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THE TIE-IN OF MALE BODY WIDTH ON COPULATION DURATION IN *CENTROBOLUS* COOK, 1897

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Abstract

Body size is a correlate of copulation duration in Centrobolus inscriptus. I tested for the presence of a relationship between male body width and copulation duration across Centrobolus in performing mating experiments. Males differed significantly from females in body mass, body length, and dorsal tergite width. Male width (n=88, 11, 18, 5) was positively related to copulation duration (n=51, 115, 32, 8) (r=0.95, Z score=1.81, n=4, p=0.04). Larger males were suspected to be more competitive.

Keywords*: Arthropods, body size, Centrobolus, copulation duration*

INTRODUCTION

Male and female body sizes can influence the duration of copulation in arthropods [3]. Body size and morph are known drivers of copulation duration [5]. These factors may be interdependent [4]. The interdependence of male and female body size on each other is manifest in the relationship between reversed sexual size dimorphism (SSD) and copulation duration [2]. Here I test for the presence of a relationship between male body width and copulation duration across the millipede genus *Centrobolus*. The null hypothesis is there is no relationship between male body width and copulation duration in any of the matings.

MATERIALS AND METHODS

Millipedes were collected in KwaZulu/Natal. Live specimens of each sex were transported to the laboratory where conditions were kept under a constant regime of 25 °C temperature; 70 % relative humidity; 12: 12 hrs light-dark cycle. Food was provided in the form of fresh vegetable ad libitum. Individuals had unknown mating histories. Unisex groups were housed in plastic containers containing moist vermiculite (± 5 cm deep) for 10 days before commencing the first mating experiments. Three measurements were taken for all individuals once copula pairs had disengaged; body mass (accurate to 0.01 g), body length (mm), and dorsal tergite width (mm). Dorsal tergite width was measured horizontally using Vernier calipers. Animals were placed into glass mating arenas (30 X 22 X 22 mm). Individuals were marked on the posterior segments with colored tipex fluid (perfect A16) before mating. This allowed data from each individual to be integrated. Single, double, and artificially-terminated mating with females were allowed. Approximately five minutes after establishing copula pairs were removed from the mating arena and placed into plastic beakers (13 cm diameter). This prevented interference from other males and allowed easy timing of the copulation durations. Statistical analyses were performed using http://www.gigacalculator.com/calculators/correlation-coefficient-calculator.phpStatgraphics. Morphometric and behavioral data were tested for normality (http://www.statskingdom.com/kolmogorov-smirnov-test-calculator.html).

RESULTS

Larger males tended to copulate (n=51, 115, 32, 8) for longer than their smaller conspecifics in *C. inscriptus* (n=88), *C. fulgidus* (n=11), *C. ruber* (n=18) and *C. annulatus* (n=5) (Figure 1: r=0.931478, Z score=1.66944296, n=4, p=0.04751479). When the accuracy of the measurement for *C. annulatus* male body width was increased to three significant figures after the decimal (i. e. 5.264 mm rather than 5.3 mm)[1] this relationship was marginal (r=0.92309482, Z score=1.60955888, n=4, p=0.05374709). Standard deviations were marginally related to accurate male width (r=0.87940328, Z score=1.37312875, n=4, p=0.08485622) and marginally related to rounded male width (r=0.89752239, Z score=1.45932999, n=4, p=0.07223719). When the accuracy of *C. annulatus* was placed at three significant figures (5.64 mm) the relationship was significant (r=0.947847, Z score=1.81014914, n=4, p=0.03513628). Copulation duration was normally distributed (D=0.3298, n=4, p=0.1293). Male width was normally distributed (D=0.2395, n=4, p=0.5771).

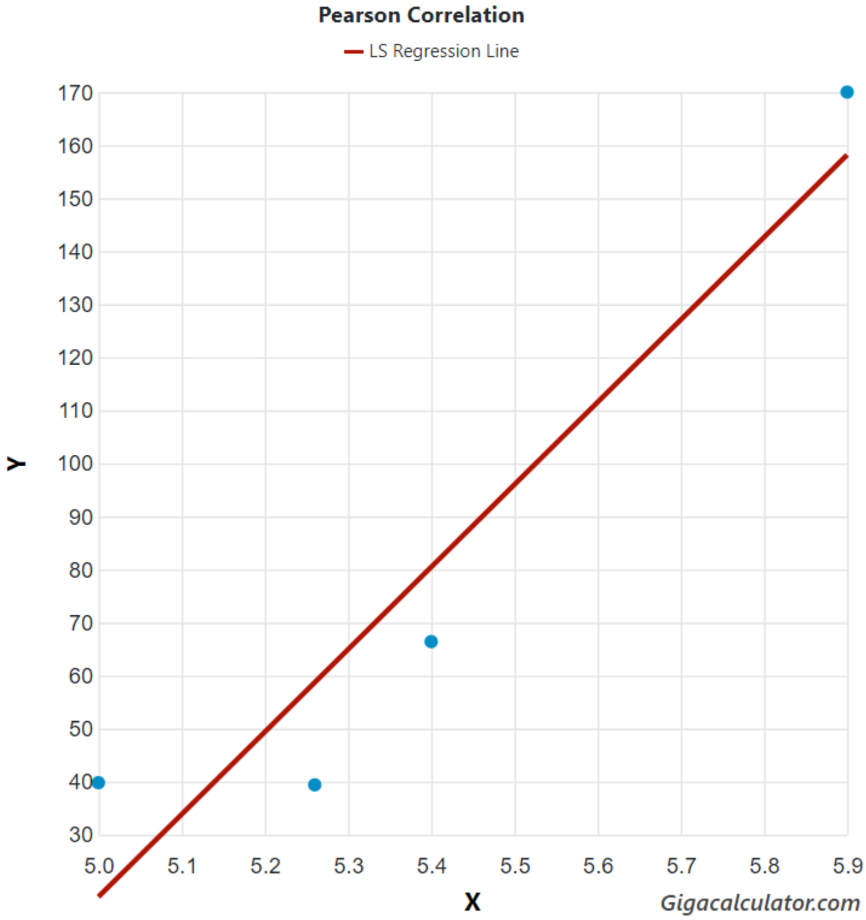

Figure 1. Relationship between copulation duration and male width across four species of *Centrobolus* (*C. fulgidus*, *C. annulatus*, *C. inscriptus*, *C. ruber*).

DISCUSSION

The null hypothesis is falsified if a relationship between male width and copulation duration is found. Males appear able to control copulations under their body size, which may relate to the competition. One reason can be given for why larger males endure longer copulations: larger males endure to control the duration of copulation and benefit from improved sperm competition. This may come about through maximizing ejaculate or some other nutrient-rich substance produced by the male;

predicting a correlation between ejaculate volume or material benefits with copulation duration. Larger males are also expected to carry larger gonopods (Cooper, in press).

When digitizing continuous signals, such as millipede width, the overall effect of some measurements is more important than the accuracy of each measurement. In this case, the overall effect of average species width is considered moderately important in the accuracy of individual averages (particularly *C. annulatus*[1]). The tie-breaking method implemented is rounding half away from zero or rounding half toward infinity with a moderate level of accuracy (http://en.wikipedia.org/wiki/Rounding#Rounding_up).

CONCLUSION

Copulations of males may significantly relate to male body width in the absence of sexual size dimorphism in mating experiments of *C. fulgidus*, *C. annulatus*, *C. inscriptus*, and *C. ruber*.

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