

Atypical mating behaviour in the empidine dance fly *Rhamphomyia (Lundstroemiella) magellensis* (Diptera : Empididae : Empidinae)

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KEY WORDS : Empididae, Empidinae, *Rhamphomyia (Lundstroemiella) magellensis*, mating and feeding behaviour.

Empidine dance flies are well known for exhibiting a large variety of mating and feeding behaviours especially mating swarms, transfer of nuptial gifts by males to females, production of silk cocoons as nuptial gifts, alternation between predation and flower visiting habit in correlation with mating and feeding periods respectively. These mating and feeding behaviours are well documented for a number of species belonging to various species groups (e.g. 1, 2, 3, 4, 5, 6, 7, 8), and now considered as autapomorphic for subfamily Empidinae (9). Some authors already suggested that this typical behaviour is absent and seems to have reversed in some species groups, such as the subgenera *Lisempis* Bezzi, 1909 (*Empis* L., 1758) and *Lundstroemiella* Frey, 1922 (*Rhamphomyia* Meigen, 1822) (10, 11, 12). However their suggestion was based only on morphological characters which seem to be incompatible with the typical behavioural traits (13); e.g. the presence of dichoptic eyes in the male suggests the absence of mating swarms. Detailed studies on such hypothesised reversed behaviour are not available.

Recently we succinctly reported the atypical behaviour of a species of the subgenus *Lundstroemiella*, namely *R. (L.) magellensis* Frey, 1922 (14), for which swarming and nuptial gift are absent. The aim of this note is to give a complete description of the mating and feeding habits, including a detailed illustration of all the stages of the mating behaviour, as well as some hypotheses related to the evolution of the mating system of this species.

The behaviour of *R. (L.) magellensis* was observed for the first time in 1999 when one of us (C.D.) found the species in the French Pyrenees. Since the species was only known from mountainous regions of central Europe before (12, 15) and also because the endemism rate is rather high in Pyrenees (e.g. see 16), collected specimens were compared with specimens of the type series (Zoological Museum, Helsinki) to confirm their identity. Two successive field trips were subsequently organised in 2001 and 2002 in order to complete our previous observations. All field studies were performed in two different localities near the "Parc National des Pyrénées" (PNP),

namely "Gavarnie, Plateau de Bellevue, limite du PNP, environ 1500 m" and "Gèdres, Granges de Bué, environ 1500 m" in June and July. The successive steps of the feeding and mating behaviour were photographed and videotaped with a digital video camera recorder. Pictures were then recovered and studied on a PC.

R. (L.) magellensis Frey is a typical mountain species of small size (3-4 mm), which is here recorded for the first time in the Pyrenees. Males and females are exclusively flower visitors, observed sucking nectar of *Valeriana* (Fig. 1A) and *Geranium* all day long. Many small flowers are to be found at the tip of each stalk of *Valeriana*, forming a rather large bearing surface on which individuals can easily move and meet. The mating behaviour as a whole takes place on this solid substrate and can be divided into three main successive stages.

In a first stage, when two males meet, and especially in the presence of a female close by, they often stop moving and face each other for impressing (Fig. 1B); a male can attack the other by jumping, this very quick fight generally ends with one of them taking flight. In this way, a male can stay on a same place trying to beat off competitors until a female comes or accepts the male for mating (Fig. 1C).

In a second stage, when the female allows the male to mount, competitors generally reappear quickly trying to evict and replace the mating male (Figs 1C, D). Consequently the competition between males is going on during mating and the female can support several males (Fig. 1D), moving from one flower to another to suck the nectar (Fig. 1E); this stage can last several tens of minutes.

In a third stage, the mating female leaves the dorsal surface of the plant to reach a sheltered place such as a blade of grass (Fig. 1F). At this place the male is generally no longer confronted to competitors and the mating pair is rarely disturbed by predators; the male grabs the thorax and abdomen of the female with its mid and hind legs respectively, whereas the fore legs are moved up and down (Figs 1G, H). Generally this stage lasts a very long time (until more than thirty minutes); mating always ends at an unpredictable moment.

From these field observations and in the light of the sexual selection theory (17), it is possible to formulate the following tentative hypotheses for the evolution of the mating system of *R. (L.) magellensis*.

There is a strong competition between males, including impressing and fighting, on the place where the individuals find their food resource, which therefore is also the place where they have a chance to meet females. We consider that this behaviour has something in common with the protection of a territory, and may be interpreted as a kind of selection ensuring females to get the best mates. During the first phase of mating, females continue to move on the surface of the flowers so that males are still in competition. It is hypothesised that this female behaviour plays the role of a second selection, although the male firstly selected is generally not evicted by competitors during this stage. Consequently females put males through a double selection : before and at the beginning of mating; after this selection stage and in all observed cases, they end up moving to a protected area where there are no longer potential competitors or predators.

There are three main differences in the mating behaviour of *Lundstroemiella* on the one hand and most of the remaining Empidinae on the other hand : first, the courtship behaviour takes place on a solid substrate in *Lundstroemiella*, not in swarms as it is usually observed in the subfamily. Second, the place where the courtship takes place is also there where males and females of *Lundstroemiella* find their food resource only consisting of nectar, whereas the remaining empidine species are generally flower visitors with males only becoming predator during the mating period. Third, there is no nuptial gift collected by males and offered to females in *Lundstroemiella* this protein-poor diet therefore implies uncommon physiological mechanisms for maturation of eggs (e.g. autogeny?) such as already hypothesised for other empidine dance flies for which silk cocoons used as nuptial gifts are empty or only contain a prey of very small size (18).

This descriptive work on the behaviour of *R. (L.) magellensis* should be considered as a preliminary and basic study for future investigations. However the mating behaviour of this species appears atypical within the Empidinae and, considering the rather derived phylogenetic position of *Lundstroemiella* within the subfamily (9), it is viewed as the result of a reversal from the traditional behaviour (mating swarms with nuptial gifts) usually observed. Such a mating behaviour is suspected for other empidine subgenera. Consequently, subject to discover this kind of behaviour in species belonging to these subgenera and to propose an extensive phylogeny of the empidine dance flies, such species groups, in addition to *Lundstroemiella*, could be relevant models to test evolutionary hypotheses such as the irreversibility of mating-systems evolution.

ACKNOWLEDGEMENT

This work was partially supported by an European Marie Curie Fellowship (grant HPMF-CT-2000-00718) and a Research Project Action 1 (Belgian Federal Office for Scientific, Technical and Cultural Affairs) (C.D.). We are very grateful to Dr. P. Viikamaa (Zoological Museum, Helsinki) for the loan of the type series of *R. (L.) magellensis*, and J. De Crozefon and J.P. Besson for delivering the licences of collections in the PNP.

Many thanks to E. Méjean-Daugeron for taking some pictures. We thank the two anonymous referees for comments on the manuscript.

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Received: April 13, 2004

Accepted: December 10, 2004

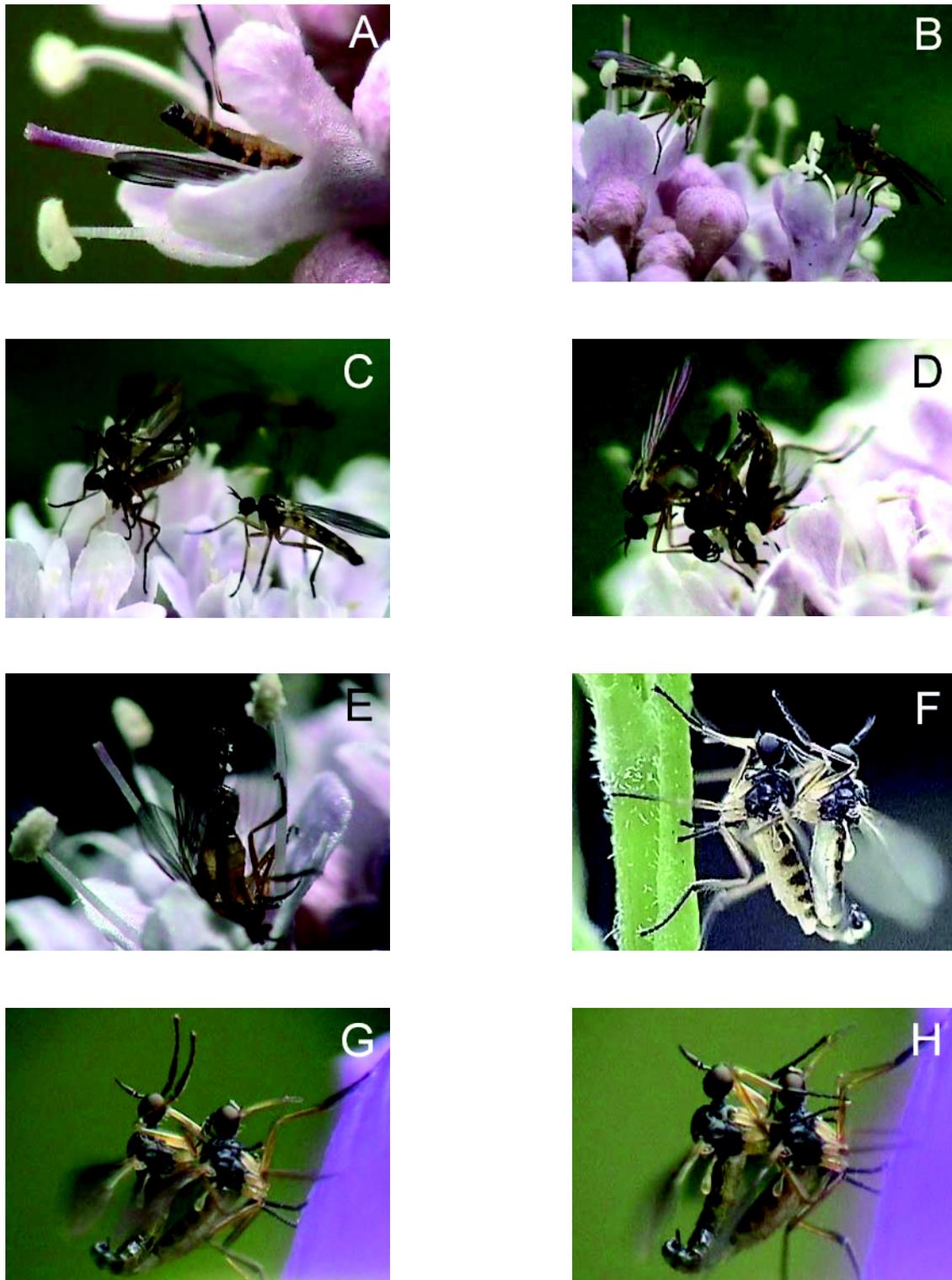


Fig. 1. – Successive stages of the mating and feeding behaviour of *R. (L.) magellensis*. A. – Male sucking the nectar of a flower of *Valeriana* sp. B. – Two males facing and impressing each other. C, D. – As soon as the mating is starting unpaired males reappear (C) and try to evict the mated male (D). E. – Although in copula, the female continues to move from flower to flower to suck the nectar during the first phase of mating. F, G, H. – Mating pairs on sheltered places during the second phase of mating.