MANCHESTER 1824

The University of Manchester

Does maternal effort change according to mate quality in the burying beetle *Nicrophorus vespilloides*?

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Introduction

- Females may gain either direct or indirect benefits for their offspring through biasing their mating towards one male over another (Tregenza & Wedell, 2000).
- Females may also alter their behaviour in response to their mate, and this may affect the performance of their offspring, as predicted by the Differential allocation Hypothesis (DAH, Burley, 1986; 1988).
- Studies into the effects of mate choice on offspring performance are therefore complex and a careful experimental design is required to determine the mechanism driving mate choice in a particular species.
- The burying beetle *Nicrophorus vespilloides* has a complex, but well studied mating system and offers an ideal opportunity to examine how mate choice may provide indirect and direct benefits to offspring, and also to test the DAH.

Methods

Female mate choice experiment

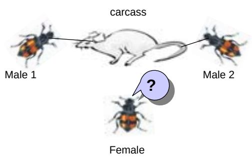

Figure 1: Female mate choice experiment. Female chooses between two non-sibling males. Carcass size 20-25g.

Males were secured so they were unable to make contact with each other (Figure 1). A choice was made when the female allowed a male to mount and initiate copulation, but the pair was separated before copulation occurred. The male that was allowed to mate was scored the preferred (P) male and the male that was not allowed to mount was scored the non-preferred (NP) male. One male was assigned to the female at random, and the pair were left to mate. Behavioural observations were performed to observe the pre-mating behaviour of females.

Recorded whether the female:

accepts the sexual advances of the male and readily mates (Accept male); shows minimal resistance to the sexual advances of the male, but then mates without aggression (Weakly accepts male);shows prolonged resistance to the males sexual advances by running away/dislodging the male, but then mates without aggression (Strongly rejects male);responds aggressively towards the male, attacking and biting, but after prolonged aggression and resistance is eventually forced by the male to mate (Aggression towards male).

Cross-fostering offspring

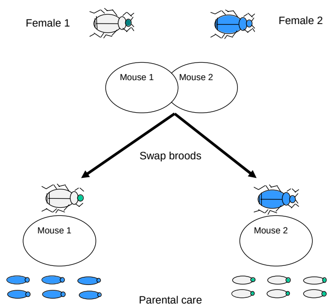

Figure 2: Cross-fostering offspring. Brood sizes between 5 and10 larvae.

At hatching, the larvae from each Dam (n = 124) were sorted into brood sizes of between 5 and 10 larvae, and the brood was weighed. One brood was then transferred to a foster females (from herein termed the caretaker) carcass (Figure 2). Cross-fostering in this way resulted in four treatment groups: 1) Caretaker female mated to a P male (from herein termed the caretakers mate) rearing offspring from a Dam mated to a P male (called the Dams mate); 2) Caretakers mate P rearing offspring from a Dams mate NP; 3) Caretakers mate NP rearing offspring from a Dams mate P; 4) Caretakers mate NP rearing offspring from a Dams mate NP. Females were left to rear their brood. Variation in various offspring life history characters was measured.

Results

Female mate choice

There was a significant association between the pre-mating behaviour observed and the initial preference of the female during the choice trials (Table 1, G-test: G = 26.318, df = 3, p< 0.001).

Female pre-mating behaviour	Number of times Behaviour Observed		
	P male	NP male	Total
Accept	18	7	25
Weakly Accept	10	5	15
Strongly Reject	5	7	12
Aggression	1	18	19
Total	34	37	71

Table 1: Female pre-mating behaviour

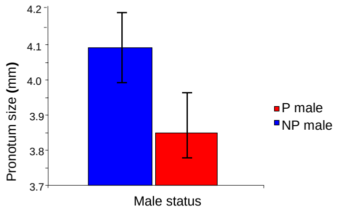

Figure 3: Females prefer small males

A significant difference between the size of the preferred and non-preferred males was observed (Figure 3, One way ANOVA: F = 4.146, df = 1, p = 0.045). Females preferred small males.

Offspring Mass

No effect of Dams mate (Two-way ANOVA: F = 0.7291, df = 1, 113, p = 0.3950) or Caretakers mate (Two-way ANOVA: F = 0.4520, df = 1, 113, p = 0.5028) on offspring mass at hatching (Figure 4).

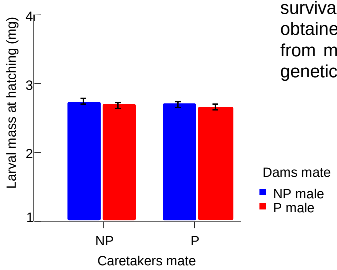

Figure 4: Larval mass at hatching

Significant effect of Dams mate (Figure 5, Two-way ANOVA: F = 5.4692, df = 1, 113, p = 0.0211) on mean larval mass at dispersal, but no effect of caretakers mate (Figure 5, Two-way ANOVA: F = 0.3169, df = 1, 113, p = 0.5746).

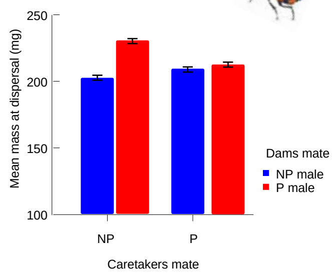

Figure 4: Larval mass at dispersal

Offspring survival

Significant Dams mate effect observed for the percentage of larvae that survived between hatching and dispersal (Figure 6, Two-way ANOVA: F = 8.8574, df = 1, 113, p = 0.0035). But no caretaker mate effect observed (Figure 6, Two-way ANOVA: F = 0.2208, df = 1, 113, p = 0.6393). No Dams mate effect (Two-way ANOVA: F = 0.0413, df = 1, 113, p = 0.8392) or caretakers mate effect (Two-way ANOVA: F = 0.1724, df = 1, 113, p = 0.6788) observed for the percentage of offspring that survived between dispersal and emergence as an adult (Figure 7).

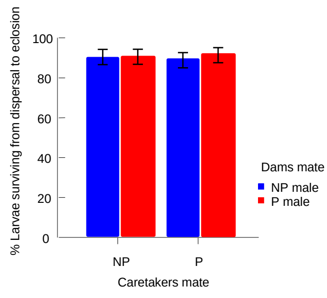

Figure 7: Larval survival from dispersal to emergence as an adult

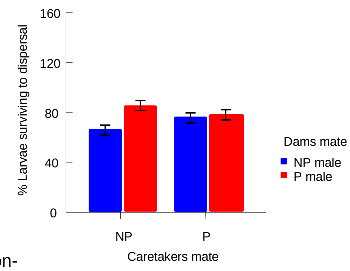

Figure 6: Larval survival to dispersal

Discussion

Females showed a clear preference for males and this preference was maintained over time. Females preferred small males. When mated to a preferred male females produced offspring that were significantly heavier at dispersal and also had significantly higher survival between hatching and dispersal. Advantage of mating to a preferred male is obtained through pre-natal allocation rather than post-natal allocation. Indirect benefits from mating to a preferred male may be due to sexual selection for good genes and/or genetic compatibility.

Acknowledgements

Many thanks to Tamara Montrose, Miriam Knollys, Judith Lock and Clarissa House for their help with data collection. Thank you to Judy Evans who provided the illustration of the beetle feeding its larvae and the illustration of the adult beetle, and Johan Oldekop whose 'mouse' was used in Figure 1. Casper Breuker is thanked for his help with the poster design.

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