DOES EJACULATE VOLUME VARY WITH SURFACE AREA AND SURFACE AREA TO VOLUME RATIO IN *CENTROBOLUS* COOK, 1897?

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Abstract- Ejaculate volume and surface area and surface area-to-volume ratio were checked for correlations in the red millipede genus *Centrobolus*. There was a relationship between male and female surface area and ejaculate volume (Kendall's τ=-0.91, Z score=-50000, n=4, p=0). There was a significant relationship between male and female surface area-to-volume and ejaculate volume (r=-0.99, Z score=-2.50, n=4, p<0.01).

I. INTRODUCTION

The millipede genus *Centrobolus* Cook, 1897 is found in the temperate South African subregion, its northern limits on the east coast of southern Africa being about -17° latitude South (S) and its southern limits being about -35° latitude S [4, 30]. It consists of taxonomically important species with 12 species considered threatened and includes nine vulnerable and three endangered species [33]. It occurs in all the forests of the coastal belt from the Cape Peninsula to Beira in Mocambique [32]. Common with worm-like millipedes is the surface area and surface-area-to-volume ratio known to differ in several populations of the genus []. These worm-like millipedes show female-biased Sexual Size Dimorphism (SSD) [3-26]. Surface area and surface-area-to-volume ratio may correlate with precipitation and may determine the ejaculate volume which correlates with the copulation durations [13, 29-31]. Ejaculate volumes and surface area and surface area-to-volume ratios are tested for a correlation with ejaculate volume during the breeding season in the pachybolid millipede genus *Centrobolus*. The aim is to determine if there are correlations between surface area and surface area-to-volume ratio across several species.

II. RESULTS

There was no relationship between male and female surface area and ejaculate volume (r=-0.75363116, Z score=-0.98130706, n=4, p=0.16322067). There was a relationship between male and female surface area and ejaculate volume (Figure 1: Kendall's τ=-0.91287093, Z score=-50000, n=4, p=0). There was a significant relationship between male and female surface area-to-volume and ejaculate volume (Figure 2: Pearson's r=-0.98672981, Z score=-2.50436264, n=4, p=0.00613363). These differences are linked to the effects of surface area and SSD differences between the species.

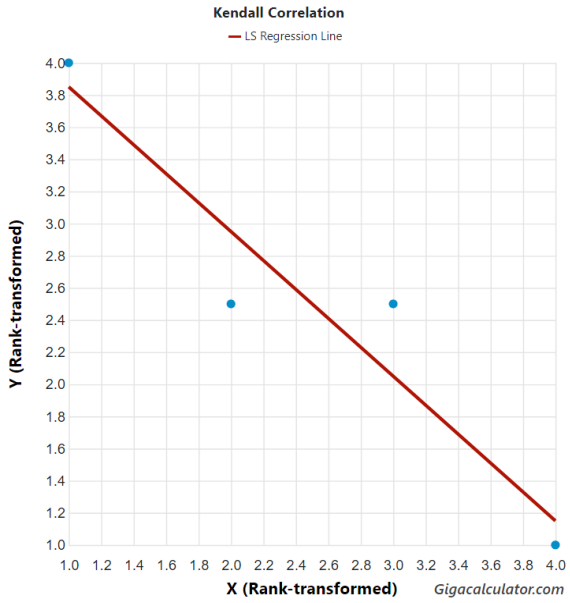

FIGURE 1. A significant relationship between male and female surface area and ejaculate volume in *Centrobolus* Cook, 1897.

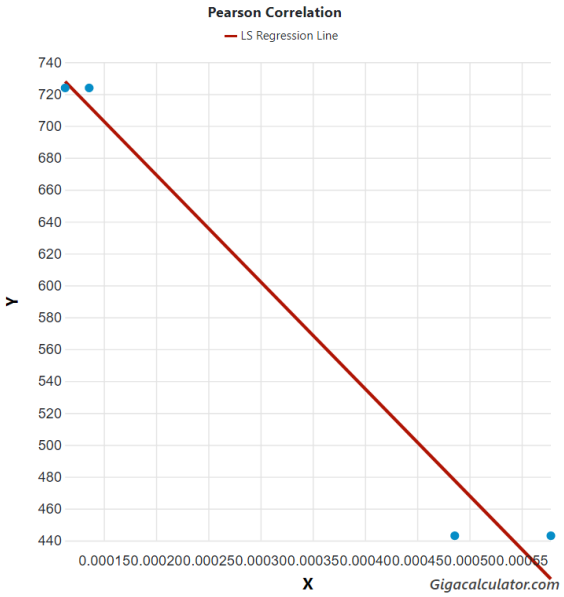

FIGURE 2. The significant relationship between male and female surface area-to-volume and ejaculate volume in *Centrobolus* Cook, 1897.

III. DISCUSSION

Two significant relationships were found between surface area and surface area-to-volume ratio and ejaculate volumes in sympatric *Centrobolus*. *Centrobolus* has surface areas that correlate with ejaculate volume. This study found the surface area and surface area-to-volume ratios recorded in *Centrobolus* were negatively related to ejaculating volumes. So both factors probably determined the opportunity for selection, degree of polygynandry, and ejaculate volume in these species. This study supports using the surface area-to-volume ratio as a correlate of ejaculate volume across *Centrobolus*. Examples of ejaculate volume varying with surface area-to-volume ratio are unknown. Ejaculate volume variation with the surface area-to-volume ratio occurs during seasonal activity patterns in species as such: millipedes [27, 28]. The surface area-to-volume ratio can determine the ejaculate volume and covary with many other factors. Spatial changes in habitat preference are known in *C. fulgidus* and *C. richardii* [29]. These differences are linked to the effects of surface area and SSD differences (65%) between the latter two species.

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