

NOTE

**MATING TROPHALLAXIS IN *METASPHENISCA NEGEVIANA*
(FREIDBERG) (DIPTERA: TEPHRITIDAE)**

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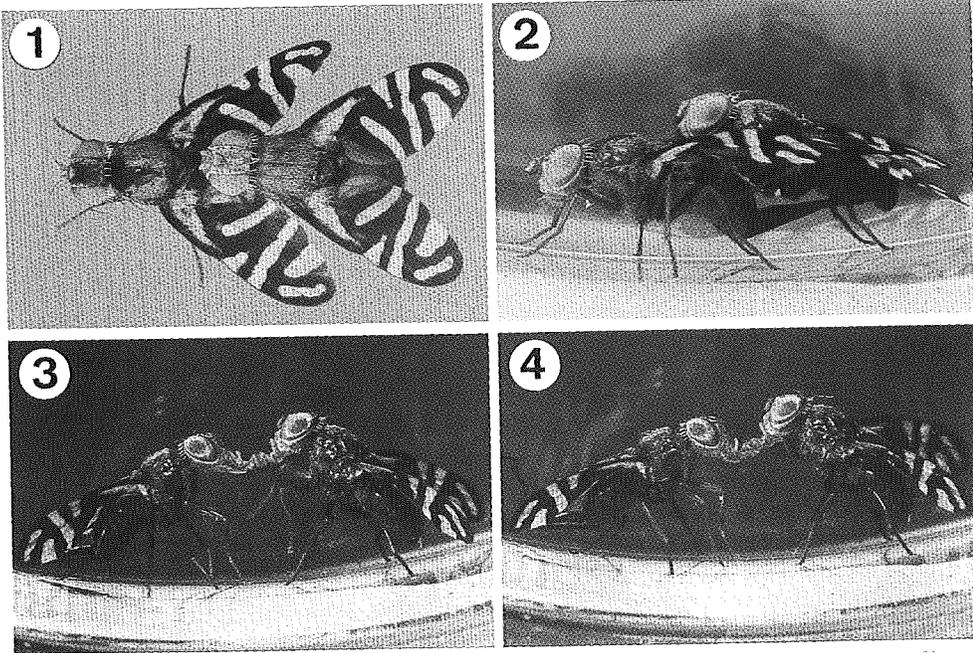
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Mating trophallaxis was defined (Freidberg, 1981) as: "trophallaxis between mates, connected to copulation and taking place shortly before, during or after copulation." It is a varied assemblage of spectacular behaviors (Freidberg, 1981, 1982), reported primarily for several families of Diptera (Freidberg, 1984). Nevertheless, it is generally a poorly studied and little understood phenomenon. In view of this and of the general importance of tephritid behavior (Landolt and Quilici, 1996), I report here on yet another manifestation of this rather peculiar phenomenon. The behavior described in this note is unique in that it comprises both pre- and postulating trophallaxis occurring in the same mating sequence. To the best of my knowledge, such a sequence has not been reported for any insect.

Metasphenisca negeviana (Freidberg) was described from Israel (Freidberg, 1974) and can be easily identified by its uniquely banded wing pattern (Fig. 1). It was originally described under *Isoconia* (Munro), but was later transferred to *Metasphenisca* (Hendel) by Hancock (1990), who synonymized the two genera, both of which are considered to belong to the tribe Tephrellini (=Aciurini). It is currently known from Israel, Egypt (Sinai) and Saudi Arabia, and in Israel it is known from Samaria, the lower Jordan Valley, Dead Sea area, Arava Valley, and the northern and southern Negev. It is a rather rare species, and its most similar congener is the East African *Metasphenisca bezziana* (Enderlein), which is also rare in collections.

The only known host plant is *Blepharis attenuata* Napper (Acanthaceae), which is a spiny perennial herb with blue flowers arranged in spikes. Larvae and puparia of the fly have been found in flowers and young fruits, especially during May and June, which is also the main activity season of the adults.

Due to the difficulty of observing adult flies in the field, most of the observations reported here were conducted in cages in the laboratory, mainly in Petri dishes (sometimes provided with a flower-bearing branch of the host plant), which enabled behavioral observations under a stereoscopic microscope. A single, partial sequence of the mating behavior observed in the field (Timna, southern Arava Valley) corroborated our laboratory observations. For terminology of behavior see Headrick and Goeden (1994) and Freidberg (1982).



Figs 1–4. Copulation and post-mating behavior in *Metasphenisca negeviana*. 1. Copulation, dorsal view. 2. Copulation, lateral view. 3. Kissing, male's front legs in the air. 4. Kissing, male's front tarsi on the female's proboscis.

Courtship. A male and a female placed in a Petri dish usually run inside it, although one of them may be less agile, sometimes standing almost motionless on the branch. When standing, the wings remain motionless, or move slowly, whereas when running, wing movement is faster and with greater amplitude. When the flies approach one another, the male usually performs partial (rarely complete) semaphore movements, often accompanied by side-stepping (“crab dance”), i.e. several steps to one side followed by several steps to the other side. Simultaneously, the male distends the pleural membrane of his abdomen. A non-receptive female decamps by running or flying, whereas a receptive female will either perform similar wing movements to those of the male, although with narrower amplitude, or stand still with horizontal and slightly spread (45°) wings. When the male approaches, the female sometimes raises one or both front legs, after which the male steps back. She may also perform “pendulum movements” with her body, swaying from side to side.

Within seconds, and provided that close contact is retained, the male extends his proboscis forward, and a yellowish brown, translucent droplet appears on the labellar surface. An unreceptive female may decamp at this stage. A receptive female will extend her proboscis and press her labella against his in a “kiss”. Such a kiss lasts a few seconds (less than 10), during which the male's wings are slightly raised. With their labella still in contact, the male raises the frontal part of his body, and while grasping the female's head with his front legs, he mounts her primarily by using his mid legs. At the beginning of the mounting, the body axes of the partners are anti-parallel, but when the male's tarsi cease to touch the substrate, he begins to rotate, and

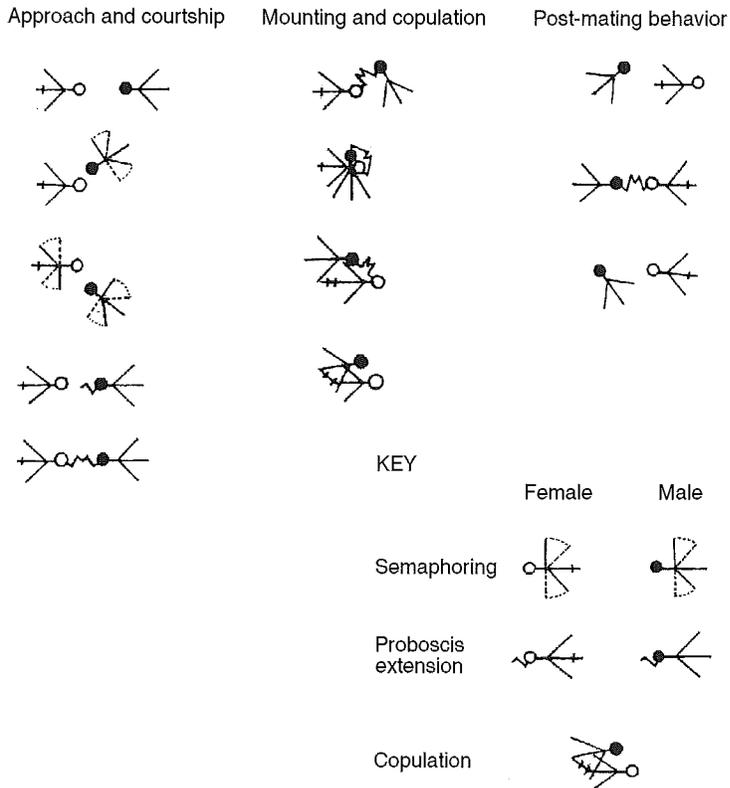


Fig. 5. Schematic representation of courtship, mating and post-mating behavior in *Metasphenisca negeviana*.

finally stands on top of the female with their body axes parallel and the labella still in contact. The transition from the anti-parallel to the parallel stance passes through a stage in which the body axes of the partners (viewed from above) are perpendicular to one another. At this stage the female stands motionless or nearly so, with her wings spread at about 70°, and her long ovipositor sheath (oviscape, syntergosternum 7) raised about 45° above the (horizontal) body axis. Her proboscis remains in contact with the male's proboscis, and is pulled posterad when he mounts her. When the male is on top of her and facing the same direction, this pull results in a rotation of her head, so that its ventral aspect turns posterolaterad (Fig. 5).

The male now moves backwards on top of the female, and the joined probosces are detached. At the same time the female extrudes her ovipositor (aculeus) from its sheath. The male directs the ovipositor with his hind legs, grasps it with his clasper (epandrium, 9th tergum), and copulation begins. When the proboscis attachment is released, the male's labella may touch the female's head or dorsum of thorax, where a viscous droplet may be deposited.

Copulation. The duration of copulation is 35–50 minutes (N=10). During copulation the female's body is generally horizontal, except for the ovipositor sheath, which is raised 20°–30°.

The head-thorax-preabdomen (preabdomen is abdomen minus segment 7 and beyond) sometimes form an arch (Fig. 2), with the thorax raised above the other parts. The antennae are drooped, forming an angle of 20° . The wings are spread at an angle of 60° – 75° , and are usually held horizontally, but are sometimes twisted with the leading edge up. The ovipositor and inversion membrane (membrane connecting the ovipositor with its sheath and enabling their telescoping) are extruded $1/6$ – $1/3$ of their length.

The male's body axis is nearly parallel to that of the female. His front tarsi hold the abdominal pleural membrane of the female close to the thorax, his mid tarsi hold her pleural membrane near sternite V, and his hind tarsi touch the substrate. His wings are spread at an angle of 45° – 60° , and are usually horizontal (Fig. 1). His antennae are drooped parallel to his face, which usually touches the apical bristles of the female's scutellum.

During copulation, while some minor variations of the above behavior were observed, there are almost always slight and rapid rhythmical movements of the wings and proboscis of both partners. Occasionally the male appears to perform strong movements with his abdomen which results in the alternating extrusion of the female's ovipositor almost to its entire length and retraction to its previous position. Sometimes the male slightly waves his wings or uses the front and mid tarsi to "caress" the female's abdomen several times.

When copulation ends the male moves backwards until contact between the partners is terminated.

Postmating behavior. As soon as the male dismounts the female, she turns toward him and extends her proboscis. The male then extends his proboscis and the partners kiss again. This kiss lasts between 15 seconds and 3 minutes. During the kiss, a translucent liquid is transferred from the male to the female. While this happens, the male caresses the female's head, including her eyes and proboscis, with swift movements of his front legs (Figs 3–4), while the female occasionally moves one of her front legs rapidly, and sometimes drums lightly upon the substrate with her ovipositor sheath. Their bodies are diagonal to the substrate, with the male slightly more upright. His wings are spread as in copulation, but slightly raised above the body axis, and are somewhere between horizontal and perpendicular. The female's wings are less twisted. The kiss is usually interrupted by several pauses. When it finally ends, the male steps back and sometimes "dances" as in courtship. He may again attempt mounting, but the female is always unreceptive at this point, and no mounting is achieved. Self-grooming is performed by both partners after the kiss. Additional copulations were occasionally observed after a lapse of time.

This is the first detailed behavioral report of a tephrelline. I have also observed the mating behavior of another tephrelline, *Katonaia aida* Hering. In this species I observed a brief pre-mating kiss but neither a secretion of droplets, nor a postmating kiss.

Salivary glands. Based on Freidberg (1982), I hypothesized that a potential source of the trophallactic substance in *M. negeviana* was the male's salivary glands. A male and a female were therefore dissected, and their salivary glands were observed. These are simple tubes, ending in a small sac. Their content was yellowish and turbid in the male, colorless and transparent in the female. This is as yet insufficient evidence to support the idea of a trophallactic role of the salivary glands in this species.

Discussion. In most cases of mating trophallaxis that have been reported thus far in Tephritidae and other Diptera families, the trophallactic substance constitutes a "nuptial gift" offered to the

female by the courting male and, therefore the phenomenon falls within the domain of sexual selection. In only one species, namely *Spathulina sicula* Rondani (Freidberg, 1982, tephritid recorded as *S. tristis*), was postmating (but not premating) trophallaxis reported, which could logically fall within the domain of natural selection. Therefore, the mating behavior of *M. negeviana*, which consists of both pre- and postmating trophallaxis, could be considered in the context of both sexual and natural selection. However, an alternative view was recently suggested by Eberhard (1994), who claimed that copulatory courtship (i.e. male courtship during or following copulation) may have evolved in conjunction with "cryptic" female choice, and thus pertains to sexual selection. A possible implication of the latter explanation to the present case could be that postmating trophallaxis in *M. negeviana* acts to ensure that the sperm deposited in the female reproductive system, would indeed fertilize her eggs. The two forms of mating trophallaxis in *M. negeviana*, therefore, could be considered as merely two manifestations of sexual selection.

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