578  
14.8, 0.540690  
11.4, 0.000484  
11.5, 0.000179  
19.8, 0.000132  
21.6, 0.000108  
18.7, 0.000113  
20.5, 0.000274  
15.3, 0.000213  
17.7, 0.000716  
11.4, 0.679931  
15.7, 0.000245  
19.8, 0.4103607  
19.7, 0.000138  
22.2, 0.000113  
16.6, 0.000135  
13.6, 0.000314  
15.0, 0.533940  
19.4, 0.000335  
9.5, 0.000318  
19.0, 0.000751