

# (FEMALE) SECOND POLAR MOMENTS OF INERTNESS ARE RELATED TO SEXUAL SIZE DIMORPHISM IN FOREST RED MILLIPEDES *CENTROBOLUS COOK, 1897*

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**Abstract-** Female second polar moments of area were correlated with sexual size dimorphism (SSD) in red millipedes *Centrobolus*. Female second polar moments of area were correlated with SSD ( $r=0.54283323$ ,  $Z$  score= $2.65092434$ ,  $n=22$ ,  $p=0.00401363$ ) ( $y = 0.00014773 \cdot x + 1.16875375$ ).

**Keywords:** Polar, Area, SSD, Red Millipedes

<https://www.gigacalculator.com/calculators/correlation-coefficient-calculator.php>. Tests for normality were conducted at <https://www.statskingdom.com/kolmogorov-smirnov-test-calculator.html>.

## I. INTRODUCTION

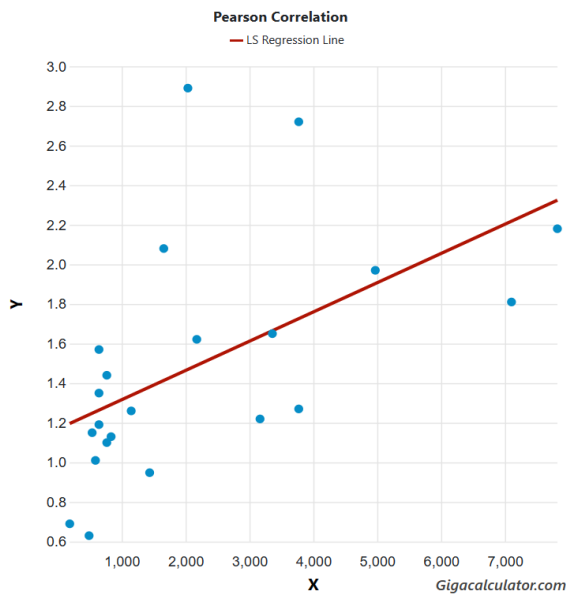
Red millipedes are found in the southern African subregion with northern limits on the east coast being about  $-17^\circ$  latitude S and southern limits being  $-35^\circ$  latitude S. They are well represented in the littoral forests of the eastern half of the subcontinent [1-300]. It consists of taxonomically important species with 12 species considered threatened and includes nine vulnerable and three endangered species [226]. It occurs in all the forests of the coastal belt from the Cape Peninsula to Beira in Mocambique [225]. These worm-like millipedes have female-biased sexual size dimorphism [57]. Here, second polar moments of inertia for females are correlated with SSD in *Centrobolus* Cook, 1897.

## II. MATERIALS AND METHODS

Horizontal tergite width measurements for 22 species of southern African *Centrobolus* were obtained from published material [57]. These were halved to get radii ( $r$ ). The second polar moments of area ( $\text{mm}^4$ ) were calculated based on the equation  $\pi/2 \cdot r^4$  for females (Appendix 1). A correlation between female second polar moments of area with SSD was generated at

## III. RESULTS

Female second polar moments of area were correlated with SSD ( $r=0.54283323$ ,  $Z$  score= $2.65092434$ ,  $n=22$ ,  $p=0.00401363$ ) ( $y = 0.00014773 \cdot x + 1.16875375$ ). Results of the lilliefors test indicated that there is a significant difference from the normal distribution in females, ( $D(22) = 0.19$ ,  $p = 0.0346$ ). Results of the lilliefors test indicated that there is a significant difference from the normal distribution in males, ( $D(22) = .2$ ,  $p = .0255$ ). Male and female second polar moments of area were significantly different ( $Z=-3.961070$ ,  $W=4.00$ ,  $n=22$ ,  $p=0.0000746146$ ).



**Figure 1. Correlation between the female second polar moment of area and sexual size dimorphism in *Centrobolus* Cook, 1897.**

#### IV. DISCUSSION

The significant differences between males and females in second polar moments of area are known in this genus. There is a correlation between female second polar moments of area and SSD is given. This is an addition to one of the many correlated with body size in millipedes. An alternative calculation including body length is another option in calculating the second polar moments of area in these millipedes with cylindrical body shapes.

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766.498501, 1.10  
7101.91201, 1.81
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**APPENDIX 1.** Second polar moments of area (mm<sup>4</sup>) and sexual size dimorphism for female *Centrobolus Cook*, 1897.

- 2035.75204, 2.89  
644.12467, 1.19086177  
488.784066, 0.63  
588.749544, 1.01  
644.12467, 1.35  
3358.5787, 1.65  
3771.48199, 2.72  
3165.33069, 1.2194459  
766.498501, 1.44  
644.12467, 1.57