

## SEX RATIO VARIES WITH HUMIDITY IN RED MILLIPEDES *CENTROBOLUS* COOK, 1897

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**Abstract-** In this paper, I check for correlations between the sex ratio for males and females and humidity in red millipedes *Centrobolus* Cook, 1897. I found correlations between sex ratio and humidity ( $r=-0.68$ , Z score= $-1.87$ ,  $n=8$ ,  $p=0.03$ ) ( $y = -2.93x + 77.1$ ). Differences of +1% humidity contributed to differences in the sex ratio. The increase in the magnitude of this factor resulted in a female-biased sex ratio.

### I. INTRODUCTION

A 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  $-17^\circ$  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 762-1016 mm, a uniform environmental 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 ample shade and humidity at ground level. As essentially shade-loving Diplopoda, the members of the genus are especially well represented in these litoral forests of the eastern half of the subcontinent [1-81].

In this paper, I check for correlations between the sex ratio for males and females and humidity in red millipedes *Centrobolus* Cook, 1897.

### II. MATERIALS AND METHODS

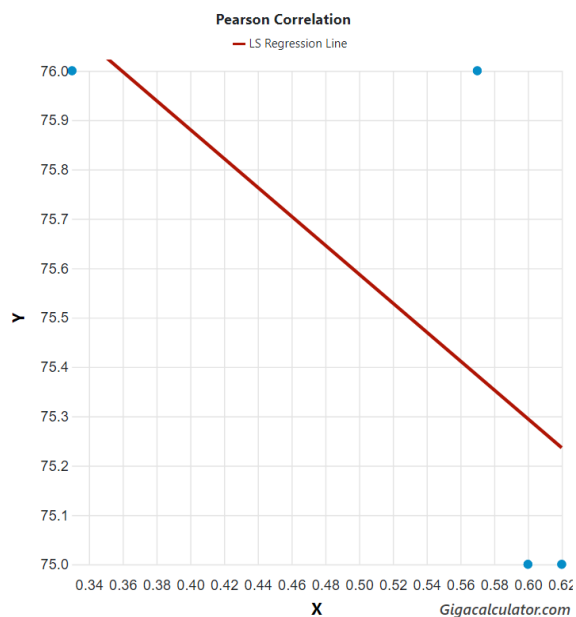
The data were collected during the rainy season because in southern Africa millipede surface activity is strongly seasonal and related to feeding

and reproduction and this is also when population densities peak. The two species of millipedes were sampled in their indigenous tropical coastal forest habitat at Twin Streams Farm, Mtunzini, South Africa ( $28^\circ 55'S$ ;  $31^\circ 45'E$ ). It is within this part of the typical coastal forest belt that *C. anulatus* and *C. inscriptus* are in geographical sympatry. An area of forest with continuous tree canopy cover was delimited and all sampling occurred within those bounds. In the first season, two temporally separate sampling efforts were made and the OSR was measured early in the season (DECEMBER) and late in the season (FEBRUARY). One weather pattern for December and February were obtained from <https://en.climate-data.org/africa/south-africa/kwazulu-natal/mtunzini-772733/>.

Correlations between sex ratios and the weather factor (one at a time versus sex ratios) were produced at <https://www.gigacalculator.com/calculators/correlation-coefficient-calculator.php>.

### III. RESULTS

Correlations were found between sex ratio and humidity (Figure 1:  $r=-0.68473679$ , Z score= $-1.87377660$ ,  $n=8$ ,  $p=0.03048055$ ) ( $y = -2.93040293 \cdot x + 77.05311355$ ).



**Figure 1.** Correlation between sex ratio and humidity in two species of *Centrobolus*.

#### IV. DISCUSSION

Differences of +1% humidity contributed to differences in the sex ratios of *C. anulatus* and *C. inscriptus*. The increase in the magnitude of any of this factor resulted in a female-biased sex ratio.

#### REFERENCES

- O. F. Cook, "New relatives of *Spirobolus giganteus*," *Brandtia* (A series of occasional papers on Diplopoda and other Arthropoda), vol. 18, pp. 73-75, 1897.
- M. Cooper, "Mating dynamics of South African forest millipede *Centrobolus* (Diplopoda: Pachybolidae)," Thesis, University of Cape Town, 1-141, 1998.
- M. I. Cooper, "Fire millipedes obey the female sooner norm in cross mating *Centrobolus*," *JOURNAL OF ENTOMOLOGY AND ZOOLOGY STUDIES*, vol 4, no. 1, pp. 173-174, 2016. DOI:10.22271/j.ento.2016.v4.i1c.05.
- M. Cooper, "Post-insemination associations between males and females in Diplopoda: A remark on Alcock's (1994) predictions of the mate-guarding hypothesis," *JOURNAL OF ENTOMOLOGY AND ZOOLOGY STUDIES*, vol. 4, no. 2, pp. 283-285, 2016. DOI: 10.22271/j.ento.2016.v4.i2d.908.
- M. I. Cooper, "Allometry of copulation in worm-like millipedes," *JOURNAL OF ENTOMOLOGY AND ZOOLOGY STUDIES*, vol. 5, no. 3, pp. 1720-1722, 2017. DOI: 10.22271/j.ento.2017.v5.i3x.03.
- M. Cooper, "Re-assessment of Rensch's rule in *Centrobolus*," *Journal of Entomology and Zoology Studies*, vol. 5, no. 6, pp. 2408-2410, 2017.
- Cooper M, "Allometry in *Centrobolus*," *Journal of Entomology and Zoology Studies*, vol. 6, no. 6, pp. 284-286, 2018.

- M. Cooper, "*Centrobolus* size dimorphism breaks Rensch's rule," *Arthropods*, vol. 7, no. 3, pp. 48-52, 2018.
- M. Cooper, "*Centrobolus* size dimorphism breaks Rensch's rule," *Scholars' Press, Mauritius*, pp. 1-48, 2018. ISBN: 978-3-659-83990-0.
- M. I. Cooper, "Sexual size dimorphism and the rejection of Rensch's rule in Diplopoda (Arthropoda)," *Journal of Entomology and Zoology Studies*, vol. 6, no. 1, pp. 1582-1587, 2018.
- M. I. Cooper, "Trigoniulid size dimorphism breaks Rensch," *Journal of Entomology and Zoology Studies*, vol. 6, no. 3, pp. 1232-1234, 2018.
- M. Cooper, "Julid and spirobolid millipede gonopod functional equivalents," *JOURNAL OF ENTOMOLOGY AND ZOOLOGY STUDIES*, vol. 7, no. 4, pp. 333-335, 2019. DOI: 10.22271/j.ento.2019.v7.i4f.5465.
- M. Cooper, "Does sexual size dimorphism vary with longitude in forest millipedes *Centrobolus* Cook, 1897?" *International Journal of Recent Research in Thesis and Dissertation*, vol. 3, no. 1, pp. 1-5, 2022. <https://www.paperpublications.org/issue/IJRRTD/Issue-1-January-2022-June-2022>.
- M. Cooper, "Does sexual size dimorphism vary with latitude in forest millipedes *Centrobolus* Cook, 1897?" *Int. J. Re. Res. Thesis Diss.*, vol. 3, no. 1, pp. 6-11, 2022. <https://www.paperpublications.org/issue/IJRRTD/Issue-1-January-2022-June-2022>.
- M. Cooper, "Does sexual size dimorphism vary with temperature in forest millipedes *Centrobolus* Cook, 1897?" *Acta Entomol. Zool.*, vol 3, no. 1, pp. 08-11, 2022. <https://doi.org/10.33545/27080013.2022.v3.i1a.51>.
- M. Cooper, "DOES SEXUAL SIZE DIMORPHISM VARY WITH MONTH WITH THE HIGHEST NUMBER OF RAINY DAYS IN FOREST MILLIPEDES *CENTROBOLUS* COOK, 1897," *Universe Int. J. Interdiscip. Res.*, vol. 2, no. 9, pp. 9-14, 2022. <https://www.doi-ds.org/doi/10.2022-63261534/UIJIR>.
- M. Cooper, "PAIR-WISE COMPARISON OF SEXUAL SIZE DIMORPHISM AMONG NINE FACTORS IN FOREST MILLIPEDES *CENTROBOLUS* COOK, 1897," *Universe Int. J. Interdiscip. Res.*, vol. 2, no. 9, pp. 31-33, 2022. <https://www.doi-ds.org/doi/10.2022-75935617/UIJIR>.
- M. Cooper, "Does sexual size dimorphism vary with female size in forest millipedes *Centrobolus* Cook, 1897?" *Acta Entomol. Zool.*, vol. 3, no. 1, pp. 15-18, 2022. <https://doi.org/10.33545/27080013.2022.v3.i1a.57>.
- M. Cooper, "Does sexual size dimorphism vary with hours of sunshine throughout the year in forest millipedes *Centrobolus* Cook, 1897?" *Acta Entomol. Zool.*, vol. 3, no. 1, pp. 19-25, 2022. DOI: <https://doi.org/10.33545/27080013.2022.v3.i1a.58>.
- M. Cooper, "DOES SEXUAL SIZE DIMORPHISM VARY WITH SPECIES RICHNESS IN FOREST MILLIPEDES *CENTROBOLUS* COOK, 1897?" *Universe Int. J. Interdiscip. Res.*, vol. 2, no. 10, pp. 25-29, 2022. <https://www.doi-ds.org/doi/10.2022-91496952/UIJIR>.
- M. Cooper, "PAIR-WISE COMPARISON OF SEXUAL SHAPE DIMORPHISM AMONG FIFTEEN FACTORS IN FOREST MILLIPEDES *CENTROBOLUS* COOK, 1897," *Universe Int. J. Interdiscip. Res.*, vol. 2, no. 10, pp.

- 9-14, 2022. <https://www.doi-ds.org/doi/10.33545/27080013.2022.v3.i1.a.64>.
22. M. I. Cooper, "Five factors effecting copulation duration in the breeding season in forest millipedes *Centrobolus* Cook, 1897," Zoological and Entomological Letters, vol. 2, no. 1, pp. 17-22, 2022. <https://www.zoologicaljournal.com/archives/2022.v2.i1.A.26>.
23. M. Cooper, "Does sexual size dimorphism vary with time in red millipedes *Centrobolus* Cook, 1897?" Zool. Entomol. Lett., vol. 2, no. 1, pp. 30-35, 2022. <https://www.zoologicaljournal.com/archives/2022.v2.i1.A.29>.
24. M. Cooper, "Mating frequencies of sympatric red millipedes differ across substrate due to absolute abundances," Acta Entomol. Zool., vol. 3, no. 1, pp. 34-39, 2022. <https://doi.org/10.33545/27080013.2022.v3.i1.a.62>.
25. M. Cooper, "Does sexual size dimorphism vary with maximum and minimum temperatures in red millipedes *Centrobolus* Cook, 1897?" Zool. Entomol. Lett., vol. 2, no. 1, pp. 60-65, 2022. <https://www.zoologicaljournal.com/archives/2022.v2.i1.B.34>.
26. M. Cooper, "Does sexual size dimorphism vary with sex ratio in red millipedes *Centrobolus* Cook, 1897?" Zool. Entomol. Lett., vol. 2, no. 1, pp. 66-68, 2022. <https://www.zoologicaljournal.com/archives/2022.v2.i1.B.35>.
27. M. Cooper, "Millipede mass: Intersexual differences," Zool. Entomol. Lett., vol. 2, no. 1, pp. 69-70, 2022. <https://www.zoologicaljournal.com/archives/2022.v2.i1.B.36>.
28. M. I. Cooper, "Do copulation duration and sexual size dimorphism vary with absolute abundance in red millipedes *Centrobolus* Cook, 1897?" Acta Entomol. Zool., vol. 3, no. 1, pp. 51-54, 2022. <https://www.actajournal.com/archives/2022.v3.i1.a.64>. <https://doi.org/10.33545/27080013.2022.v3.i1.a.64>.
29. M. Cooper, "DOES SEXUAL SIZE DIMORPHISM VARY WITH FEMALE LENGTH INFOREST MILLIPEDES *CENTROBOLUS* COOK, 1897?" Universe Int. J. Interdiscip. Res., vol. 2, no. 12, pp. 1-7, 2022. <https://www.doi-ds.org/doi/10.33545/27080013.2022.v3.i1.a.64>.
30. M. Cooper, "DOES SEXUAL SIZE DIMORPHISM VARY WITH PRECIPITATION IN FOREST MILLIPEDES *CENTROBOLUS* COOK, 1897?" Munis Entomology and Zoology, vol. 17, no. 2, pp. 1185-1189, 2022. <https://www.munisentzool.org/Issue/abstract/does-sexual-size-dimorphism-vary-with-precipitation-in-forest-millipedes-centrobolus-cook-1897-13813>.
31. M. I. Cooper, "Do copulation durations of sympatric red millipedes vary seasonally with mating frequencies?" Int. J. Re. Res. Thesis Diss., vol. 3, no. 1, pp. 85-90, 2022. <https://doi.org/10.5281/zenodo.6613001>.
32. M. I. Cooper, "The inverse latitudinal gradients in species richness of Southern African millipedes," Int. J. Re. Res. Thesis Diss., vol. 3, no. 1, pp. 91-112, 2022. <https://doi.org/10.5281/zenodo.6613064>.
33. M. I. Cooper, "DOES SEXUAL SIZE DIMORPHISM VARY WITH LOG SEXUAL SIZE DIMORPHISM IN RED MILLIPEDES *CENTROBOLUS* COOK, 1897?" Universe Int. J. Interdiscip. Res., vol. 2, no. 12, pp. 52-54, 2022. <https://www.doi-ds.org/doi/10.33545/27080013.2022.v3.i1.a.64>.
34. M. I. Cooper, "Do copulation duration and sexual size dimorphism vary with absolute abundance in red millipedes *Centrobolus* Cook, 1897?" Acta Entomol. Zool., vol. 3, no. 1, pp. 51-54, 2022. <https://www.actajournal.com/archives/2022.v3.i1.a.64>. <https://doi.org/10.33545/27080013.2022.v3.i1.a.64>.
35. M. Cooper, "DOES SEXUAL SIZE DIMORPHISM VARY WITH FEMALE LENGTH INFOREST MILLIPEDES *CENTROBOLUS* COOK, 1897?" Universe Int. J. Interdiscip. Res., vol. 2, no. 12, pp. 1-7, 2022. <https://www.doi-ds.org/doi/10.33545/27080013.2022.v3.i1.a.64>.
36. M. Cooper, "DOES SEXUAL SIZE DIMORPHISM VARY WITH PRECIPITATION INFOREST MILLIPEDES *CENTROBOLUS* COOK, 1897?" Munis Entomology and Zoology, vol. 17, no. 2, pp. 1185-1189, 2022. <https://www.munisentzool.org/Issue/abstract/does-sexual-size-dimorphism-vary-with-precipitation-in-forest-millipedes-centrobolus-cook-1897-13813>.
37. M. I. Cooper, "Do copulation durations of sympatric red millipedes vary seasonally with mating frequencies?" Int. J. Re. Res. Thesis Diss., vol. 3, no. 1, pp. 85-90, 2022. <https://doi.org/10.5281/zenodo.6613001>.
38. M. I. Cooper, "The inverse latitudinal gradients in species richness of Southern African millipedes," Int. J. Re. Res. Thesis Diss., vol. 3, no. 1, pp. 91-112, 2022. <https://doi.org/10.5281/zenodo.6613064>.
39. M. I. Cooper, "DOES SEXUAL SIZE DIMORPHISM VARY WITH LOG SEXUAL SIZE DIMORPHISM IN RED MILLIPEDES *CENTROBOLUS* COOK, 1897?" Universe Int. J. Interdiscip. Res., vol. 2, no. 12, pp. 52-54, 2022. <https://www.doi-ds.org/doi/10.33545/27080013.2022.v3.i1.a.64>.
40. M. I. Cooper, "FEMALE VOLUME, LOWEST HOURS OF SUNSHINE, MONTH WITH THE HIGHEST NUMBER OF RAINY DAYS, RAINFALL, AND TEMPERATURES IN THE COOLEST AND WARMEST MONTHS OF THE YEAR ARE RELATED TO LATITUDE (AND LONGITUDE) ACROSS THE DISTRIBUTION OF PILL MILLIPEDES *SPHAEROTHERIUM* BRANDT, 1833," Universe Int. J. Interdiscip. Res., vol. 3, no. 1, pp. 11-22, 2022. <https://www.doi-ds.org/doi/10.33545/27080013.2022.v3.i1.a.64>. URL: <http://hdl.handle.net/10019.1/125464>.
41. M. Cooper, "THE TIE-IN OF MALE BODY WIDTH ON COPULATION DURATION IN *CENTROBOLUS* COOK, 1897," Universe Int. J. Interdiscip. Res., vol. 3, no. 1, pp. 45-47, 2022. <https://www.doi-ds.org/doi/10.33545/27080013.2022.v3.i1.a.64>.
42. M. I. Cooper, "IS A PROMINENT STERNITE RELATED TO MOMENTS OF INERTIA IN *CENTROBOLUS* COOK, 1897?" International Journal of Engineering Science Invention Research & Development, vol. 8, no. 12, pp. 26-28, 2022. [http://www.ijesird.com/1\\_june\\_22.PDF](http://www.ijesird.com/1_june_22.PDF).
43. M. I. Cooper, "IS COPULATION DURATION RELATED TO MOMENTS OF INERTIA IN *CENTROBOLUS* COOK, 1897?" International Journal of Engineering Science Invention Research & Development, vol. 8, no. 12, pp. 29-31, 2022. [http://www.ijesird.com/2\\_june\\_22.PDF](http://www.ijesird.com/2_june_22.PDF).
44. M. I. Cooper, "COPULATION DURATION IS RELATED TO EJACULATING VOLUME IN *CENTROBOLUS*

- INSCRIPTUS (ATTEMS, 1928),” International Journal of Engineering Science Invention Research & Development, vol. 8, no. 12, pp. 32-40, 2022. [http://www.ijesird.com/3\\_june\\_22.PDF](http://www.ijesird.com/3_june_22.PDF).
45. M. I. Cooper, “Is a prominent sternite related to mass in *Centrobolus Cook, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 1-4, 2022. [http://www.ijesird.com/1\\_jul\\_22.PDF](http://www.ijesird.com/1_jul_22.PDF).
46. M. I. Cooper, “Does sex ratio vary with absolute abundance in red millipedes *Centrobolus Cook, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 5-8, 2022. [http://www.ijesird.com/2\\_jul\\_22.PDF](http://www.ijesird.com/2_jul_22.PDF).
47. M. I. Cooper, “Does copulation duration vary with absolute abundance in red millipedes *Centrobolus Cook, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 9-11, 2022. [http://www.ijesird.com/3\\_jul\\_22.PDF](http://www.ijesird.com/3_jul_22.PDF).
48. M. I. Cooper, “Are a prominent sternite, coleopod spine length, and spine number related to mating frequencies in *Centrobolus Cook, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 12-15, 2022. [http://www.ijesird.com/4\\_jul\\_22.PDF](http://www.ijesird.com/4_jul_22.PDF).
49. M. I. Cooper, “Are coleopod spine length and number related to weather in *Centrobolus Cook, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 16-23, 2022. [http://www.ijesird.com/5\\_jul\\_22.PDF](http://www.ijesird.com/5_jul_22.PDF).
50. M. I. Cooper, “Are coleopod spine length and number related to mass in *Centrobolus Cook, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 24-26, 2022. [http://www.ijesird.com/6\\_jul\\_22.PDF](http://www.ijesird.com/6_jul_22.PDF).
51. M. I. Cooper, “Is mass related to latitude, longitude, and weather in *Centrobolus Cook, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 27-32, 2022. [https://www.ijesird.com/7\\_jul\\_22.PDF](https://www.ijesird.com/7_jul_22.PDF).
52. M. I. Cooper, “ARE MATING FREQUENCIES RELATED TO ABSOLUTE ABUNDANCE IN *CENTROBOLUS COOK, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 33-37, 2022. [https://www.ijesird.com/8\\_jul\\_22.PDF](https://www.ijesird.com/8_jul_22.PDF).
53. M. I. Cooper, “Does sex ratio vary with absolute abundance in red millipedes *Centrobolus Cook, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 5-8, 2022. [http://www.ijesird.com/2\\_jul\\_22.PDF](http://www.ijesird.com/2_jul_22.PDF).
54. M. I. Cooper, “Does copulation duration vary with absolute abundance in red millipedes *Centrobolus Cook, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 9-11, 2022. [http://www.ijesird.com/3\\_jul\\_22.PDF](http://www.ijesird.com/3_jul_22.PDF).
55. M. I. Cooper, “Are a prominent sternite, coleopod spine length, and spine number related to mating frequencies in *Centrobolus Cook, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 12-15, 2022. [http://www.ijesird.com/4\\_jul\\_22.PDF](http://www.ijesird.com/4_jul_22.PDF).
56. M. I. Cooper, “Are coleopod spine length and number related to weather in *Centrobolus Cook, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 16-23, 2022. [http://www.ijesird.com/5\\_jul\\_22.PDF](http://www.ijesird.com/5_jul_22.PDF).
57. M. I. Cooper, “Are coleopod spine length and number related to mass in *Centrobolus Cook, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 24-26, 2022. [http://www.ijesird.com/6\\_jul\\_22.PDF](http://www.ijesird.com/6_jul_22.PDF).
58. M. I. Cooper, “Is mass related to latitude, longitude, and weather in *Centrobolus Cook, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 27-32, 2022. [https://www.ijesird.com/7\\_jul\\_22.PDF](https://www.ijesird.com/7_jul_22.PDF).
59. M. I. Cooper, “ARE MATING FREQUENCIES RELATED TO ABSOLUTE ABUNDANCE IN *CENTROBOLUS COOK, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 33-37, 2022. [https://www.ijesird.com/8\\_jul\\_22.PDF](https://www.ijesird.com/8_jul_22.PDF).
60. M. I. Cooper, “DOES COPULATION DURATION VARY WITH SEX RATIO IN THE RED MILLIPEDE *CENTROBOLUS INSCRIPTUS (ATTEMS, 1928)?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 38-40, 2022. [https://www.ijesird.com/9\\_jul\\_22.PDF](https://www.ijesird.com/9_jul_22.PDF).
61. M. I. Cooper, “IS A PROMINENT STERNITE RELATED TO WEATHER IN *CENTROBOLUS COOK, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 41-44, 2022. [https://www.ijesird.com/10\\_jul\\_22.PDF](https://www.ijesird.com/10_jul_22.PDF).
62. M. I. Cooper, “ARE MATING FREQUENCIES RELATED TO SEX RATIO IN *CENTROBOLUS COOK, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 45-48, 2022. [https://www.ijesird.com/11\\_jul\\_22.PDF](https://www.ijesird.com/11_jul_22.PDF).
63. M. I. Cooper, “ARE MATING FREQUENCIES RELATED TO SEXUAL SIZE DIMORPHISM IN *CENTROBOLUS COOK, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 49-51, 2022. [https://www.ijesird.com/12\\_jul\\_22.PDF](https://www.ijesird.com/12_jul_22.PDF).
64. M. I. Cooper, “ARE MATING FREQUENCIES RELATED TO MOMENTS OF INERTIA ACROSS THE SEXES IN *CENTROBOLUS COOK, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 1, pp. 52-55, 2022. [https://www.ijesird.com/13\\_jul\\_22.PDF](https://www.ijesird.com/13_jul_22.PDF).
65. M. I. Cooper, “ARE MATING FREQUENCIES RELATED TO TARSAL PAD LENGTH IN *CENTROBOLUS COOK, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 2, pp. 1-4, 2022. [https://www.ijesird.com/1\\_aug\\_22.PDF](https://www.ijesird.com/1_aug_22.PDF).
66. M. I. Cooper, “IS COPULATION DURATION RELATED TO TARSAL PAD LENGTH IN *CENTROBOLUS COOK, 1897?*” International Journal of Engineering Science Invention Research & Development, vol. 9, no. 2, pp. 65-67, 2022. [https://www.ijesird.com/3\\_aug\\_22.PDF](https://www.ijesird.com/3_aug_22.PDF).
67. M. I. Cooper, “ARE ABSOLUTE ABUNDANCES RELATED TO TARSAL PAD LENGTH IN

- CENTROBOLUS COOK, 1897?" International Journal of Engineering Science Invention Research & Development, vol. 9, no. 2, pp. 68-70, 2022. [https://www.ijesird.com/4\\_aug\\_22.PDF](https://www.ijesird.com/4_aug_22.PDF).
68. M. I. Cooper, "ARE MATING FREQUENCIES RELATED TO MALE AND FEMALE SIZE IN CENTROBOLUS COOK, 1897?" International Journal of Engineering Science Invention Research & Development, vol. 9, no. 2, pp. 71-76, 2022. [https://www.ijesird.com/5\\_aug\\_22.PDF](https://www.ijesird.com/5_aug_22.PDF).
69. M. Cooper, "DOES EJACULATE VOLUME VARY WITH ABSOLUTE ABUNDANCE IN RED MILLIPEDES CENTROBOLUS COOK, 1897?" International Journal of Engineering Science Invention Research & Development, vol. 9, no. 2, pp. 77-79, 2022. [https://www.ijesird.com/6\\_aug\\_22.PDF](https://www.ijesird.com/6_aug_22.PDF).
70. M. I. Cooper, "THE MOMENTS OF INERTIA TIE-UP WITH FEMALE SIZE, HOURS OF SUNSHINE THROUGHOUT THE YEAR, LATITUDE, LONGITUDE, AND MINIMUM TEMPERATURE IN RED MILLIPEDES CENTROBOLUS COOK, 1897." Universe Int. J. Interdiscip. Res., vol. 3, no. 2, pp. 6-12, 2022. <https://www.doi-ds.org/doi/10.2022-76913842/UIJIR>.
71. M. I. COOPER, "ARE MATING FREQUENCIES RELATED TO EJACULATE VOLUMES IN CENTROBOLUS COOK, 1897?" International Journal of Engineering Science Invention Research & Development, vol. 9, no. 3, pp. 93-95, 2022. [https://www.ijesird.com/aug\\_ten.PDF](https://www.ijesird.com/aug_ten.PDF).
72. M. Cooper, "DOES SEXUAL SIZE DIMORPHISM VARY WITH FEMALE WIDTH IN FOREST MILLIPEDES CENTROBOLUS COOK, 1897?" Munis Entomol. Zool., vol. 17(supplement), pp. 1562-1565, 2022. [https://www.munisentzool.org/Issue/abstract/does-sexual-size-dimorphism-vary-with-female-width-in-forest-millipedes-centrobolus-cook-1897\\_13854](https://www.munisentzool.org/Issue/abstract/does-sexual-size-dimorphism-vary-with-female-width-in-forest-millipedes-centrobolus-cook-1897_13854).
73. M. Cooper, "DOES SEXUAL SIZE DIMORPHISM VARY WITH THE HIGHEST TOTAL HOURS OF SUNSHINE IN A MONTH IN FOREST MILLIPEDES CENTROBOLUS COOK, 1897?" Munis Entomol. Zool., vol. 17(supplement), pp. 1596-1602, 2022. [https://www.munisentzool.org/Issue/abstract/does-sexual-size-dimorphism-vary-with-the-highest-total-hours-of-sunshine-in-a-month-in-forest-millipedes-centrobolus-cook-1897\\_13858](https://www.munisentzool.org/Issue/abstract/does-sexual-size-dimorphism-vary-with-the-highest-total-hours-of-sunshine-in-a-month-in-forest-millipedes-centrobolus-cook-1897_13858).
74. M. Cooper, "DOES SEXUAL SIZE DIMORPHISM VARY WITH BODY MASS IN FOREST MILLIPEDES CENTROBOLUS COOK, 1897?" Munis Entomol. Zool. Suppl., vol. 17(supplement), pp. 1621-1624, 2022. [https://www.munisentzool.org/Issue/abstract/does-sexual-size-dimorphism-vary-with-body-mass-in-forest-millipedes-centrobolus-cook-1897\\_13861](https://www.munisentzool.org/Issue/abstract/does-sexual-size-dimorphism-vary-with-body-mass-in-forest-millipedes-centrobolus-cook-1897_13861).
75. M. COOPER, "IS SIZE OR SSD RELATED TO ABUNDANCE IN CENTROBOLUS COOK, 1897?" International Journal of Engineering Science Invention Research & Development., vol. 9, no. 3, pp. 96-102, 2022. [https://www.ijesird.com/sep\\_one.PDF](https://www.ijesird.com/sep_one.PDF).
76. M. I. COOPER, "IS A PROMINENT STERNITE RELATED TO SEX RATIOS AND ABUNDANCE IN CENTROBOLUS COOK, 1897?" International Journal of Engineering Science Invention Research & Development, vol. 9, no. 3, pp. 103-106, 2022. [https://www.ijesird.com/sep\\_two\\_6.PDF](https://www.ijesird.com/sep_two_6.PDF).
77. M. I. Cooper, "DOES SEXUAL SIZE DIMORPHISM VARY WITH FEWEST DAILY HOURS OF SUNSHINE IN RED MILLIPEDES CENTROBOLUS COOK, 1897?" Universe Int. J. Interdiscip. Res., vol. 3, no. 3, pp. 89-92, 2022. <https://www.doi-ds.org/doi/10.2022-94655978/UIJIR>.
78. M. COOPER, "DOES (PREDICTED) MASS CORRELATE WITH MATING FREQUENCIES IN CENTROBOLUS COOK, 1897?" Universe Int. J. Interdiscip. Res., vol. 3, no. 4, pp. 141-19.
79. M. I. COOPER, "IS MASS CORRELATED WITH LENGTH AMONG RED MILLIPEDES CENTROBOLUS COOK, 1897?" (ACCEPTED).
80. Hamer ML. Checklist of Southern African millipedes (Myriapoda: Diplopoda). Annals of the Natal Museum. 1998;39(1):11-82.
81. Lawrence RF. The Spiroboloidea (Diplopoda) of the eastern half of Southern Africa\*. Annals of the Natal Museum. 1967;18(3):607-646.