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High Condition Male Rhinoceros Beetles Transfer More Nutrients to Females During Mating, Contributing to Female Preference for Body Condition Rather than Body or Weapon Size

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Introduction

Males across species fight with each other over mating rights, utilizing massive weapons like elk antlers or rhinoceros beetle horns (Figure 1). It's obvious that males with the biggest weapons will win in fights and thus mate with the females. This is what drives the evolution of extreme weapons as only the biggest, strongest males get the chance to mate. In these systems the males are thought to do the sorting, but there are key elements in the rhinoceros beetle system that may be less obvious. First, males perform stridulatory songs and trembling dances to court females. Additionally, females regularly reject males, even ones who have large horns and win fights. We set out to find out what females may be detecting that we as observers cannot see from the outside.

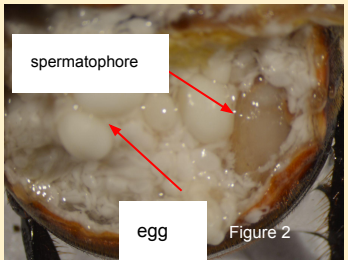

Figure 2

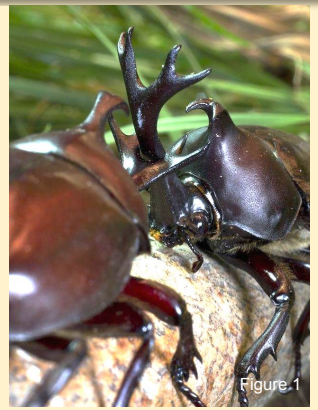
Figure 1

Spermatophore

One feature that females may be trying to gain insight on is the spermatophore (Figure 2). Spermatophores are common in insects; enclosed packages containing lipids, proteins, and sperm that a male transfers to a female during copulation. These nutrients are metabolized by the female and are beneficial to her own reproductive processes. It may be that females want to mate with males who have the largest spermatophores and thus transfer the most nutrients.

Hypothesis

1. High condition (well fed) males will produce larger spermatophores.
2. Females will select high condition males rather than low condition males.

Methods

To test our hypothesis we began with larvae shipped to us from Taiwan. The larvae were placed in jars in incubators until they emerged as adults. Upon emergence they were assigned fed or starved status, this treatment effect was confirmed to be effective (Figure 3). We then began data collection by setting up courtships in acoustic boxes with 2 camera views, red light, and a high frequency microphone (Figure 4). From this we captured song and dance data, time from onset of courtship to copulation which is known as "latency to mate", and the females were frozen after copulation for dissection. The spermatophores were later dissected from the female's abdomen, weighed, and analyzed with other data.

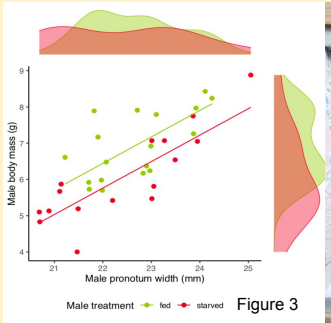

Figure 3

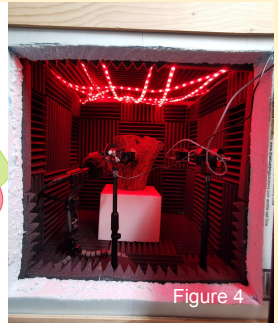
Figure 4

Results

From our data we confirmed that males in high short term condition males do indeed transfer larger spermatophores to females than starved males of the same body size (Figure 5). There is still work to be done in determining the latency to mate when females are courted by males with larger vs. smaller spermatophores.

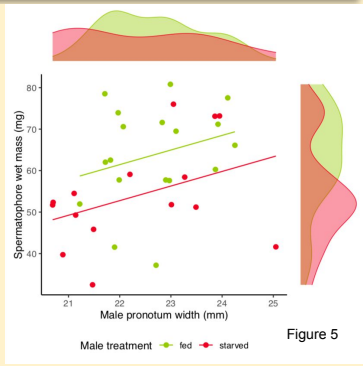

Figure 5

Final Considerations

What would happen if a male was spending all night defending the sap wounds on a tree to have control over females? He will be starved, possibly unable to sing or dance in a way that is appealing to a female, or his spermatophore may suffer nutritional losses that a female can detect. Nonetheless, the rhinoceros beetle system exemplifies the complexity of sexual selection, showing that female choice may play a factor in more systems than we once thought.

Acknowledgements

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