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CORRELATION COEFFICIENT MATRIX FOR SIXTEEN FACTORS IN THE MATING SYSTEMS OF RED MILLIPEDES *CENTROBOLUS* COOK, 1897

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Abstract

A correlation coefficient matrix including 16 factors was constructed to summarize the polygynandrous mating systems of red millipedes Centrobolus. *The sixteen factors summarized were abundance, copulation duration, ejaculate volume, latitude, longitude, mass, mating frequency, moments of inertia, sex ratio, spine length, spine number, sternite prominence, size of males, size of females, sexual size dimorphism, and tarsal pad length. Correlation coefficients were included for interspecific values between 111 pair-wise comparisons of 16 factors. The results of this study demonstrated between 46.8-49.5% (52-55) were significant or highly significant relationships between all pair-wise comparisons which were present.*

Keywords: *Correlation, Coefficient, Matrix*

INTRODUCTION

The forest genus of diplopods belonging to the Order Spirobolida found along the eastern coast of southern Africa was the subject of this study. The millipede genus *Centrobolus* is found in the temperate South African subregion, its northern limits on the east coast of southern Africa being about -17° latitude S. It occurs in all the forests of the coastal belt from the Cape Peninsula to Beira in Mocambique. While the coastal forests of the South-West and Eastern Cape are mist belt temperate forests, those of the Transkei, Natal, Zululand and Mocambique are somewhat different, being better described as East Coast Bush, they are developed almost entirely in a narrow strip of the litoral on a dune sand substratum, and are more tropical in aspect and composition than those to the west of them. There is a summer rainfall of 762-1016mm, a uniform temperature, and an absence of frost; the component trees of the coastal bush with their abundant creepers and lianes, while not usually reaching a height of more than 11 meters, provide a dense covering with abundant shade and humidity at ground level. As essentially shade-loving Diplopoda, the members of the genus are especially well represented in these littoral forests of the eastern half of the subcontinent (Lawrence, 1967). Members of the genus all have polygynandrous mating systems with sperm competition and cryptic female choice (Cooper 2017; Cooper 2019).

MATERIALS AND METHODS

Sixteen factors were selected from a possible 24 factors thought to influence the mating systems of red millipedes (Appendix) (Cooper, 2022). Two factors include species richness and time (which were not included) and the other six include the breakdown of some of these sixteen factors into male and female components (abundance, mass, mating frequencies, and moments of inertia) and copulation duration into first, second and artificially terminated copulation durations accounting for the remaining factors. This excluded all effects of the weather which were dealt with elsewhere. Correlation coefficients were generated from studies on the mating systems of *Centrobolus*.

RESULTS

Correlation coefficients were found for 111 pair-wise comparisons between the 16 factors given in Table 1. 55 significant or highly significant cases were reported.

TABLE 1. Correlation coefficient matrix for sixteen factors measured in *Centrobolus* Cook, 1897

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	X	0.75*	0.63*	?	?	0.01	0.62*	0.20	0.40	0.93*	0.63	0.63*	0.63*	-0.63*	0.63*	0.63*
2		X	1.00*	-0.04	-0.04	0.75*/0.93*	0.93*	0.67*	-0.98*	-0.40	1.00	1.00	0.94	0.39	0.97*	0.75*
3			X	-0.14	-0.04	0.27	0.93*	0.60	-0.46	1.00	1.00	0.64*	1.00	-1.00	1.00	1.00
4				X	0.75*	0.78*	?	0.55*	?	-	0.15/0.19	0.64*	-0.14	0.14	-0.14	-0.14
										0.44*						
5					X	0.75*	?	0.61*	?	0.37*	0.41*/0.45*	1.28/0.43	-0.04	0.04	-0.04	-0.04
6						X	0.63*	0.74*	0.07	-0.76*	0.94*	0.87*	0.76*	-0.76*	0.72*	0.16
7							X	0.79*/0.82*	-0.51*--0.87*	0.93*	0.80*	0.80*	0.93*	0.93*	-0.93*	0.93*
8								X	-0.15*	0.79*	0.78	0.85*	0.71*	-0.70*	0.69*	0.60
9									X	0.74*	-0.46	-0.46	-0.46	0.46	-0.46	-0.46
10										X	0.56*	0.07	-0.48	-0.71	0.57	1.00
11											X	0.70	0.98	-0.92	0.83	-1.00
12												X	0.85	-0.73	0.63	1.00
13													X	-0.98	0.98	1.00
14														X	-0.99	-1.00
15															X	1.00
16																X

* the significant or highly significant relationship between pair of factors.

DISCUSSION

The results of this study demonstrated just half (55) of the correlation coefficients between paired factors were significant or highly significant relationships among 111 pair-wise comparisons that are present in the form of correlation coefficients explaining the polygynandrous mating systems of red millipedes. Together these correlation coefficients explain the linear relationships between each pair of factors and can thus make predictions, calculate rates, and make conversions. These coefficients are thought to determine the pairing of opposite sexes in the polygynandrous mating systems. For half of the correlation coefficients, individual studies were conducted and are available in the literature. The products, processes, and patterns of the red millipede polygynandry can successfully be understood through this matrix. Several gaps in the understanding are in abundance, mating frequencies, and sex ratios with latitude-longitude (Table 1). Significant or highly significant relationships were found between abundance and copulation duration, ejaculate volume, mating frequency, sexual size dimorphism (SSD), size of males, spine length and tarsal pad length; copulation duration and ejaculate volume, mass, moments of inertia, sex ratios, sternite prominence, and tarsal pad length; ejaculate volume and mating frequency, and size of males; latitude and longitude, mass, moments of inertia, and size of males; longitude and mass, moments of inertia, SSD, and size of males; mass and mating frequency, moments of inertia, SSD, size of females, size of males, spine length, and spine number; mating frequency and moments of inertia, sex ratios, SSD, size of females, size of males, spine length, spine number, sternite prominence, and tarsal pad length; moments of inertia and sex ratios, SSD, size of males, spine length, and sternite prominence; sex ratio and SSD; and SSD and size of females.

APPENDIX

A list of sixteen factors was used in the order they were inserted into the correlation coefficient matrix.

- Abundance (1)
- Copulation duration (2)
- Ejaculate volume (3)
- Latitude (4)
- Longitude (5)
- Mass (6)
- Mating frequency (7)
- Moments of inertia (8)
- Sex ratio (9)
- Sexual size dimorphism (10)
- Size of females (11)
- Size of males (12)
- Spine length (13)
- Spine number (14)
- Sternite prominence (15)
- Tarsal pad length (16).

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