

**FREQUENCY OF SPERMATOPHORE PRODUCTION AND REGENERATION IN
THE MALES OF *Tityus (Atreus) magnimanus* POCOCK, 1897 (Scorpiones,
Buthidae)**

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ABSTRACT: The frequency of spermatophore production and the amount of time between matings for laboratory-reared males of *Tityus (Atreus) magnimanus* to regenerate spermatophores were examined. Males attain sexual maturity at the fifth or sixth instar (after a period of 137 to 155 days) and can produce initial spermatophores shortly after maturation. After mating, males can regenerate spermatophores within a single 24-hour period and remate. The present contribution represents the first report on an aspect of reproductive biology in this species and is part of a continuing study of the life history and post-embryonic development of *Tityus (Atreus) magnimanus*.

KEY WORDS: scorpions, Buthidae, *Tityus (Atreus) magnimanus*, courtship, mating, spermatophores, sperm transfer.

CONFLICTS OF INTEREST: There is no conflict.

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INTRODUCTION

Courtship and mating among scorpions involves a complex series of ritualized acts leading up to sperm transfer to females via an external stationary spermatophore (1-4). Courtship and mating behaviors in scorpions have been described in thirty species and typically involve the male initiating courtship by grasping female chelae within his own and leading her in a series of coordinated movements until a suitable surface is located, upon which the spermatophore will be deposited (3, 4). Once a suitable surface is selected, the male lowers his body and the hemispermatothores slide out of the paired paraxial organs, move into the genital atrium where the two hemispermatothores are joined, forming the completed spermatophore, and the pedicel is attached to the surface chosen by the male.

The spermatophores of male scorpions are divided into two basic types: flagelliform and lamelliform (5). The family Buthidae C. L. Koch, 1837 is characterized by flagelliform spermatophores while other scorpion families, on which such data is available, possess lamelliform spermatophores (5). Flagelliform spermatophores consist of three basic parts: the pedicel that attaches to the surface selected by the male (the first part of the spermatophore to be extruded); the rod-like trunk that contains the sperm vesicle and the sperm duct opening; and the flagellum which represents the free, distal end of the spermatophore, and in some species can stretch to forty times its length (6).

Males of most, if not all, scorpion species are capable of mating more than once (3). Based on a substantial number of published reports (7-12), there exists considerable evidence that recently mated males can produce new spermatophores and remate in a very short period of time. In one published account, a single male *Tityus (Tityus) bahiensis* (Perty, 1834) mated 11 times in 102 days, with six days being the minimum reported time between successive matings (8). The present contribution provides the first reported data on the number of molts up to maturity and frequency of spermatophore production in the medically significant scorpion species *Tityus (Atreus) magnimanus* Pocock, 1897 (Buthidae).

During laboratory observations of courtship and mating sequences in the buthid scorpion *Tityus (Atreus) magnimanus*, the frequency of spermatophore production between successive matings were recorded as part of a continuing series of life history studies of this species. *Tityus (Atreus) magnimanus* is a medium size (60 to

70 mm), reddish to reddish-brown scorpion species endemic to tropical altitudinal forest in Falcón and Lara states, north-central Venezuela.

Males of *Tityus (Atreus) magnimanus* were mature at the fifth or sixth instar (in 130 to 152 days) and females at the sixth instar (after a period of 172 to 190 days) (Ross, personal observation). Attaining sexual maturity at different instars is a common life history strategy among buthid scorpions (13). Francke and Sissom (14) reported the number of developmental instars in 32 scorpion species, with 47% (n = 15) maturing at multiple instars within the same sex. Polymorphic maturation has been previously reported to occur in several members of the genus *Tityus* C. L. Koch, 1836 (3).

For this study, ten unrelated adult males of known age were randomly selected. Of the ten males, eight matured at the fifth instar, after 130 to 147 days, and two at the sixth instar, after 148 and 152 days. After their maturing molts, males were provided a 72-hour recuperative period. Beginning on the fourth day after maturing molts, males were randomly paired with laboratory reared females (n = 30) of known age on successive days in order to determine the number of days required for males to produce their initial spermatophores. As soon as mating occurred and a spermatophore was deposited and sperm transfer completed, participants were separated from each other and the males returned to individual containers and the date of each spermatophore deposition was recorded for each animal. Mature males of fifth (n = 1) and sixth instars (n = 1) were able to produce initial spermatophores six days after their maturing molts. The remaining males of fifth (n = 7) and sixth instars (n = 1) produced initial spermatophores seven days after their maturing molts (Table 1).

Table 1. Spermatophore production and regeneration time in ten males of *Tityus (Atreus) magnimanus*

Specimen ID	Maturing molt ♂	Maturing instar ♂	Initial mating	2 nd mating	3 rd mating
Tm♂G1-01	18/II/2008	5	24/II/2008	26/II/2008	28/II/2008
Tm♂G1-02	20/II/2008	5	26/II/2008	28/II/2008	01/III/2008
Tm♂G1-03	02/III/2008	5	08/III/2008	10/III/2008	12/III/2008
Tm♂G1-04	05/III/2008	5	11/III/2008	13/III/2008	15/III/2008
Tm♂G1-05	05/III/2008	5	12/III/2008	14/III/2008	16/III/2008
Tm♂G1-06	10/III/2008	5	16/III/2008	18/III/2008	20/III/2008
Tm♂G1-07	16/III/2008	5	22/III/2008	24/III/2008	26/III/2008
Tm♂G1-08	22/III/2008	5	28/III/2008	01/IV/2008	03/IV/2008
Tm♂G1-09	28/III/2008	6	05/IV/2008	07/IV/2008	09/IV/2008
Tm♂G1-10	01/IV/2008	6	07/IV/2008	09/IV/2008	11/IV/2008

Subsequent to each initial mating, males were provided a 24-hour recuperative period before being introduced into mating arenas containing previously unmated females on successive days. If mating did not occur within two hours, males were removed and returned to their respective enclosures. Each of the ten males was allowed to mate with three different previously unmated females of known age in order to assess the frequency of spermatophore regeneration. During successive mating trials, males (n = 10) were capable of producing new spermatophores within 24-hours and successfully remating in a very short period of time, with the period between spermatophore regeneration for each male limited to 24 hours.

The time for spermatophore regeneration in *Tityus (Atreus) magnimanus* is the shortest one registered for males of any scorpion species. Additional studies are

being conducted to assess the potential costs of rapid spermatophore regeneration and high rates of mating and their effects on longevity in males of this species.

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