MALE COURTSHIP BEHAVIOUR IN *PHALERIA GRACILIPES* CASEY (COL., TENEBRIONIDAE)

BY RAFAEL LUCAS RODRIGUEZ S.

ABSTRACT

Precopulatory and copulatory male courtship behaviour is described for the tenebrionid beetle *Phaleria gracilipes*.

INTRODUCTION

The tenebrionid beetle *Phaleria* is associated with sandy littoral and dune areas (Tongiorgi, 1969; Caussanel, 1970; Moore, 1974; Chelazzi & Colombini, 1989), where individuals burrow in the sand (Caussanel, 1970; Chelazzi *et al.*, 1985), remain under stranded logs or stay at the bases of plants (Caussanel, 1970). Members of this genus have an important role in the consumption of stranded plant debris and carrion (Chelazzi & Colombini, 1989). *Phaleria (Epiphaleria) prolixa* Fairmaire lays its eggs in the upper layers of the sand, where larval development occurs (Chelazzi *et al.*, 1985).

Behavioural studies on this genus cover activity rhythms and zonation patterns (Tongiorgi, 1969; Chelazzi & Colombini, 1989), as well as orientation based on a solar compass (Pardi, 1956, cited in Chelazzi & Colombini, 1989). Although mating has been studied in detail for some tenebrionids (see Thornhill & Alcock, 1983), no accounts of sexual behaviour were found in the literature for this genus. Here, male courtship and mating behaviour of *Phaleria gracilipes* Casey is described.

MATERIAL AND METHODS

Beetles were captured during the night in April, 1991, as some attempted to mount others on a sandy beach, just above the high tide mark, at Puerto Vargas (Limón Province, Costa Rica). About 50 individuals were taken to the laboratory and kept in plastic bags containing sand moistened with tap water. They were given freshly crushed Mediterranean fruit flies (*Ceratitis capitata* (Wiedemann)).

Mating behaviour was observed in petri dishes with a dissecting microscope (7×). Some interactions were recorded with a National Omnipro video camera with +6 close-up lenses. Most of 9 copulations (5 recorded) and 50 copulation attempts (40 recorded) were observed. In 6 of the 9 copulations, the aedeagus was observed directly. In the other three, the male was in the typical copulatory position, showed the typical behaviour (see below), and afterwards sought no further interaction with the female. Sample sizes given below refer to the number of times couples were in a position that allowed particular movements to be seen, and do not fully reflect their frequency of occurrence. Figures shown below were copied from video images, and

the details were filled in from drawings made with a camera lucida. Body parts and details which were out of focus on the video are not shown. Voucher specimens were deposited in the Museo Nacional de Costa Rica (at the Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica).

RESULTS

When two beetles met, they touched with their antennae and mouth parts. Male sexual behaviour began when the male mounted the female from any angle, and turned to face the direction she was facing. All the male's legs could be on the female's elytra (seen in 6 cases) or sometimes his hind legs were on the ground (seen in 8 cases).

Once mounted, the male always rubbed his tarsi (particularly fore and mid) against the dorsal and lateral surfaces of the female's elytra (fig. 1), sometimes rocking from side to side while doing so (30 cases) (fig. 2). Bouts of rubbing lasted between 2 and 68 seconds and alternated with quiescent periods of 1 to 36 seconds. Evidence that those rubbing movements did not result from the male slipping on the female's elytra is that no slipping was observed when individuals walked over each other. Some males fell from the female when they shifted too much to one side. However, they usually resumed their position without difficulty by simply remounting, and then began

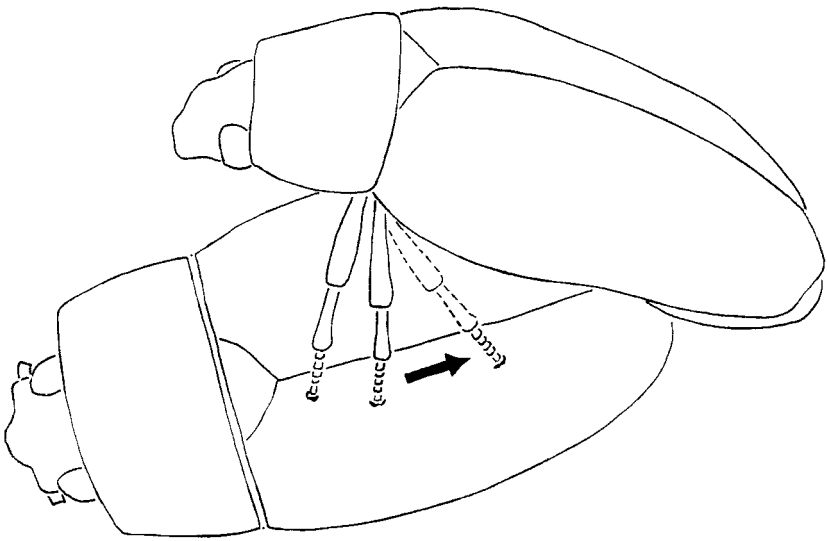

Fig. 1. — Schematic drawing of a male rubbing the female's elytra with his left middle leg, prior to intromission. Time elapsed between each position of the leg was 0.2 seconds. The foreleg is still.

rubbing again. The male sometimes also tapped the female's pronotum and elytra with his antennae (3 cases) or with his antennae and mouthparts (3 cases).

To achieve intromission, the male moved rearward and downward, extended his aedeagus and tapped repeatedly on the female's last abdominal sternite (6 cases). One male extended his genitalia in this way without any previous courtship, and the female walked away. When the male achieved intromission, he alternated periods of rubbing with his legs and tapping with his antennae as described above with periods of remaining still. These rubbing motions were slower and gentler than those of precopulatory courtship. No rocking to the sides was observed.

Estimated copulation length was between 1 and 2 minutes. In two copulations, I was able to distinguish which beetle ended the mating: in one, the male walked away, and in the other the female dislodged the male.

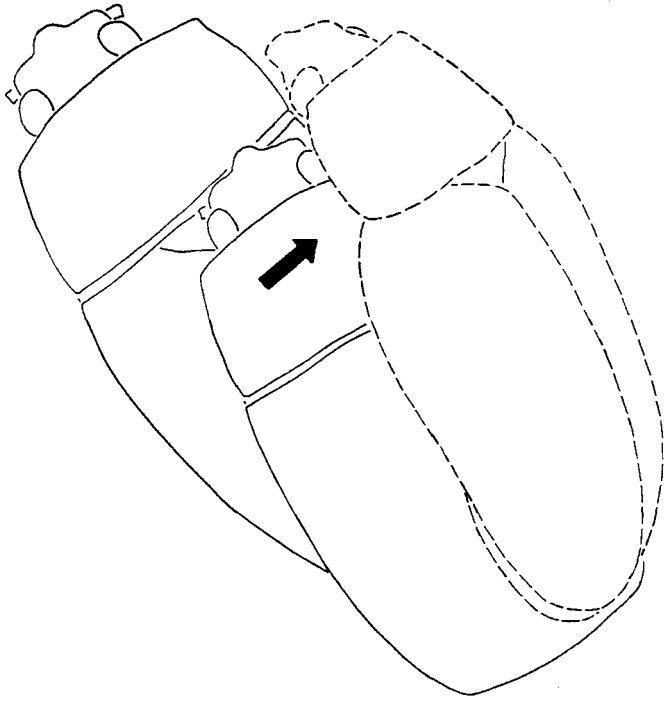

Fig. 2. — Male body positioning as he swings to one side during precopulatory courtship. Time elapsed between each position of the body was 1.1 seconds.

Females rejected a male prior to mating in several ways: walking away (16 cases); rubbing her legs along the sides of her elytra, thus breaking the hold of the male's legs (6 cases); pressing the tip of her abdomen to the ground to prevent intromission (4 cases); swinging her body from side to side (2 cases); or dropping on one side (6 cases). Some males were able to stay on a female which was trying to dislodge them, and one achieved copulation after having remained on top of a female which walked a distance of at least five body lengths. Most males, however, fell off and lost track of females that rejected them.

Couples were often separated by other beetles walking over them. One individual disrupted a couple, using its head and pronotum as a lever to lift the male, then walking under the female and overturning her.

DISCUSSION

In addition to the traditionally accepted function of inducing a female to accept copulation, male courtship behaviour may have functions that have evolved due to sexual selection by cryptic female choice (Eberhard, 1991; in press). Evidence for this is the widespread occurrence of courtship during and after copulation in insects (Eberhard, 1991; in press). *Phaleria gracilipes* shows both precopulatory and copulatory male courtship behaviour. Presumably, male courtship preceeding copulation in this species has the traditionally accepted function of inducing the female to accept copulation. Courtship performed during copulation may induce the female to remain still, or influence some other aspect of cryptic female choice (Eberhard, 1990; 1991; in press).

Males attempted copulation repeatedly with females in an apparently indiscriminate fashion, and copulating pairs were observed frequently. Thus, multiple matings by females were possible and cryptic female choice is feasible in this species.

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Escuela de Biologia, Universidad de Costa Rica. Ciudad Universitaria Rodrigo Facio, San José, Costa Rica.
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