Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2016; 4(4): 394-395

Received: 15-05-2016
Accepted: 16-06-2016

Mark Ian Cooper
Department of Biological Sciences, Private Bag X3, Rondebosch 7701, Cape Town, South Africa.

Correspondence
Mark Ian Cooper
Department of Biological Sciences, Private Bag X3, Rondebosch 7701, Cape Town, South Africa.

Sperm dumping in *Centrobolus inscriptus* Attems (Spirobolida: Trigoniulidae)

Mark Ian Cooper

Abstract
Differential ejaculate usage was tested in the diplopod *Centrobolus inscriptus*. Copulation duration, post-mating interval, and ejaculate volume (disintegrations per minute of H^{3+}) were analysed for single and double mating sequences. During the 24h post-mating, ejaculate volumes decline was identified. The significant drop in ejaculate volumes (dpm) post-mating ($Z = 3.00$, $n = 6, 7$, $P = 0.003$) indicates a female process thought to be sperm dumping.

Keywords: *Centrobolus*, copulation, diplopod, female, mating

1. Introduction
Sperm dumping has been studied as examples of cryptic female choice in spiders [1] *Physocyclus globosus* [2], armored goblin spiders [3-4], Palearctic gift-giving spider *Pisaura mirabilis* [5], *Orsolobus pucara* [6], fly *Drosophila simulans* [7-8], millipede *Alloporus uncinatus* [9], Odonata [10], *Apis* bees [11], moth *Ephestia kuehniella* [12], water strider *Gerris lateralis* [13]. The active release of ejaculate post-insemination and copulation duration was studied in *Centrobolus inscriptus* where sperm or ejaculate precedence correlates with prolonged second copulation duration and re-analysis of sperm volumes from single and double mating experiments with 24 hour (h) delays post-mating [14-26]. In order to provide supporting evidence for female control of ejaculate and sperm dumping after mating, ejaculate volumes released from females 24h after mating was studied and compared alongside double matings.

2. Materials and methods
Chersastus inscriptus were collected from Twin Streams (28°55'S, 31 °45'E) (1995 - 1998). Live specimens of each sex were taken to a laboratory, kept at 25 °C; 70% relative humidity; 12:12 h light-dark. Vegetables were provided *ad lib*. Unisex groups were kept in plastic containers lined by moist vermiculite (± 5cm deep). Ejaculate volume was measured as disintegrations per minute (dpm) tritium in a 1600 scintillation counter (low count reject = 0; dpm multiplier = 1). Millipedes were marked on posterior segments with colored tipex and placed in glass aquaria (30 X 22 X 22 mm). Pairs were isolated in plastic beakers (13cm diameter) and mating timed. Double mating sequences were performed to test for order or interval effect. Mating order was controlled by mating females with labelled and un-labelled males in reciprocity. Females were given the opportunity for second mating immediately (0-h delay) or later (24-h delay). As controls, females that had single mating with labelled males were dissected immediately or 24 h later. Females that had single mating with un-labeled males were dissected to control for background radiation. Data were analyzed with Pearson's correlation (r), t-tests (t), Spearman's rank order correlation coefficients (r), two-tailed Mann-Whitney U-tests (Z), and Wilcoxon tests (T). A Kruskal Wallis 1-way ANOVA (H) was used to test for differences in dpm data prior to Mann-Whitney U-tests.

3. Results
I successfully demonstrate differential ejaculate usage or control by female millipedes post-copulation. There was a significant drop in ejaculate volumes (dpm) during 24h after single mating (Figure 1: $Z = 3.00$, $n = 6, 7$, $P = 0.003$).

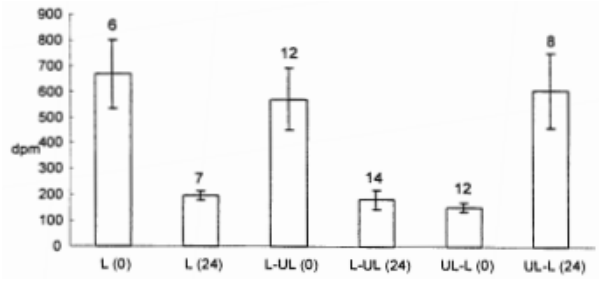

Fig 1: Ejaculate volumes (mean disintegrations H^{3+} per minute ± SE) obtained from the spermathecae of *Centrobolus inscriptus* females engaged in single and double mating experiments where (0) and (24) represent the period (hours) before dissection and the remating intervals, respectively. L - H^{3+} labelled male, UL – un-labelled male.

4. Discussion

Here differential ejaculate usage is acknowledged in the millipede *C. inscriptus*. It is known that the re-mating interval negatively relates to second duration (y = 36 + 0.01x) and relative ejaculate volume increased from 21% to 77% in favour of second males after 24h intervals [14]. This is a male process and as yet little or no supporting evidence for a female process are known in millipedes with one exception in the spirostreptidan millipede [9].

Evidence is shown for ejaculate dumping as a form of cryptic female control by the sudden drop in ejaculate volumes 24 post-mating. This may contribute toward understanding the ecology of sperm [27].

5. Conclusion

During the 24h post-mating ejaculate volumes in *C. inscriptus* consistently decline and this is due to sperm dumping.

6. Reference

1. Elias DO, Andrade MCB, Kasumovic MM. Dynamic Population Structure and the Evolution of Spider Mating Systems. Academic Press, Burlington, 2011, 114.
2. Peretti AV, Eberhard WG. Cryptic female choice via sperm dumping favours male copulatory courtship in a spider. Journal of Evolutionary Biology. 2010; 23(2):271-81.
3. Burger M. Complex female genitalia indicate sperm dumping in armored goblin spiders (Arachnida, Araneae, Oonopidae). Zoology. 2010; 113(1):19-32.
4. Burger M. Sperm dumping in a haplogyne spider. Journal of Zoology. 2007; 273(1):74-81.
5. Albo MJ, Peretti AV. Worthless and Nutritive Nuptial Gifts: Mating Duration, Sperm Stored and Potential Female Decisions in Spiders. PLoS ONE. 2015; 10(6):e0129453.
6. Izquierdo MA, Labarque FM. Description of the female of Orsolobus pucara Forster & Platnick 1985, with comments on the functional morphology of the female genitalia in Dysderoidea (Araneae: Dysderoidea: Orsolobidae). The Journal of Arachnology. 2010; 38(3):511-520.
7. Price T, Lewis Z, Wedell N. Sperm dumping as a defense against meiotic drive. Journal of Biology. 2009; 8(1):6.
8. Snook RR, Hosken DJ. Sperm death and dumping in *Drosophila*. Nature. 2004; 428(6986):939-941.
9. Barnett M, Telford SR, Tibbles BJ. Female mediation of sperm competition in the millipede *Alloporus uncinatus* (Diplopoda: Spirostreptidae). Behavioural Ecology and Sociobiology. 1995; 36(6):413-419.
10. Córdoba-Aguilar A. Sperm ejection as a possible cryptic female choice mechanism in Odonata (Insecta). Physiological Entomology. 2006; 31(2):146-153.
11. Baer B. Sexual selection in Apis bees. Apidologie. 2005; 36(2):187-200.
12. Xu J, Wang Q. Mechanisms of last male precedence in a moth: sperm displacement at ejaculation and storage sites. Behavioral Ecology. 2010; 21(4):714-721.
13. Arnqvist G, Danielsson I. Post-mating sexual selection: the effects of male body size and the recovery period on paternity and egg production rate in a water strider. Behavioural Ecology. 1999; 10(4):358-365.
14. Cooper MI. Competition affected by re-mating interval in a myriapod. Journal of Entomology and Zoology Studies. 2015; 3(4):77-78.
15. Cooper MI. Sperm storage in Centrobolus spp. and observational evidence for egg simulation. Journal of Entomology and Zoology Studies. 2016; 4(1):127-129.
16. Cooper MI. Fire millipedes obey the female sooner norm in cross mating Centrobolus (Myriapoda). Journal of Entomology and Zoology Studies. 2016; 4(1):173-174.
17. Cooper MI. Symmetry in ejaculate volumes of Centrobolus inscriptus Attems (Spiroboloidea, Trigoniulidae). Journal of Entomology and Zoology Studies. 2016; 4(1):386-387.
18. Cooper MI. Instantaneous insemination in the millipede Centrobolus inscriptus (Spirobolida, Trigoniulidae) determined by artificially-terminated mating. Journal of Entomology and Zoology Studies. 2016; 4(1):487-490.
19. Cooper MI. Gonopod mechanics in Centrobolus Cook (Spirobolida, Trigoniulidae) II. Images. Journal of Entomology and Zoology Studies. 2016; 4(2):152-154.
20. Cooper MI. 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. 2016; 4(2):283-285.
21. Cooper MI. Heavier-shorter-wider females in the millipede Centrobolus inscriptus Attems (Spirobolida, Trigoniulidae). Journal of Entomology and Zoology Studies. 2016; 4(2):509-510.
22. Cooper MI. Sexual bimaturism in the millipede Centrobolus inscriptus Attems (Spirobolida, Trigoniulidae). Journal of Entomology and Zoology Studies. 2016; 4(3):86-87.
23. Cooper MI. Tarsal pads of Centrobolus Cook (Spiroboloidea, Trigoniulidae). Journal of Entomology and Zoology Studies. 2016 4(3):385-386.
24. Cooper MI. Elaborate gonopods in the myriapod genus Centrobolus (Diplopoda, Trigoniulidae). Journal of Entomology and Zoology Studies. 2015; 3(4):235-238.
25. Cooper MI. Sex ratios, mating frequencies and relative abundance of sympatric millipedes in the genus Centrobolus (Diplopoda, Trigoniulidae). Arthropods 3(4):174-176.
26. Cooper MI. Sexual size dimorphism and corroboration of Rensch's rule in Centrobolus millipedes (Diplopoda, Trigoniulidae). Journal of Entomology and Zoology Studies. 2014; 2(6):264-266.
27. Reinhardt K, Dobler R, Abbott J. An Ecology of Sperm: Sperm Diversification by Natural Selection. Annual Review of Ecology, Evolution, and Systematics. 2015; 46:435-459.