OVIPOSITION BEHAVIOR IN *DROMIUS PICEUS* DEJEAN (COLEOPTERA: CARABIDAE, LEBIINI)

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Abstract. Females of *Dromius piceus* Dejean were observed ovipositing on tree trunks in Ithaca, New York, USA. Behavior prior to oviposition includes an initial phase of searching, followed by scraping of the substrate and bolus formation. The bolus is formed of the bark and algal material that was loosened by scraping and is used to coat the egg.

Résumé. L'auteur a observé des femelles de *Dromius piceus* Dejean pondant sur des troncs d'arbres à Ithaca dans l'État de New York (États-Unis). Après avoir sélectionné un site de ponte, la femelle gratte la surface du substrat pour agglutiner une boule constituée de fragments d'écorce et d'algues, qu'elle utilise pour recouvrir chaque oeuf.

Introduction

Dromius piceus Dejean is a common North American ground beetle that exibits distinctly arboreal habits (Lindroth 1968, Mahar *et al.* 1983) and has a trans-American distribution (Bousquet and Larochelle 1993). Although Mahar *et al.* (1983) added much to the knowledge of adult, larval and pupal phenology for *D. piceus*, and Casale *et al.* (1996) similarly treated *Dromius meridionalis* Dejean, details of the egg stage and behavior leading up to and including oviposition have not been reported.

Aspects of oviposition behavior in many species of Carabidae were reviewed by Thiele (1977). In cases where eggs are encased, soil particles were used to form earthen cells to coat eggs, or a «bowl» was formed in the ground to hold the deposited egg. Even in primarily arboreal species in the Calleidina (Carabidae: Lebiini), known to hang encased eggs from plants by a thread (Larson 1969: 64), the egg coating is made of soil particles. These soil cases are formed by manipulating the soil with the gonocoxae, apex of the abdomen and mandibles.

Methods

Numerous individual adults were observed in the field, at night, while headlamp-collecting ground beetles in Tompkins Co., New York in May-July of 1996 and 1997. Approximately a dozen females were observed ovipositing. Several individuals were videotaped in the field and the tapes reviewed for more careful analysis. Weak lighting, either the peripheral light of the headlamp or a headlamp masked with thin paper, was used to observe the beetles. Intense white light would cause the beetles to cease all activity or to rapidly attempt to escape. Specimens were collected for identification and dissection and voucher specimens are held in the author's collection. Encased eggs were collected and examined using a dissection microscope and portions of the case were slide-mounted and examined using a compound microscope.

Results

Males and females were found moving on tree trunks shortly after sunset, particularly during humid weather when the temperature was around 15-18°C. Most observations occurred in beech-maple secondary growth forest. Active beetles were found on algae-covered, living red maple (*Acer rubrum* L., Aceraceae) and live or dead locust (*Robinia pseudoacacia* L., Fabaceae). Oviposition was only observed on maple.

When oviposition was observed the following sequence of behavior occurred:

1. Searching. Individual females actively moved in an irregular pattern over the surface of the trunk at a height of one to three meters (it was not possible to observe individuals beyond three meters above the ground). The movement pattern was apparently random. Some individuals made several passes over the same area of the trunk. Periods of movement were frequently punctuated by pauses of one to five seconds. While stopped, beetles often briefly scraped the substrate with their mandibles before moving on.

2. Scraping. Beetles scraped the bark surface with their mandibles loosening fragments of algae and bark. The method of scraping during this phase did not differ from scraping observed during the searching phase, however, each scraping episode is longer. The movement of the head and mandibles was very rapid and pauses were frequent. The longest period of scraping observed was less than two seconds.

3. Bolus formation. After scraping the bark surface, beetles walked over the spot scraped until that area was aligned with the terminal portion of the abdomen. The beetle lowered its abdomen and used a rapid anterior-posterior jerking motion together with extension of the ovipositors (fig. 1) to pick up the previously loosened algal and bark material, placing it onto its last visible

tergite. The ovipositors have a medial concavity, two patches of elongate setae and thin blade-like tip that are used to manipulate the material (fig. 1). Beetles repeated steps 2 and 3, three to five times in the same general area (approximately a $0.1m^2$ area) until a bolus was formed on the beetle's tergum. Once beetles began forming the bolus, they did not return to searching until the completion of oviposition.

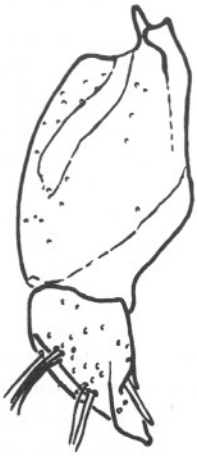

FIGURE 1. Left ovipositor of female *Dromius piceus*, ventral view.

4. Oviposition. Carrying the bolus, the beetle searched an area of about 1 m^2. Upon finding an apparently suitable irregularity in the bark, the beetle stopped, lowered its abdomen and remained motionless for approximately 1-2 minutes. A quick motion of the terminal portion of the abdomen was observed just as the egg with its bolus covering was deposited on the bark.

The outer surface of the egg was completely covered by the bark and algal material that was prepared by the female, and was virtually invisible on the tree trunk. The coating had a very uniform particle size and was held together and to the egg with an adhesive substance. Also, the bottom of the egg was attached to the substrate with the same adhesive substance. Beetles did not begin searching again immediately after oviposition but typically moved up the tree once the egg was laid.

Discussion

Oviposition that includes the formation of a covering cell for the egg has been observed only in the Harpalinae tribes with harpalidian or brachinidian abdominal types[4] (Deuve 1993, Liebherr and Will in press). Therefore, it is likely that the added mobility of the terminal portion of the abdomen allows for sophisticated manipulations, permitting cell formation. Cell formation is achieved by various methods (King 1919, Thiele 1977) and is analogous among the Harpalinae tribes. Species with entire elytra and generally well-

[4] «Evidence» for cell formation in *Scarites subterraneus* Fab. reported by Riley, (1886: 23) remains unsubstantiated.

developed elytral plicae (*e.g.* species of Pterostichini and Chlaeniini) must extend the terminal abdominal segments to hold and form the case (King 1919, and my observations of *Chlaenius* spp). Species with truncate elytral apices are able to load the last tergite and cover the egg rather than forming a purse of the coating material (King 1919, and my observations of *Brachinus* and *Galerita* spp.). However, relatively few carabids have been observed during oviposition and so much is yet to be discovered concerning the origins of this behavior and associated morphological structures.

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