

SECOND POLAR MOMENTS OF INERTNESS ARE RELATED TO MOMENTS OF INERTIA IN FOREST RED MILLIPEDES *CENTROBOLUS* COOK, 1897

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Abstract- Second polar moments of area (mm^4) were correlated with moments of inertia ($\text{kg}\cdot\text{m}^2$) in red millipedes *Centrobolus*. Male second polar moments of area were correlated with moments of inertia ($r=0.96796379$, Z score= 2.91178635 , $n=22$, $p<0.01$) ($y = 0.00590478 \cdot x + -1.72454991$). Female second polar moments of area were correlated with moments of inertia ($r=0.84627787$, Z score= 1.75771212 , $n=4$, $p=0.03939821$) ($y = 0.00355650 \cdot x + 1.24650534$).

Keywords: Polar, 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° latitude S and southern limits being -35° latitude S. They are well represented in the littoral forests of the eastern half of the subcontinent [1-301]. 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 Mozambique [225]. These worm-like millipedes have female-biased sexual size dimorphism [57]. Here, second polar moments of inertia for females are correlated with moments of inertia in *Centrobolus* Cook, 1897.

II. MATERIALS AND METHODS

Horizontal tergite width measurements for 4 species of southern African *Centrobolus* were obtained from published material [57]. These were halved to get radii (r). The second polar moments of area (mm^4) were calculated based on the equation $\pi/2 \cdot r^4$ for males and females (Appendix 1 & 2). A correlation between female second polar moments of area with moments of inertia was generated at <https://www.gigacalculator.com/calculators/correlation-coefficient-calculator.php>. Tests for normality were conducted at

<https://www.statskingdom.com/kolmogorov-smirnov-test-calculator.html>.

III. RESULTS

Male second polar moments of area were correlated with moments of inertia (Figure 1: $r=0.96796379$, Z score= 2.91178635 , $n=5$, $p=0.00179691$) ($y = 0.00590478 \cdot x + -1.72454991$). Female second polar moments of area were correlated with moments of inertia (Figure 2: $r=0.84627787$, Z score= 1.75771212 , $n=5$, $p=0.03939821$) ($y = 0.00355650 \cdot x + 1.24650534$). Results of the lilliefors test indicated that there is a significant difference from the normal distribution in females' second polar moments of area, ($D(22) = 0.19$, $p = 0.0346$). Results of the lilliefors test indicated that there is a significant difference from the normal distribution in males' second polar moments of area, ($D(22) = .2$, $p = .0255$). Male and female second polar moments of area were significantly different ($Z=-3.961070$, $W=4.00$, $n=22$, 22 , $p=0.0000746146$).

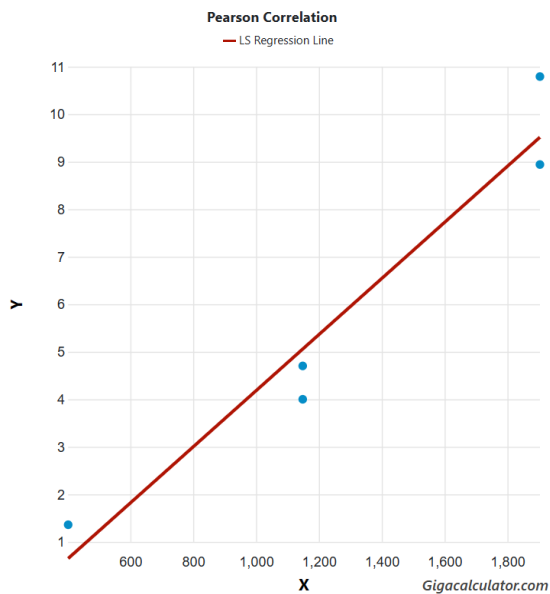


Figure 1. Correlation between the male second polar moment of area and moments of inertia in *Centrobolus* Cook, 1897.



Figure 2. Correlation between the female second polar moment of area and moments of inertia 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 male and female second polar moments of area and moments of inertia which is given. This is an addition to one of the many correlations 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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APPENDIX 1. Second polar moments of area (mm^4) and moments of inertia (kg.m^{-2}) for male *Centrobolus Cook*, 1897.

402.12386, 1.36

1148.50596, 4.70205

1148.50596, 4

1903.39062, 10.7911

1903.39062, 8.9401

APPENDIX 2. Second polar moments of area (mm^4) and moments of inertia (kg.m^{-2}) for female *Centrobolus Cook*, 1897.

3165.33069, 12.7375375

3358.5787, 9.46585

2174.89962, 9.3025

588.749544, 2.9376

3165.33069, 16.0777305