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Mark Cooper
School of Animal, Department of Plant and Environmental Sciences, University of the Witwatersrand, Johannesburg, South Africa

Corresponding Author:
Mark Cooper
School of Animal, Department of Plant and Environmental Sciences, University of the Witwatersrand, Johannesburg, South Africa

Millipede mass: Intersexual differences

Mark Cooper

Abstract
Mass (g) was re-analyzed in 15 species of diplopods. Values were compared intersexually. Male and female mass was not normally distributed (D=0.28, n=44, $p< 0.01$) and differed significantly (z=-3.60, n=22, 22, $p< 0.01$). The mean female mass was 2.47 g and the mean male mass was 1.98 g. Mean male mass was significantly correlated with mean female mass (r=0.97, Z score=8.81, n=22, p=0).

Keywords: Diplopoda, heavier, lighter, sex

1. Introduction
Millipedes display female-biased Sexual Size Dimorphism (SSD) based on body mass, length, width, and leg dimensions [7-17, 19-23]. SSD is mostly reversed in many species [6]. Female-biased SSD is most probably under Darwinian fecundity selection [4]. Size-assortative mating is known in some species [22]. Live body mass records have been demonstrated in some 15 populations [1, 2, 5, 15, 17, 19, 22]. No trend in sex-specific differences across the 15 species has been documented [3]. Mass was investigated in 15 examples, and SSD was re-analyzed [3]. A re-analysis of the same data to establish if there is lighter sex is undertaken here. A test for normality was a requirement.

2. Materials and Methods
Previous analyses and reviews using the available literature were used [3]. The first test (Kolmogorov-Smirnov) is to see if the data are normally distributed and the second test (Wilcoxon Signed-Rank) is a comparison between the same male and female mass data. Mean male mass was correlated with mean female mass using a Pearson Correlation Coefficient.

3. Results: Male mass did not fit a normal distribution (D=0.32748, n=22, p=0.01331). Female mass did not fit a normal distribution (D=0.32163, n=22, p=0.01591). Male and female mass was not normally distributed and differed significantly (D=0.27825, n=44, p=0.00165). The mean female mass was 2.474 g and the mean male mass was 1.97541 g. An intersexual difference in mass was detected (z=-3.5974, n=22, 22, p=0.0032). Mean male mass was significantly correlated with mean female mass (Figure 1: r=0.96546690, Z score=8.80839043, n=22, p=0).

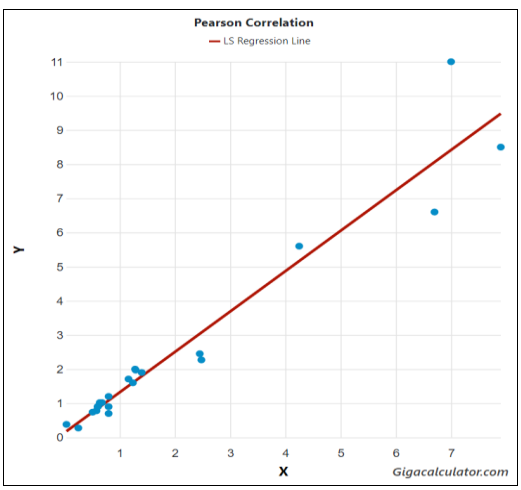

Fig 1: Correlation between mean male mass (x) and mean female mass (y)

4. Discussion

15 species illustrate significant intersexual differences in mass [3]. Mean male mass was correlated with mean female mass. The mass statistics of 15 species were presented and re-analyzed to show a non-normal distribution of data showing males are lighter than females. In a single study on millipede mass, no difference between male and female mass could be found [3]. This was because no test for normality was carried out. The distribution of mean female and mean male body mass was not normally distributed. One of the requirements for a T-test is for the data to be normally distributed [18]. Because this was not carried out in the previous study the data were re-analyzed here using an appropriate non-parametric test and a difference across taxa was found. Wilcoxon signed-rank test, also known as Wilcoxon matched pair test - a non-parametric hypothesis test that compares the median of two paired groups and tells if they are identically distributed or not - was used [25]. This is appropriate because differences between the pairs of data are non-normally distributed [25]. The interaction between divergence, selection, time, and variation may further explain differences in mass evolution across the sexes.

5. Conclusion

SSD of diplopods based upon body mass being lighter in male millipedes was shown in a re-analysis of previous data. The interaction between divergence, selection, time, and variation explains condition-dependent evolution.

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