KING OF THE HILL: INTRASPECIFIC INTERACTIONS IN *ONTHOPHAGUS CHRYSES*

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Abstract. Beetles in the subfamily Scarabaeinae depend on mammal dung, a patchy and ephemeral commodity, as their primary food source. In 25 dung-baited pitfall traps at La Selva Biological Station, Costa Rica, we caught 144 beetles representing five species, the majority of which were *Onthophagus chryses*. We hypothesized that intraspecific competition was important in resource acquisition in these beetles, and tested whether mean mass gain would be less, and variance among beetles woul dbe greater I groups of *O. chryses* feeding on limited dung resources. We also hypothesized that larger beetles would be superior competitors and would gain more mass than small beetles. Beetles were able to increase their body mass by ≅ 18% in twelve hours. Variance in weight gain was similar for beetles regardless of competition, but most beetles were accidentally lost during the experiment and the statistical power was very low. Because of the sensitivity of beetle growth rates, and the ease of catching and manipulating these organisms, intraspecific competition in dung beetles is an area inviting further investigation.

Key Words: dung beetle, Scarabaeinae, resource limitation

INTRODUCTION

The diets of beetles of the subfamily Scarabaeinae consist primarily of mammal dung, a limited resource in tropical forest ecosystems. Resources such as this, which are patchy and ephemeral, tend to reduce interspecific competition (Begon et al., 1990). Preliminary investigations of dung beetle abundance and distribution indicated that certain dung beetle species were found throughout the forest and others were more patchily distributed. *Onthophagus chryses*, a dung-digging beetle, was found consistently throughout forested areas implying that intraspecific competition could be a strong selective force on this species. We hypothesized that intraspecific competition would be high among *O. chryses*, and predicted that the mean mass gain would be less in resource limited situations, but variance among individuals would be greater. We also predicted that larger beetles would gain proportionally more mass than smaller beetles within the beetle groups.

METHODS

We set 25 pit fall traps over the nights of 16-18 February 1998 on the SUR (between 50 - 350 m), CES (50 - 100 m), and STR (50-250 m, 1650 - 2100 m) trails at La Selva Biological Station, Costa Rica. A trap consisted of a 20 ml ball of cow dung wrapped in two layers of cheese cloth and tied to a stick with a string. The stick was placed over a 50 cm deep hole lined with plastic. We filled the hole with approximately 100 ml of 20% ethanol. The cow dung for the traps and the experiments was collected daily at a neighboring dairy farm. The morning after the traps had been set, we collected the beetles and identified them using the ALAS project arthropod collection.

All experimental manipulations were conducted in plastic containers lined with paper towels and sealed in tin foil. We weighed all *O. chryses* to ± 0.1 mg, and divided them randomly into a treatment and a control group. The control treatment included 10 replicates, each with one beetle offered ≅ 2 g of cow dung. The competition treatment also included 10 replicates, each with 5 individually marked beetles offered 2 g of dung. Beetles and dung were left overnight to feed and were then reweighed after 12 h. To control for the effect of moisture evaporation, control portions of dung were exposed to the same conditions and reweighed.

RESULTS

In 25 traps, we caught a total of 144 beetles, representing five different species (Table 1). *O. chryses* was caught at 24/25 traps, the highest proportion of the five species. Beetle growth data were compromised because nearly all of our beetles escaped during an unexpected transport of our plastic containers. In an analysis using the remaining beetles (five beetles from the group treatment and four beetles from the individual treatment), the variance in the amount of weight gained between the group and individual treatments did not differ ($F_{3,4} = 0.70$, $P = 0.40$, Bartlett test for unequal variance). The mean (±1SD) mass gain per individual was 3.6 ± 2.6 mg in the control and 4.9 ± 4.0 mg in the group treatment. On average, an individual gained 18% of its body weight in one night of feeding.

DISCUSSION

Onthophagus chryses gained considerable mass of weight relative to its body size after 12 h of feeding. Its ability to consume large portions of food may be an adaptation due to the patchy and ephemeral nature of its food source. Though variation in the amount of mass gain was indistinguishable between treatments, the statistical power was very low. Greater variance in mass gain in the group treatment would have indicated that some beetle individuals are better competitors and able to obtain relatively more of the resource. Our intended sample size probably would have provided a robust test for this relationship.

A graphical model representing final mass as a function of the initial mass between the treatment and control describe three alternative outcomes of intraspecific competition in *O. chryses* (Figure 1). If beetle size is not a factor influencing competitive ability we would expect similar slopes for the growth functions of the control and treatment (Fig. 1a). One alternative is that larger beetles may gain proportionally more mass than smaller beetles, indicating that larger beetles are better competitors (Fig. 1b), or larger beetles may interfere with the ability of smaller beetles in acquiring the dung resource. A second alternative is that smaller beetles may gain proportionally more mass than larger beetles indicating that smaller beetles are better competitors (Fig. 1c). This could be true if smaller beetles have lower energetic costs and are able to search larger areas for food, or if they are able to feed more effectively because they avoid interference from other beetles.

An individual *Onthophagus chryses* beetle foraging at a dung pile was more likely to encounter a conspecific than a different beetles species. Beetles that succeed in finding and securing dung can increase their body mass by at least 18% relative to those that do not. Intrapecific competition could exert strong selection in this system. The dung beetle community makes up a larger percentage of the terrestrial insect biomass than any other insect group (Penny and Arias 1982). This community is easily manipulated and we encourage future research on both inter- and intraspecific competition among the Scarabaeinae.

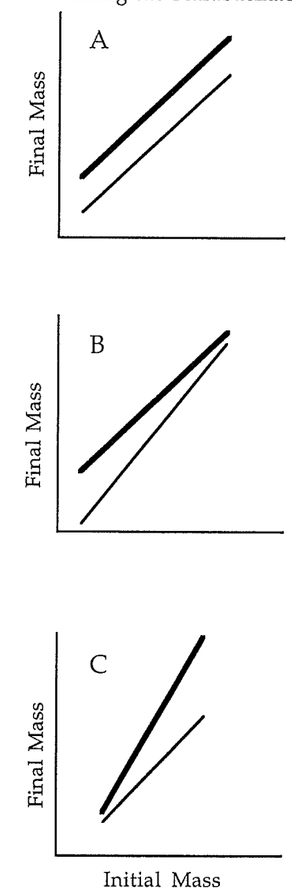

FIG. 1. Three theoretical absolute relationships between initial and final mass for dung beetles feeding singly (thick lines) or in groups (thin lines). See text.

TABLE 1. Species composition of Scarabaeinae beetles captured in 5 trap nights.

Species	Total number found	Mean length (mm)
Onthophagus chryses	126	3-5
Onthophagus acuminatus	9	3-5
Copris spp.	6	10
Dichotomies Carolinas	2	30
Dichotomies satins	1	5-7

LITERATURE CITED

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