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ARE MATING FREQUENCIES RELATED TO SEXUAL SIZE DIMOROPHISM IN CENTROBOLUS COOK, 1897?

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***Abstract*- Two species of *Centrobolus* were identified (*C. anulatus*, *C. inscriptus*) based on morphology and confirmed using Scanning Electron Microscopy (SEM) of gonopod structure. Two sets of measurements were made from field data: (1) sexual size dimorphism (SSD), and (2) mating frequencies. Mating frequencies and SSD were positively correlated (r=0.92554221, Z score=5.86394325, n=16, p=0) across the two species.**

I. INTRODUCTION

The red millipede genus *Centrobolus* is well known for studies on sexual size dimorphism (SSD) and displays prolonged copulation durations for pairs of individuals of the species [3-8]. *Centrobolus* is distributed in temperate southern Africa with northern limits on the east coast of southern Africa at -17° latitude South (S) and southern limits at -35° latitude S. It consists of taxonomically important species with 12 species considered threatened and includes nine vulnerable and three endangered species [23]. It occurs in all the forests of the coastal belt from the Cape Peninsula to Beira in Mocambique [22]. Spirobolida has two pairs of legs modified into gonopods on the eighth and ninth diplosegments [25]. In *Centrobolus* the coleopods are the anterior gonopods of leg-pair eight. They can be classed as paragonopods or peltogonopods because they are fused into a single plate-like structure and play a subsidiary role as inseminating devices. In contrast, leg-pair nine is sperm-transferring [1]. The sternites (or stigma-carrying plates [26]) prevent lateral shifting (stabilizer) and stretch the vulva sac in a medial plane [3].

These worm-like millipedes have female-biased SSD [3-8, 11-18, 20]. From the results, correlations between SSD and mating frequencies were checked for correlation.

II. MATERIALS AND METHODS

Millipedes were hand collected in coastal forest habitat at Mtunzini (28° 55' S; 31° 45' E) during the summer season (1995-1996). Individual millipedes were identified as species and sexed based on the presence of gonopods in males and their absence in females. Individuals were counted as either on or above ground (>30cm but <3m above ground surface). The number of mating pairs was recorded. The total number of adults was used to estimate the relative abundance. Intercalary males were excluded from the counts. SSD was calculated as the ratio of female volume divided by male volume from length and width measurements. Two species of *Centrobolus* were identified based on morphology and confirmed using Scanning Electron Microscopy (SEM) of gonopod structure (*C. anulatus*, *C. inscriptus*). The gonopods were dissected from males of these two species and prepared for SEM. Specimens were fixed, first in 2.5% glutaraldehyde (pH 7.4 phosphate-buffered saline) at 4 °C for 24 hours, then in osmium tetroxide (2%). Dehydration through a graded alcohol series (50%, 60%, 70%, 80%, 90% to 100% ethanol) and critical point drying followed. Specimens were mounted on stubs and sputter coated with gold palladium. Gonopods were viewed under a Cambridge S200 SEM. SEM micrographs were examined and the individual components of the gonopods were identified according to the available species descriptions. Two sets of measurements were made from the field data (1) SSD, and (2) mating frequencies. SSD and mating frequencies were correlated using Pearson's Correlation Coefficient

(https://www.gigacalculator.com/calculators/correlation-coefficient-calculator.php).

III. RESULTS

Mating frequencies and SSD were positively correlated (Figure 1: r=0.92554221, Z score=5.86394325, n=16, p=0).

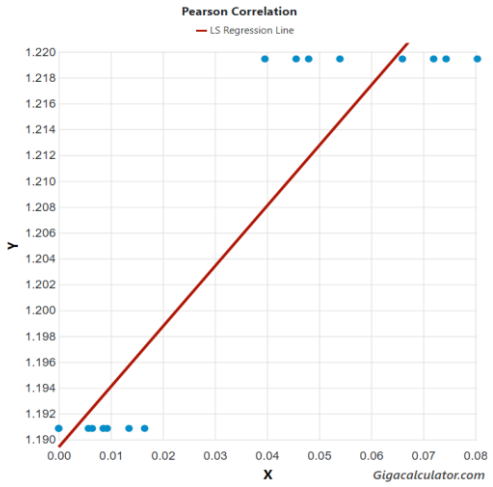

Figure 1. Relationship between sexual size dimorphism (y) and mating frequencies (x) for *C. anulatus* and *C. inscriptus*.

IV. DISCUSSION

The SSD and mating frequencies were estimated in two *Centrobolus* species. A direct relationship between two factors (SSD and mating frequencies) in the millipedes is compared which certainly supports the relationship. A relationship between these behavioral factors is present across two species. *C. inscriptus* had the mating frequencies and higher SSD while *C. anulatus* had lower mating frequencies and a lower SSD.

V. CONCLUSION

A new relationship between SSD and mating frequencies among the *Centrobolus* millipedes was proposed.

APPENDIX.

Male and female mating frequencies (early, and late in a season, on the ground, and in the trees), in two species of *Centrobolus*, are followed by sexual size dimorphism.

0, 1.19086177 (*C. anulatus*).
0, 1.19086177 (*C. anulatus*).
0.0165, 1.19086177 (*C. anulatus*).
0.0135, 1.19086177 (*C. anulatus*).
0.0093, 1.19086177 (*C. anulatus*).
0.0057, 1.19086177 (*C. anulatus*).
0.00855, 1.19086177 (*C. anulatus*).
0.00645, 1.19086177 (*C. anulatus*).
0.066, 1.2194459 (*C. inscriptus*).
0.054, 1.2194459 (*C. inscriptus*).
0.0744, 1.2194459 (*C. inscriptus*).
0.0456, 1.2194459 (*C. inscriptus*).
0.072, 1.2194459 (*C. inscriptus*).
0.048, 1.2194459 (*C. inscriptus*).
0.0396, 1.2194459 (*C. inscriptus*).
0.0804, 1.2194459 (*C. inscriptus*).

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