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Nesting Behavior of *Eurysternus plebejus* Harold (Coleoptera: Scarabaeidae) under Laboratory Conditions

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Abstract

The reproductive behavior of *Eurysternus plebejus* Harold under laboratory conditions is described. Following a feeding period, reproduction takes place starting with a nuptial feast characterized by female production of food balls. Mating then takes place prior to nesting. One or two compound nests are made during the lifespan of the female. Nests are located in a crater beneath a dung pat, and contain several brood balls that are cared for by the female until emergence of the offspring. Larvicide does not occur. Males live for a significantly shorter time than females.

Key Words: dung beetle, reproduction, Oniticellini, Eurysternina

The reproductive behavior of species of the Neotropical genus *Eurysternus* Dalman is a complex process. According to Halffter (1977), *Eurysternus* nidification behavior is defined as Pattern VI, which is characterized by: a) the nuptial feast; b) the preparation of a compound nest of one or two different types; c) care of the young, mainly by the female, but with the participation of the male; d) the formation of a stable pair that defends the nest while it is under construction; and e) destruction of some of the brood balls (with eggs) following initiation of the care period.

The nesting behavior of only nine species of Eurysternus has been described (Huerta et al. 2003). The habitat requirements of *Eurysternus plebejus* Harold have already been described (Escobar 1997; Génier 2009). Noriega and Calle (2008) reported that this species feeds on the decaying petals of *Gustavia hexapetala* (Aublet) Smith (Lecythidales: Lecythidaceae). However, they did not confirm the use of these petals as a resource for constructing brood balls. According to Génier (2009), several different kinds of bait have been successfully used to capture this species.

Eurysternus nesting behavior is one of the most complex of all the Scarabaeinae, and that of *E. plebejus* has been reported only once before (Ohaus 1909). I therefore consider the findings of this study represent a significant contribution to the knowledge of one of the species of the *Eurysternus impressicollis* species-group.

Material and Methods

Adult *E. plebejus* were collected in traps baited with human feces during May 2002 in Esmeraldas, Ecuador (Cantón Eloy Alfaro, El Progreso 1°00′ N, 78°53′ W). Collection was carried out in a tropical forest that had been selectively logged 15 years ago. To study the nesting process, captured beetles were transferred to a laboratory at the Institute of Ecology A.C. (Xalapa, Mexico). Each of the 20 randomly formed breeding pairs was placed in a 20 × 15 × 7 cm plastic terrarium below a 5 cm layer of soil. All terraria were kept in an insectarium under controlled environmental conditions (27° C and 70% relative humidity, with a photoperiod of 14 h in summer and 12 h in winter). Behavioral observations were recorded throughout the nesting period until the emergence of offspring. All terraria were checked twice a day: first between 0900 and 1100 h and then between 1600 and 1800 h. Every two days, 30 g of cow dung were given to each pair for feeding and nesting.

In order to understand other aspects of the nesting behavior of *E. plebejus*, 35 pairs that had emerged under laboratory conditions were also studied. Balls associated with both nuptial feast and nests were selected at random, then counted, measured, and weighed. Student t statistical tests were used to analyze potential differences between the different parameters considered.

Results

Pre-Nesting Period. As with other *Eurysternus* species, *E. plebejus* was observed during this period feeding directly from the surface of, or underneath, the dung. The duration of this period was 50 ± 25 days (n = 55; 20 from the field and 35 laboratory-reared). No production of balls was observed until the end of this stage.

Nesting Period. Seventy percent of 20 field-sourced pairs and 46% 16 laboratory-reared pairs were observed to construct a nest. The occurrence of a nuptial feast at the end of the pre-nesting period and prior to initiation of the nesting period was only observed in 10 of the 16 laboratory-reared pairs that nested (Fig. 1). However, nuptial feasting was not observed in any of the field-sourced pairs.

None of the balls made by females during the nuptial feast contained eggs or larvae. The number of nuptial feast balls ranged from 3 to 9 (mean = 6 ± 2, n = 10; Fig. 1). The balls remained on the soil surface in the terraria or close to the dung for periods ranging from six to 50 days (mean = 14 ± 6, n = 10), but were never placed within a crater. During this time, the feast balls were eaten by the male and/or the female, or finally abandoned. The average size of the balls made during the nuptial feast was 10.32 ± 2.36 mm in length × 9.68 ± 2.23 in width (n = 25). Their mean weight was 0.804 ± 0.346 g (n = 25).

Mating was not observed during the nuptial feast, despite the presence of balls among the pairs. However, mating was observed on two occasions at the onset of nesting. Approximately one week after consumption or abandonment of the nuptial feast balls, the laboratory-reared females initiated the nesting period.

Nests made by females (both field-sourced and laboratory-reared) were always observed in a crater excavated beneath the dung (Fig. 2). Each nest contained between two and seven brood balls (mean = 5 ± 2, n = 32). Figure 3 shows the frequency distribution of number of brood balls per nest. There were significant differences in terms of volume (t = 16.98, d.f. = 44, P <0.001) and weight (t = 14.34, d.f. = 44, P < 0.001) between the brood balls and balls constructed during the nuptial feast, with the brood balls being both larger (mean = 15.74 ± 0.52 mm long × 15.28 ± 0.49 mm wide, n = 22) and heavier (mean = 2.213 ± 0.33 g, n = 22).

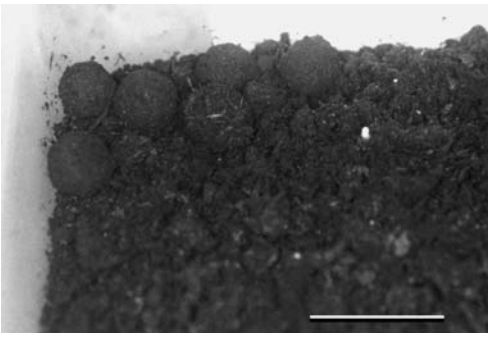

Fig. 1. Nuptial feast of *Eurysternus plebejus*. Scale = 2 cm. Photo by C. Huerta.

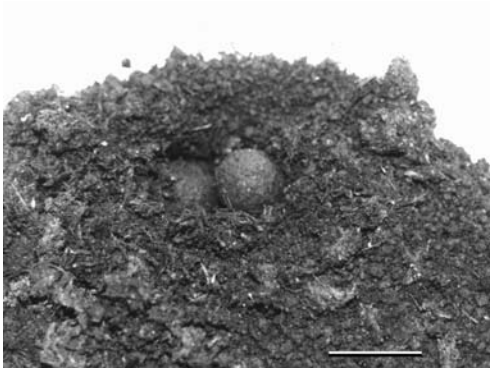

Fig. 2. Nest of *Eurysternus plebejus.* Scale = 2 cm. Photo by C. Huerta.

Following oviposition, all females remained within the nests, caring for the brood balls on average 52 ± 19 days (n = 33). They were found to nest only once or twice during their adult life.

Longevity. Males lived significantly less time than females (t = 2.32, d.f. = 30, P < 0.05). Males lived on average 127 ± 55 days (n = 14), whereas females lived on average 192 ± 95 days (n =18). During the final period of their lives, both sexes ate and rested exclusively underground while exhibiting considerably reduced activity.

Discussion

Some aspects of the biology of the genus *Eurysternus* are only known in ten of the 53 known species (Génier 2009). To date, nesting behavior has

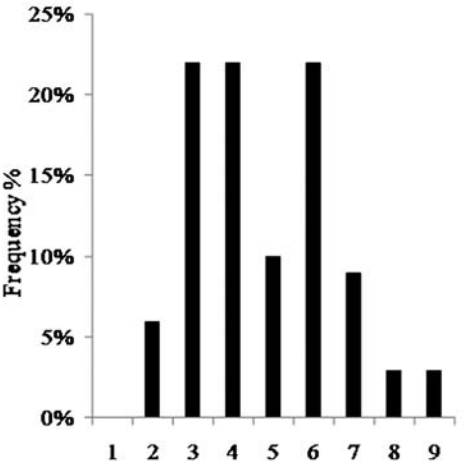

Fig. 3. Frequency distribution of number of brood balls per nest of *Eurysternus plebejus.*

Table 1. Similarities and differences in nesting processes observed among *Eurysternus* species. Data for species other than *E. plebejus* taken from Huerta *et al*. (2003, 2005).

	Behavior observed					
Species	Nuptial feast	Mating	Provisional nest	Larvicide	Definitive nest	Parental care
E. plebejus	Yes	At the onset of nesting period (observed only on two occasions)	No	No	Yes	Yes
E. balachowskyi	Yes	Not observed	Yes	Yes	Yes	Yes
E. caribaeus	Yes	During nuptial feast	Yes	Yes	Yes	Yes
E. deplanatus	No	Not observed	No	No	Yes	No
E. inflexus	No	Not observed	No	No	Yes	No
E. foedus	No	Prior to nesting	No	No	Yes	Yes
E. jessopi	No	During nesting period	No	Sometimes	Yes	No
E. magnus	Yes	Not observed	No	No	Yes	Yes
E. marmoreus	No	During nesting period	Yes	Yes	Yes	Yes
E. mexicanus	No	During nesting period	Yes	Yes	Yes	Yes

only been described in nine species of the genus; hence the importance of pursuing studies regarding the reproductive behavior and life cycles of the remaining species.

Although Ohaus (1909) reported that *E. plebejus* in Ecuador leaves its "cherry-sized" brood ball lying on the surface of the ground, I never observed nests on the surface but always in a crater built beneath the dung. The only balls observed on the surface were those corresponding to nuptial feasts, but they did not contain eggs.

Comparing the nesting processes of *E. plebejus* to the other studied species, I found some similarities but also important differences, as shown in Table 1. In the laboratory-reared adults, females were observed producing nuptial feast balls, which did not occur in adults collected in the field. This probably suggests that the feast had already occurred prior to collection, or could have been disrupted by the transport of adults to the laboratory, or was altered by the laboratory conditions. Following abandonment or consumption of the feast balls, the adults resume active searching for new resources with which to make the nest. Although a subsocial species, *E. plebejus* did not commit larvicide as do the other subsocial brood ball-constructing *Eurysternus* species. In addition, no production of provisional nests was observed. Although mating was observed only twice among the 30 pairs that made a nest, this behavior only took place prior to brood ball formation.

It would be of interest to verify, as suggested by Noriega and Calle (2008), whether *E. plebejus* uses other food sources for nesting, such as decaying petals of *G. hexapetala*, or if this is only used for feeding when dung sources are unavailable. *Eurysternus plebejus* appears to be a generalist species, since it can be collected using different types of bait such as the corpses of small vertebrates, decayed fruits and mushrooms, and various kinds of vertebrate excrement. For this reason, I consider it important to continue field studies elucidating the biology of this species and others belonging to the genus, as it seems to be one of the most heterogeneous genera in terms of reproductive behavior, comprising as it does both subsocial and non-subsocial species.

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