VOLUMES AND CURVED SURFACE AREAS ARE DIFFERENT BETWEEN THE SEXES OF A PAIR OF SYMPATRIC FOREST RED MILLIPEDES *CENTROBOLUS* COOK, 1897

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***Abstract*- Volumes and curved surface areas were compared in sympatric forest red millipedes *Centrobolus*. Volumes were significantly different between the sexes (P-value calculator: P-value=0.000568, Z score=3.254342, n=2, 2) (P-value=0.000362, Z score=3.380658, n=2, 2). Mean volumes of males in *C. anulatus* and *C. inscriptus* were 1785mm^3 and females were 21520mm^3; 0.205602mm^3 relative difference and 367mm^3 absolute difference. Curved surface areas were significantly different between the sexes (P-value calculator: P-value=0.002839, Z score=-2.765863, n=2, 2). Curved surface areas in *C. anulatus* and *C. inscriptus* females were 2734.7565mm^2 and males were 2390.8020mm^2; -343.9545mm^2 difference.**

***Keywords*: curved 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° latitude S and southern limits being -35° latitude S. They are well represented in the littoral forests of the eastern half of the subcontinent [1-483]. 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, volumes and curved surface areas are compared in a pair of sympatric *Centrobolus* Cook, 1897.

II. MATERIALS AND METHODS

Horizontal tergite width measurements for 2 species of southern African *Centrobolus* were obtained from published material [7]. These were halved to get radii (r). The surface areas (mm^2) were calculated based on the equation $2 \cdot \pi \cdot r \cdot (r + h)$ for males and females. A P-value test between volumes and curved surface areas with (sympatric) species (Appendix 1-4) was generated at https://www.gigacalculator.com/calculators/p-value-significance-calculator.php.

III. RESULTS

Curved surface areas were significantly different between the sexes (Fig. 1: P-value calculator: P-value=0.002839, Z score=-2.765863, n=2, 2) (P-value=0.002066, Z score=-2.867969, n=2, n=2). Curved surface areas in *C. anulatus* and *C. inscriptus* females were 2734.7565mm^2 and males were 2390.8020mm^2; -343.9545mm^2 absolute difference/-0.125772mm^2 relative difference.

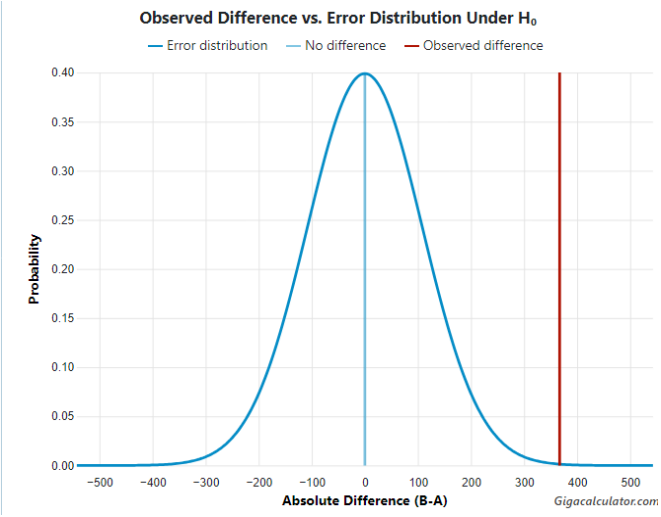

Fig. 1 Volumetric differences in P-value calculation of absolute difference between sexes of sympatric *Centrobolus* Cook, 1897.

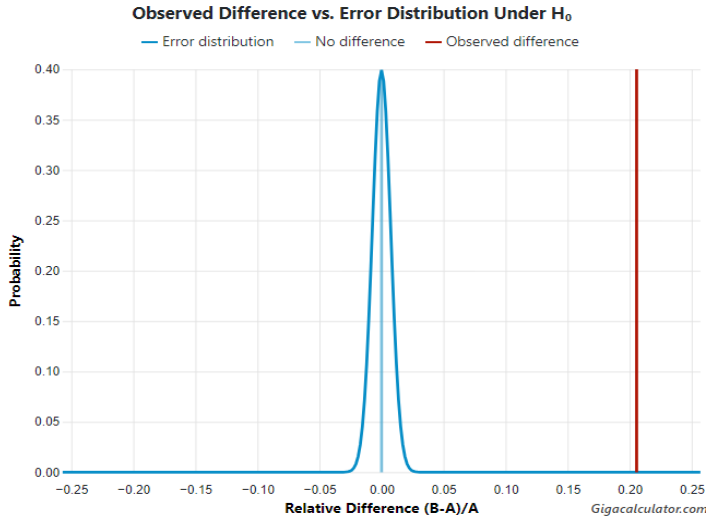

Fig. 2 Volumetric differences in P-value calculation of relative difference between sexes of sympatric *Centrobolus* Cook, 1897.

Curved surface areas were significantly different between the sexes (Fig. 3: P-value calculator: P-value=0.002839, Z score=-2.765863, n=2, 2) (Fig. 4: P-value=0.002066, Z score=-2.867969, n=2, n=2). Curved surface areas in *C. anulatus* and *C. inscriptus* females were 2734.7565mm^2 and males were 2390.8020mm^2; -343.9545mm^2 absolute difference/-0.125772mm^2 relative difference.

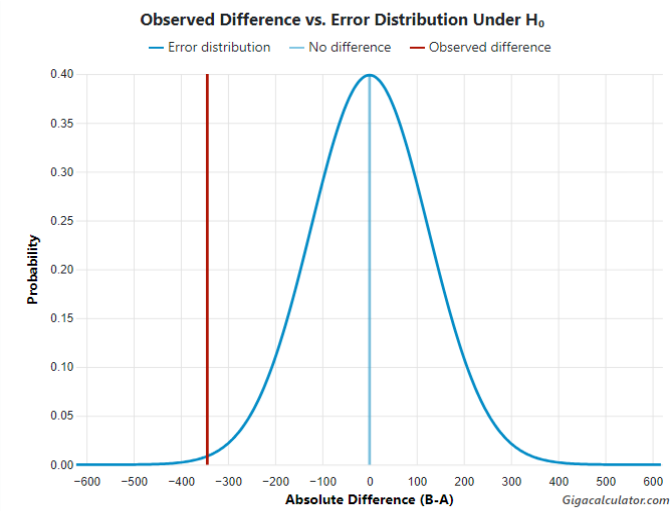

Fig. 3. Curved surface areas differences in P-value calculation of absolute difference between sexes of sympatric *Centrobolus* Cook, 1897.

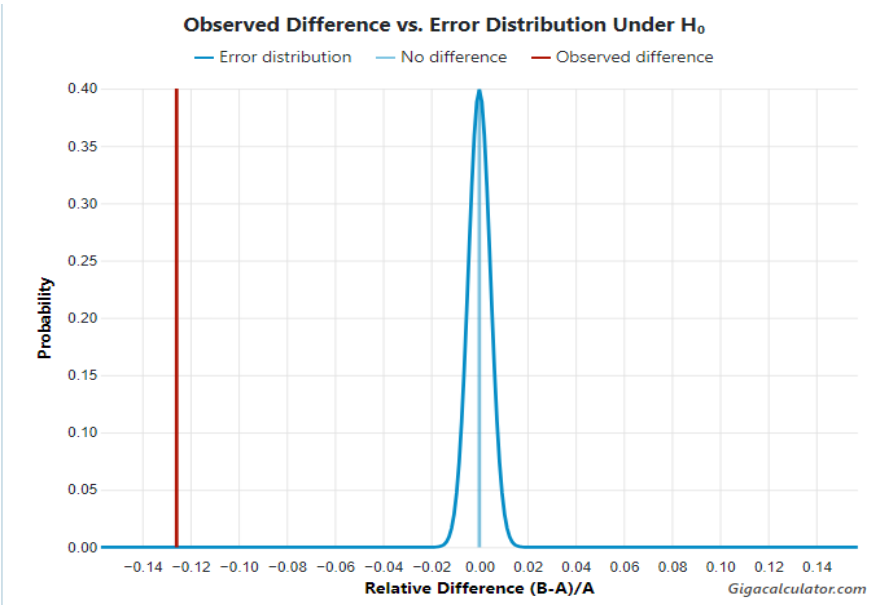

Fig. 4. Curved surface areas differences in P-value calculation of relative difference between sexes of sympatric *Centrobolus* Cook, 1897.

IV. DISCUSSION

A significant correlation between males and females in volume is known in this genus [32, 50]. There is a correlation between volumes between both sexes in sympatric species which differ absolutely and relatively. There is a correlation between curved surface areas in between both sexes and sympatric species differ (absolutely and relatively). This is an addition to one of the many correlated with body size in millipedes.

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APPENDIX 1. Volume (mm^3) for female *Centrobolus anulatus* and *C. inscriptus*.
2245
2059
APPENDIX 2. Volume (mm^3) for male *Centrobolus anulatus* and *C. inscriptus*.
1729
1841
APPENDIX 3. Curved surface area (mm^2) for female *Centrobolus anulatus* and *C. inscriptus*.
2652.133
2817.38
APPENDIX 4. Curved surface area (mm^2) for male *Centrobolus anulatus* and *C. inscriptus*.
2483.743
2297.861